HARVARD
Campus Services
ENVIRONMENTAL HEALTH & SAFETY

Harvard University Chemical Hygiene Plan

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Overview

1.0 Foreword

Harvard University encourages and supports all programs which promote the safety, good health, and well-being of university faculty, staff, students and visitors. The University is committed to providing a safe and healthy environment for all members of the Harvard community and to reducing injuries and illness to the lowest possible level. To assist academic institutions and businesses in enhancing the safety of laboratory personnel, the Occupational Safety and Health Administration (OSHA) published standard 29 CFR 1910.1450, "Occupational Exposure to Hazardous Chemicals in Laboratories." A copy of the standard and its appendices may be obtained by visiting OSHA Laboratories Overview. This regulation, known as the "Lab Standard," is designed to protect laboratory personnel from potential hazards associated with the use of laboratory chemicals.

The key elements of the OSHA Lab Standard include the development and implementation of the following:

- Chemical Hygiene Plan (CHP)
- Employee Training and Information
- Hazard Identification
- Managing Chemical Hazard Information
- Container Labeling
- Exposure Monitoring
- Medical Examinations and Consultation
- Methods of Exposure Control
- Personal Protective Equipment (PPE)
- Laboratory Safety Equipment
- Chemical Waste Management
- Safeguards for Particularly Hazardous Substances (PHS)

- Emergency Procedures
- Recordkeeping

The Standard's intent is to ensure that laboratory personnel are apprised of the hazards of the chemicals in their work area and that appropriate work practices and procedures are in place to protect laboratory personnel from chemical health and safety hazards.

2.0 Introduction

2.1 Scope and Applicability

This CHP has been prepared to provide guidance in safe laboratory operations for Harvard University laboratory personnel. The policies and procedures set forth in this CHP are applicable to all laboratory operations and personnel. The CHP focuses on chemical safety. Other documents set forth expectations related to additional hazards, including but not limited to Harvard's Laboratory Safety Policy, Biosafety Manual, Laser Safety Manual, and Radiation Safety Manual.

Laboratory Operations

Laboratory operations under the CHP are defined as handling or manipulation of hazardous chemicals, such as in reactions or transfers, and in small quantities on a non-production basis. They may be performed in research, teaching, or core facility spaces. While the CHP specifically addresses chemical safety within these laboratory operations, it is important to note that all university-related laboratory or field teaching and research work with hazardous materials or equipment are governed under the Harvard University Lab Safety Policy. This policy broadly defines a laboratory as any room, space, or field site equipped with chemical, biological, radiological, or other hazardous materials, research animals, or mechanical equipment that is used for teaching, research, observation, or measurement. It includes academic, research, teaching, conservation, and engineering labs as well as shops exclusively operated for these purposes.

Hazardous Chemicals

Hazardous chemicals are defined as any chemical or mixture of chemicals which is classified as a physical hazard or health hazard, simple asphyxiant, combustible dust, pyrophoric gas, or hazard not otherwise identified as specified in Appendix A and Appendix B of the OSHA 29 CFR 1910.1200 Hazard Communication Standard. These chemicals are also identified, when required, using Globally Harmonized System pictograms, which visually communicate the specific nature of the hazards.

Laboratory Personnel

Laboratory personnel include faculty, research associates and assistants, technicians, teaching assistants, post-doctoral fellows, graduate and undergraduate students, high school students, interns, visiting personnel, volunteers, part-time and temporary employees, and other individuals performing lab work.

2.2 Purpose

This CHP is designed to identify the safety practices that should be implemented when working with common hazardous chemicals found in the laboratory. These safeguards will protect laboratory personnel from unsafe conditions in most situations. There are instances, however, when the physical and chemical properties, the proposed use, the quantity used, or the toxicity of a substance will be such that these controls may need to be modified. Professional judgment is essential in the interpretation and application of these procedures, and laboratories may modify or enhance these procedures to meet their specific uses and operational needs.

The Harvard University Laboratory Safety Program is based on the premise that every member of the lab community shares the responsibility for safety. As part of the community, it is important for laboratory personnel to be familiar with the health and safety guidelines that apply to their work and to conduct that work in the safest possible manner. The CHP is a resource to assist laboratory personnel in fulfilling these responsibilities.

2.3 Availability of Documents

This document identifies the ways in which Harvard University is complying with each portion of the OSHA Lab Standard. An official copy of the Harvard University CHP is available on the EHS website. For laboratory-specific procedures, contact the Lab Safety Officer (LSO) or Principal Investigator (PI) for that laboratory. Refer to EHS School and Unit Safety Officers for specific EHS Lab Safety Advisors that work with each department.

Key elements of the OSHA Lab Standard are outlined in the OSHA Fact Sheet: Laboratory Safety OSHA LAB Standard.

2.4 Plan Organization

1. Part I contains information regarding the general administrative components of the CHP, including:
    - Purpose, Scope, and Applicability of the Plan
    - Responsibilities, Authority, and Resources
    - Training
    - Medical Surveillance
    - Exposure Monitoring
    - Hazard Identification
    - Recordkeeping
    - Plan Evaluation and Review
    - Resources
2. Part II contains recommended general precautions for working with laboratory chemicals. These precautions address broad classes of chemicals and include information and guidance in the following areas:
    - Common Hazards
    - General Safe Work Practices

- Chemical Storage
- PPE
- Other Safety Equipment and Engineering Controls
- Work Practices for PHS
- Chemical Waste Management
- Emergency Procedures

3. Part III provides information and templates to enable individual laboratories to customize this CHP for their operations, including the addition of lab-specific Standard Operating Procedures (SOPs). The EHS SOP: Hazardous Chemical or Procedure Template is also available to assist with laboratory personnel generating specific safety procedures.

2.5 General Principles

To provide for the safety of the Harvard community and to protect Harvard University and surrounding property from damage, the following general principles apply to all personnel performing work in laboratories:

- **Perform Hazard Assessments:** Assessment of potential hazards must be performed prior to initiation of new experiments or procedures. Appropriate protective measures, including PPE and engineering controls, must be identified and implemented. Laboratories should develop process-specific or experiment-specific guidelines and protective procedures.
- **Minimize Chemical Exposures:** Since few laboratory chemicals are without hazards, general precautions for chemical handling, storage, and disposal should be implemented in all laboratories. Use of less hazardous materials, implementation of engineering controls whenever feasible, and use of PPE to avoid skin contact with or inhalation of chemicals is encouraged and may be required depending on the hazards.
- **Avoid Underestimation of Risk:** Even for substances with no known significant hazard, exposure should be minimized. For work with PHSs, which includes chemicals that are carcinogens, reproductive toxins, and substances with a high degree of acute toxicity, special precautions must be taken such as those contained

in Part II and Part III. Refer to Appendix II-A: Particularly Hazardous Chemical Information for more information on identifying PHSs. All substances of unknown toxicity should be considered toxic.

- **Provide Adequate Ventilation:** The best way to prevent exposure to airborne substances is to prevent their escape into the working atmosphere by using chemical fume hoods or other ventilation devices.
- **Observe Established Standards:** The Occupational Exposure Limits (OELs) established by OSHA and other organizations should be observed. Where a regulatory standard does not exist, other recognized exposure limits should be followed. Contact EHS for more information.
- **Follow the CHP:** Procedures described in this CHP are designed to minimize or prevent exposure to hazardous chemicals. Implementation of the CHP should be a regular, continuing effort.

Executive Summary

Chemical Hygiene Plan Executive Summary

The Harvard University CHP addresses the general hazards of common chemicals that may be present in laboratories, and describes work practices, procedures, and controls which are in place to protect personnel from those hazards. Personnel should consult with their LSO, PI, or supervisor regarding specific safety practices to be used in the laboratory. It is the individual's responsibility to participate in laboratory safety training and to plan and conduct each operation or experiment in accordance with the general safety procedures, or those safety procedures specific to the laboratory or experiment.

OSHA Lab Standard Executive Summary

The OSHA Lab Standard (29 CFR 1910.1450) aims to enhance laboratory safety by providing personnel with information and guidance on safety protocols and work practices. Laboratory personnel are aware that their technical skills are critical to their work. Understanding the hazards of the substances they work with and safe work practices are equally critical to research progress and continuity. The key requirements of the Lab Standard that laboratory personnel should be aware of are as follows:

- They must have access to this CHP along with lab-specific chemical safety information.

- Chemical safety information, including Safety Data Sheets (SDS), must be available to them either as hard copies or electronically.
- They must be informed of the hazardous chemicals present in their laboratory and the operations in which they are involved.
- They must receive adequate training in working with hazardous chemicals.
- Chemical containers and chemical waste must be labeled properly.
- They must know how to detect the presence or release of a hazardous chemical.
- They must be provided with PPE such as safety glasses, gloves, and lab coats when they are required.
- They must be provided with engineering controls such as fume hoods when needed.
- They must receive training in the proper procedures for responding to emergencies.
- They are entitled to a medical consultation whenever there is an event, such as a spill or leak, that increases their risk of chemical exposure.
- They may be required to undergo air monitoring if there is reason to believe that the airborne concentration of a hazardous chemical exceeds established exposure limits.
- They must be notified of the results of any air monitoring conducted.
- They are entitled to a copy of established exposure limits for hazardous chemicals.
- They are entitled to a complete copy of the OSHA Lab Standard.

Part I: General Administration

1.0 Roles and Responsibilities

1.1 Environmental and Safety Compliance Officers

Under the authority delegated by the Deans and Senior University Administration, the EHS Environmental and Safety Compliance Officer (ESCO) for each school or administrative unit is responsible for promoting and maintaining a safe, healthful, and environmentally responsible workplace. Specific responsibilities include:

- Ensuring the adequacy of technical and financial resources to conduct compliance programs in accordance with Harvard standards and regulatory requirements.
- Identifying personnel affected by specific compliance requirements.
- Communicating compliance program requirements to administration and faculty.
- Securing faculty and administration input for the development and implementation of compliance management programs.
- Periodically communicating compliance program status to the Harvard community, including program results, effectiveness, and agendas.

1.2 Departments and Schools

Each department is responsible for supporting and promoting safe and compliant work practices in their laboratories. Department faculty and administration are responsible for facilitating the implementation of the CHP within each department. In schools that are not divided into departments, the responsibilities outlined in this CHP section for departments and departmental personnel fall on the school or their subdivisions.

Department Chairs

Department Chairs have overall responsibility for ensuring that all work performed within their departments complies with applicable health, safety, and environmental requirements. The department chairs may implement this responsibility through delegation to PIs, other faculty, department administration, or other departmental personnel deemed appropriate.

Department Faculty

The Department Faculty, Supervisors, and Core Managers are responsible for:

- Collaborating with the administration, EHS, and others to identify effective means to implement the CHP in the laboratory.
- Providing feedback to departmental administration regarding compliance status.
- Ensuring that personnel receive required training to implement the CHP effectively.

- Coordinating and facilitating exchange of information regarding chemical hygiene issues with the research and teaching community.

Department Administration and Laboratory Directors

Department Administration and Laboratory Directors are responsible for:

- Facilitating compliance with CHP requirements.
- Ensuring the appointment of Chemical Hygiene Officers (CHOs).
- Ensuring that compliance responsibilities are assigned and implemented for all areas and operations in the department. These responsibilities include training, recordkeeping, reporting, program evaluation, and plan revision.

Research Operations Managers at the Longwood Campus

Research Operations Managers (ROMs) at the Longwood Campus are responsible for:

- Communicating EHS programs to the laboratories, PIs, Supervisors, Core Managers, and their appointed LSOs.
- Serving as the primary liaison between the EHS Department and their basic science department.
- Monitoring compliance and safety issues within their department.

1.3 Principal Investigators, Supervisors, and Core Managers

PIs, Supervisors, and Core Managers are responsible for managing research, teaching, or core facility space. They play a critical role in the implementation of the CHP within the spaces they manage and have primary responsibility for chemical hygiene and EHS compliance in their laboratory. These responsibilities include ensuring that:

- Laboratory personnel have adequate knowledge and information to recognize and control chemical hazards in the laboratory.

- Hazardous operations are defined and safe practices and protective equipment are designated and provided.
- Safe work practices, PPE, and engineering controls are used to reduce the potential for exposure to hazardous chemicals.
- Laboratory personnel are informed of the potential hazards of the chemicals they use and are trained in safe laboratory practices, controls, and emergency procedures.
- Laboratory personnel are instructed on where to locate information about chemicals they plan to introduce into a space and provided with resources on how to safely design an experiment.
- Laboratory personnel are informed of the signs and symptoms associated with exposures to hazardous chemicals used in their laboratory.
- Chemical waste is managed properly.
- Action is taken to correct work practices and conditions that may result in the release of hazardous chemicals.
- Incidents and other potential exposure conditions are reported to the CHO or EHS for further investigation, exposure monitoring, or input regarding appropriate corrective actions.
- Approval is granted, where required, prior to the use of PHS in the laboratory.
- Laboratory operations are supervised to ensure that the CHP is followed.
- Compliance with the CHP is maintained and documented.
- Visitors entering their laboratory are informed of the potential hazards and safety precautions to be taken.

1.4 Chemical Hygiene Officers

The CHO (for example, the PI, Supervisor, or Core Manager) is critical to the effective implementation of the CHP. The CHO is responsible for the adaptation and implementation of the CHP in their laboratory, thus maintaining a safe work environment and ensuring compliance with regulatory requirements.

PIs, Supervisors, or Core Managers may designate a qualified employee to serve as their CHO, working in support of the PIs, Supervisors, or Core Managers. The lab CHO consults with EHS as needed for support and subject matter expertise.

The duties of the CHO include ensuring that:

- Appropriate training is provided to new and current laboratory personnel and is properly documented.
- Workers know and follow established safe work procedures and emergency procedures.
- Safety equipment and engineering controls are utilized.
- Appropriate PPE is utilized.
- Laboratory practices are routinely reviewed.
- Safety and control equipment inspections are routinely conducted and properly documented.
- Copies of the current CHP and chemical hazard reference materials (for example, SDSs) are available to laboratory personnel.
- Procedures developed for new PHSs or operations are coordinated with input from EHS.
- Recommended actions are taken to correct any unsafe condition.

1.5 Laboratory Safety Officers

Laboratory Safety Officers (LSOs) support PIs, Supervisors, Core Managers, and CHOs in implementing the CHP and other EHS programs in their laboratories. They may be graduate students, postdocs, lab managers, or other lab staff. PIs, Supervisors, and Core Managers perform the duties of an LSO if they haven't assigned one for their lab. A laboratory may also have more than one LSO. Responsibilities may include:

- Assisting with the implementation of the CHP and other EHS requirements within the laboratory.
- Serving as a primary liaison between the laboratory and EHS.
- Assisting with onboarding of new laboratory personnel.
- Helping to ensure that laboratory personnel complete required safety training and that training is documented.

- Assisting with the development, communication, and review of lab-specific SOPs and emergency procedures.
- Supporting routine lab safety inspections, PPE assessments, and follow-up on corrective actions.
- Helping to maintain current lab documentation, such as door placards, inventories, and lab rosters.
- Reporting potential safety issues to their PIs, Supervisors, Core Managers, and/or EHS.
- Promoting safe work practices, appropriate use of PPE and engineering controls, and timely reporting of incidents and near misses by laboratory personnel.

1.6 Laboratory Personnel

Laboratory personnel are responsible for:

- Participating in laboratory safety training sessions.
- Being aware of the hazards of the chemicals they are working around or with and safe storage, handling, and disposal procedures.
- Planning and conducting each operation or experiment in accordance with established chemical hygiene procedures.
- Using appropriate safe work practices, PPE, and engineering controls at all times.
- Reporting any newly introduced hazards or observed unsafe conditions to their supervisor or Chemical Hygiene Officer (CHO)
- Informing visitors entering their laboratory of potential hazards and safety precautions to be taken.

1.7 EHS Department

The primary responsibility of EHS is to provide technical support and guidance to laboratory personnel for the development and management of environmental, health, and safety programs. EHS is responsible for reviewing and updating the common (non-lab specific) portions of this CHP on an annual basis and distributing any required changes to appropriate University personnel. The EHS Department offers the following services relating to chemical hygiene:

- Development and Evaluation of Safety Procedures
- Laboratory Inspections and Audits
- Fume Hood Evaluation and Inspection
- Training and Information Dissemination
- Hazardous Waste Disposal Management
- Hazard and Exposure Assessments
- Incident Investigation
- Emergency Assistance

An overview of EHS and its services may be obtained by visiting the EHS website.

2.0 Information and Training

Harvard University will provide laboratory personnel with information and training to ensure that they are apprised of the hazards of the chemicals present in their work area. The purpose of information and training is to ensure that all individuals at risk are adequately informed about the work being performed in the laboratory, as well as associated hazards and actions to be taken to protect themselves during normal operations and emergencies.

2.1 General Requirements

Information that must be provided or made available to laboratory personnel includes:

- How to obtain copies of the OSHA Lab Standard, OSHA Lab Standard Appendix A, and OSHA Lab Standard Appendix B.
- The location and availability of the CHP.
- How to obtain OSHA Permissible Exposure Limits (PEL) for OSHA-regulated substances and the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV) (for example, by contacting EHS) for hazardous substances not given OSHA PELs.

- Resources and reference sources for signs and symptoms associated with exposure to hazardous substances used in the laboratory (see Section 3.0 Signs and Symptoms of Chemical Exposure for a general overview).
- The location and availability of known reference materials on hazards, safe handling, storage, and disposal of hazardous chemicals found in the laboratory (see Section 2.2 Chemical Safety Information Sources).

Training includes coverage of the following topics:

- Methods and observations that may be used to detect the presence or release of a hazardous chemical.
- Determining physical and health hazards of chemicals in the work area.
- Measures laboratory personnel can take to protect themselves from these hazards.
- Specific procedures to provide protection, including engineering controls, work practices, and PPE.
- Emergency procedures.
- Explanation of SDSs and container labeling.
- How to obtain and use chemical hazard information.
- Review of the components and implementation of the CHP.

The Harvard University safety training program for laboratory personnel consists of two parts:

- General Laboratory Safety - Offered by EHS and addresses general laboratory safety practices.
- Laboratory-Specific Safety Training – Provided by the PI, LSO, or other designated personnel and addresses specific chemicals, experiments, or procedures within a given laboratory.

The EHS SOP: Hazardous Chemical or Procedure Template can be used to assist laboratories in the development and documentation of specific safety procedures and training.

Safety information and training must be provided to personnel initially, upon assignment to a laboratory where hazardous chemicals are present, and prior to assignments involving new hazardous chemicals or new laboratory work procedures. The PI or their designee, during annual review of lab hazards as part of the PPE Assessment process, may at that time determine whether refresher information and training is warranted.

Records of each individual's general EHS training are maintained in the Harvard Training Portal, including the course name and completion date. Labs maintain records of lab-specific orientations.

General and customized training is available on a regular schedule and upon request by checking the Harvard Training Portal.

2.2 Chemical Safety Information Sources

The Laboratory Standard requires employers to provide chemical information to all laboratory personnel. Harvard University makes numerous sources of chemical information available for personnel working in laboratory settings.

Laboratory personnel can identify basic chemical hazards through the product labeling on incoming chemical containers that's required by OSHA's Hazard Communication Standard. Laboratory personnel are also instructed to label temporary containers with the chemical name and hazard type. Laboratory door placards and signs such as those required by some local fire departments provide a visual indicator of the type and degree of hazards within the lab.

More detailed chemical hazard information is provided on the Harvard EHS Chemicals and Hazardous Materials webpage.

3.0 Signs and Symptoms of Chemical Exposure

The hazards of laboratory chemicals can be ascertained by referring to labels and chemical hazard reference material such as SDSs. In addition, the ability to recognize the signs and symptoms of chemical exposure is important so that, if adverse effects do arise despite all precautions, they can be recognized early and appropriate action can be taken.

If chemical exposure has occurred:

- Call 911 for serious and life-threatening medical emergencies.
- Refer to the Lab Emergency Response Guide for procedures to follow after an exposure.

Some signs and symptoms of chemical exposure include:

- Skin that has become dried, whitened, reddened, swelled, blistered, itchy, or exhibits a rash.
- A chemical odor. Many chemicals can be smelled at concentrations well below harmful levels. On the other hand, a chemical may be present without a detectable odor.
- A chemical taste. Some chemicals have characteristic tastes.
- Tearing or burning eyes.
- Burning sensations of the skin, nose, or throat.
- Development of a cough.
- Onset of a headache or dizziness.

These general symptoms may also be associated with conditions other than chemical exposure. The signs and symptoms of exposure to specific chemicals are often contained in the SDS under Section 11: Toxicological Information. Laboratory personnel should be aware of the signs and symptoms of exposure to the chemicals they use.

4.0 Medical Examination and Consultation

4.1 Examination and Consultation Determination

Harvard University is required to provide laboratory personnel who work with hazardous chemicals an opportunity to receive medical attention, including physician-determined follow-up examinations, when any of the following conditions are met:

- The individual develops signs or symptoms associated with a hazardous chemical used in the laboratory.
- Exposure monitoring reveals consistent exposure greater than the OSHA action level (AL), or in the absence of an AL the applicable OSHA exposure limit, for a chemical.
- Whenever a leak, spill, explosion, or other occurrence results in the likelihood of hazardous exposure to the individual.
- When respiratory protective equipment is required.

- When medical surveillance requirements for OSHA-regulated chemicals must be met.
- At the discretion of the PI, Supervisor, Core Manager, CHO, or EHS.

4.2 Exposure Information

A physician or other licensed health care professional providing care to a potentially exposed individual must be provided with the following information:

- The SDS(s) for the hazardous substance(s) to which the individual may have been exposed.
- The condition(s) leading up to the exposure.
- The signs and symptoms of exposure that the individual is experiencing, if any.

4.3 Examination Criteria and Frequency

Medical Exam Criteria

Medical exam criteria will be determined by the licensed physician performing or directly supervising the exam. Where medical exam guidance exists, such as for OSHA-regulated substances, EHS will provide the information required by the substance-specific standard (for example, 29 CFR 1910.1048(l) for formaldehyde) to the physician to be included in the physician's exam.

Frequency of Medical Examinations

Frequency of medical examinations is at the discretion of the physician if the examination resulted from a potential overexposure to hazardous substances. If the examination resulted from an exposure to an OSHA-regulated substance, further examinations will be at least as frequent as the period set in the OSHA standard for each particular substance. Medical evaluations provided for required respirator use will be performed at a frequency determined by the physician.

4.4 Physician's Written Opinion

For medical examinations or consultations required under the OSHA Laboratory Standard, Harvard University (through Occupational Health and/or EHS as the employer's designated representative) shall obtain a written opinion from the examining physician consistent with 29 CFR 1910.1450(g)(4).

- The written opinion shall not reveal specific findings or diagnoses unrelated to occupational exposure.
- A copy of the physician's written opinion will be provided to the affected employee.
- The written opinion will be maintained as a confidential employee medical record, with access limited to those with a legitimate need to know, consistent with 29 CFR 1910.1020 and other applicable privacy obligations.
- Where necessary to implement workplace controls or accommodations, Occupational Health/EHS may communicate functional limitations or recommended work restrictions to the PI, Supervisor, or Core Manager without disclosing diagnoses or unrelated medical findings.

4.5 Cost and Scheduling

All required medical examinations and consultations must be provided to laboratory personnel at no cost, without loss of pay, and at a reasonable time and place.

5.0 Exposure Monitoring

Regular environmental or personal exposure monitoring of airborne contaminants is not usually necessary in laboratories since chemicals are typically used for relatively short periods of time, in small quantities, and with engineering controls such as fume hoods. However, air monitoring will be conducted if:

- There is reason to believe that exposure levels for a substance routinely exceed either the AL or PEL set by OSHA.
- Air monitoring is required to comply with an Environmental Protection Agency (EPA) Toxic Substances Control Act (TSCA) rule.

- Individuals suspect or report that they have been overexposed to a chemical in the laboratory.

Monitoring will be conducted in accordance with established sample collection and analytical methodology for the chemical exposure being evaluated. If initial monitoring indicates that worker exposure is above the AL or PEL, then periodic monitoring provisions of the relevant OSHA standard or EPA rule will be met.

Upon receipt, results of personal monitoring will be made available to laboratory personnel, in writing, within 15 days, either individually or by posting in an appropriate location accessible to the affected individuals.

6.0 Recordkeeping

6.1 Records

Harvard University will maintain accurate and complete records concerning the following:

- Medical examination and consultation
- Exposure monitoring
- Training
- Fume hood evaluations
- Laboratory inspections

6.2 Retention and Storage

Medical Examination and Consultation Records

Medical examination and consultation records, including test results and physician's written opinions, are to be maintained in an appropriate confidential manner by the laboratory's department. These records are to be kept, transferred, and made available for at least the duration of the worker's employment plus thirty years. These records shall be maintained in accordance with OSHA 29 CFR 1910.1020 "Access to Employee Exposure and Medical Records."

Employee Exposure Records

Employee exposure records, including sampling results, are to be maintained in the laboratory's department files. These records are to be kept, transferred, and made available for at least 30 years. These records shall be maintained in accordance with OSHA 29 CFR 1910.1020. Exposure monitoring records generated by EHS will also be maintained in the EHS central files.

Training Records

Training records for central EHS trainings are maintained online in the Harvard Training Portal. Records of lab-specific orientation are maintained at the lab level.

Fume Hood Records

Fume hoods are certified annually. Fume hood certification records for evaluations performed by EHS are maintained by EHS. Groups may choose to use an outside vendor for certifications. In those cases, certification records are maintained in the laboratory's department files. In both cases, records are maintained at a minimum until the next certification is performed.

Inspection Records

Inspection records for General Lab Inspections performed by EHS are maintained by EHS in an online system.

7.0 Plan Evaluation, Review, and Update

7.1 Plan Evaluation and Inspections

To evaluate the implementation status and effectiveness of the CHP, EHS conducts General Lab Inspections at least every two years to review laboratory safety practices and check safety equipment.

Inspection checklists are available in the Assessment and Inspection Management System (AIMS).

In some cases, an alternate or expanded checklist may be used. Records of these checklists and inspection results must be maintained through EHS.

EHS will also perform annual fume hood certifications. These certifications will assess the adequacy of air flow in the hood by determining average face velocity, air flow pattern and direction and extent of turbulence, if any. Details of the fume hood evaluation procedures and documentation are contained in Part I 6.2 and Part II 6.1 of this document.

7.2 Plan Review and Update

EHS will review annually and, if necessary, update this CHP. Changes to the plan will be based on regulatory changes, changes in university-wide safety policies and practices, feedback from laboratory personnel, and results of laboratory inspections.

The laboratory PI or designee reviews lab hazards annually or when hazards change as part of the PPE assessment process, updates laboratory-specific safety procedures as needed, when PHSs are introduced into or removed from the laboratory, and when experimental procedures involving PHSs change.

Part II. General Safety Practices

1.0 Introduction

Part II of this CHP is intended to provide Harvard University laboratory personnel with information regarding generic hazards of common chemicals that may be present in the laboratory and appropriate work practices, procedures, and controls to protect laboratory personnel from those hazards.

Hazardous chemicals can cause harm when they enter the body in sufficient amounts via inhalation, ingestion, injection, or skin absorption. Harmful effects can also occur by eye or skin contact alone. The nature of the hazardous chemical and the routes by which it enters or contacts the body determine the type of controls that are needed. OSHA and other organizations have set occupational exposure limits on airborne chemical exposure. Keeping exposures below these limits is generally believed to protect personnel. PELs, which are legally enforceable limits set by OSHA for airborne concentrations of specific chemicals, can be found in OSHA

1910.1000, TABLE Z-1: Limits for Air Contaminants. TLVs, which are recommended exposure limits established by the ACGIH, are available on SDSs or by contacting EHS.

Regardless of the established exposure limit for a particular chemical, all laboratory personnel should take steps to minimize chemical exposure via all routes of entry. Whenever possible, substitution of less hazardous chemicals should be used as a primary method of preventing adverse effects due to chemical exposure.

Three methods are used to limit chemical exposure:

- Engineering controls
- Administrative controls
- PPE

1.1 Engineering Controls

Properly exhausted fume hoods, other local exhaust ventilation, glove boxes, and other special purpose hoods must be used when there is a likelihood of excessive exposure to air contaminants generated by laboratory activity. Used in conjunction with good work practices, properly designed and operated exhaust ventilation is effective in minimizing air contaminant exposure.

1.2 Administrative Controls

Administrative controls are work procedures such as safety policies, rules, supervision, and training used to reduce the duration, frequency, and severity of exposure via inhalation and physical contact to hazardous chemicals.

Some administrative controls include, but are not limited to, following written SOPs for higher-hazard chemicals, using low pours, and avoiding working alone with PHS or procedures.

1.3 Personal Protective Equipment

The use of PPE is necessary when feasible engineering and administrative controls are unavailable or if there is a need to supplement those controls.

The following are examples of PPE used to minimize inhalation and physical contact exposures. In addition, personnel should wear a combination of clothes and shoes that fully cover their legs and feet when working in labs.

PPE Type	PPE Examples
Eye and face protection	Safety glasses, chemical splash goggles, and face shields.
Body protection	Lab coats, aprons, and arm covers.
Hand protection	Gloves chosen based on the hazards.
Respiratory protection	Respirators for short-term use or during emergencies may be necessary to supplement existing engineering or administrative controls.

2.0 Prior Approvals and Procurement

Laboratory personnel should obtain prior approval to proceed with a laboratory procedure from a senior member of the lab or one more experienced in similar procedures when:

- Working with PHS (see Appendix II-A for definitions).
- Performing particularly hazardous procedures such as those with the potential for a violent reaction.
- Working alone with particularly hazardous materials or hazardous procedures.

EHS is available to assist laboratory personnel in reviewing hazards associated with any procedure, equipment, or chemical to be used in the laboratory to ensure that appropriate safety procedures are established.

Part III of this CHP is intended to provide guidance in the establishment and documentation of specific safety procedures.

3.0 General Safety Procedures

3.1 Basic Precautions

Awareness is the most fundamental rule of chemical safety. Take time to understand the safety and health hazards of the chemicals in the workplace. All laboratory personnel should take the following precautions:

- Review the safety and health hazard data of all chemicals used in the laboratory prior to use.
- Know the signs and symptoms of overexposure and the physical and sensory characteristics of these chemicals, such as odor and appearance.
- Know appropriate procedures for emergencies, including the location and operation of all emergency equipment.
- Have a second person nearby when working with hazardous materials.
- Avoid leaving experiments unattended, whenever possible.
- Never use unlabeled chemicals.
- Always order the least amount of chemical needed.
- Use hazardous chemicals in a chemical fume hood.
- Maintain equipment and inspect it regularly for proper function.
- Use guards and shields where possible. All mechanical equipment should have adequate guarding.
- Use safety shields when there is a possibility of explosion or implosion.
- Store and handle chemicals in accordance with the guidelines contained in this CHP or in accordance with the chemical manufacturer's guidelines.
- Store hazardous waste in a closed, labeled container in a designated Satellite Accumulation Area (SAA).
- Dispose of hazardous waste through the University Hazardous Waste Program. For more information on hazardous waste, review EHS Lab Waste Management.
- Use mechanical pipettes or aspirators.
- Do not eat, drink, chew gum, vape, or apply cosmetics while near or within chemical use or storage areas.

- Do not store food or drink containers or personal products such as hand lotion in the laboratory or in a chemical refrigerator.
- Do not use chipped or cracked glassware.
- Do not use damaged hot plates.
- Store cryo-gloves away from gloves used for handling hot items.
- Report all incidents, even if they do not result in injury, to the PI, LSO, laboratory supervisor, and/or EHS immediately.

3.2 Housekeeping and Hygiene

The following housekeeping and hygiene practices should be implemented at all times to reduce the likelihood of an incident or chemical exposure:

- Keep work areas clean and free of obstructions.
- Wash hands after every experiment, before touching any non-contaminated area or object, and before leaving the laboratory area.
- Do not block access to exits, emergency exits, aisles, hallways, stairways, stairwells, and controls.
- Ensure that emergency exits are unlocked from the inside.
- Do not use hallways as storage areas.
- Clean work areas at the end of the experiment and at the end of the day.

3.3 Chemical Storage and Handling

Many potential risks are associated with the storage and handling of laboratory chemicals. Understanding the properties of the chemicals and planning procedures by which they may be handled safely may minimize these risks. Simply storing chemicals alphabetically is not prudent. Flammable, corrosive, explosive, and peroxide-forming agents require special precautions. Storing incompatible chemicals together may have disastrous results.

The following guidelines are prudent for all chemical storage and handling:

- Chemical handling:
  - Use bottle carriers to transport chemicals by hand.
  - Close caps securely.
  - Pour all chemicals carefully.
  - Add acid to water, not water to acid.
  - Clean any residue off chemical bottles after use.
- Labels:
  - Be sure all labels are securely attached and legible.
  - Labels on stored chemicals should be easily readable.
  - Keep chemicals in their original container if possible.
  - Label all secondary containers with the full chemical name or names and hazards to avoid unknown chemicals or inadvertent reactions.
  - Thoroughly deface original labels when reusing chemical bottles.
  - Date all chemicals which may become unstable over time or are peroxidizable.
- Shelves:
  - Avoid storing hazardous liquid chemicals on hard-to-reach shelves.
  - Shelves should be made of a chemically resistant material.
- Incompatible chemicals:
  - Incompatible chemicals must not be stored together.
  - For each chemical, the hazardous nature must be considered individually and in relation to other chemicals in the area.
  - Refer to the chemical SDS, the EHS Chemical Storage Guide, or Appendix II-B for information on incompatible chemicals.
- Excessive storage:

  - Avoid stockpiling chemicals.
  - Ensure enough space so bottles are upright on a flat surface, not stacked or stored on their sides.
  - Purchase only what is needed.
  - Use older stock first.
  - Discard chemicals which are no longer needed or that have expired.
- Hallway storage:
  - Hallways should not be used as storage areas for chemicals.
- Chemical fume hoods:
  - In general, fume hoods should not be used for storage of chemicals, unless they are part of the experiment being conducted in the fume hood at that time. The exception is storage in a fume hood specifically designed for chemical storage where experimental procedures are not carried out.
  - Fume hoods should be kept clean and free of obstructions such that work can be performed safely and the hood can operate as designed.

3.4 Flammable Liquids

- Glass containers:
  - Whenever practical, glass containers should not be used for storing flammable liquids.
  - If a glass container must be used, the maximum allowable container size is 1 gallon (4 liters).
- Metal or plastic containers:
  - No more than 5 gallons of flammable liquid should be stored in regular metal or plastic containers.
  - Larger quantities must be stored in approved flammable-liquid safety cans or other approved containers.
- Safety cans:
  - Safety cans are the preferred containers for storage outside a flammable liquid storage cabinet.

- Safety cans are available in several sizes.
- They have spring-loaded spout covers that can open to relieve internal pressure when subjected to fire and will prevent leakage if tipped over.
- Flame arresters are present in the spout to prevent flame propagation into the can.
- The maximum size of the container should be 5 gallons.

- Kegs:
  - Kegs may be used for storing larger volumes of flammable liquids.
  - Ensure that kegs are constructed of metal or other approved materials that provide robust protection against fire and physical damage.
  - Kegs should be equipped with pressure-relief mechanisms to prevent pressure buildup and have secure seals to avoid leaks.
  - They should be grounded and bonded when dispensing or transferring liquids to prevent static discharge.
  - Do not refill empty kegs. Return them to the supplier per the supplier's shipping instructions.
- Solvent dispensing systems:
  - Solvent dispensing systems are designed to safely transfer liquids while minimizing exposure risk.
  - These systems should employ secondary containment to capture spills during dispensing.
  - Dispensing areas should be equipped with appropriate ventilation to mitigate vapor accumulation.
  - All components including hoses and nozzles must be compatible with the solvents being dispensed and should be regularly maintained to prevent leaks or malfunctions.
- Flammable liquid storage cabinets:
  - Use of flammable liquid storage cabinets is the method of choice for storage of flammable liquids.
  - Most flammable storage cabinets are made of double-walled steel.
  - Those that are vented are equipped with flame arresters.

  - Some models have doors that close automatically.
  - Refrigerators and freezers used for storage of flammable materials must be rated for flammable storage. Most standard lab refrigerators and freezers, having internal sources of ignition, do not meet this requirement.

- Maximum quantities:
  - The maximum quantities of flammable liquids allowed outside of flammable storage cabinets or safety cans depends on a number of factors such as the class of flammable liquid, type of space, presence or absence of sprinkler heads, and floor level. Minimize storage of flammable liquids outside of storage cabinets and consult with EHS if storage outside these units may be needed.
- Handling:
  - Transfer and storage of flammable materials should not be in an area where a spill of the liquid could block an exit from the room, hallway, or building in the event of a fire, and where there is a source of ignition.
- Incompatibles:
  - Store flammable liquids separate from oxidizers, compressed gases, highly toxic materials, corrosives, and water-reactive chemicals.

3.5 Oxidizing Agents

- Storage:
  - Oxidizers should be stored in corrosives cabinets, standard lab cabinets, or standard chemical storage refrigerators and freezers.
  - Do not store directly on combustible materials such as wooden shelves.
- Incompatibles:

- Oxidizing agents can initiate combustion and therefore should not be stored in the same area with fuel, such as flammables, organic chemicals, dehydrating agents, or reducing agents.
- Consult SDSs for additional compatibility information.

3.6 Perchloric Acid

At room temperatures, perchloric acid solutions below a concentration of 72% are non-oxidizing acids. At concentrations above 72%, or at elevated temperatures, usually above 160 degrees Celsius, it is an exceedingly strong and active oxidizer and dehydrating agent. Anhydrous perchloric acid is unstable at room temperature and will ultimately decompose spontaneously with a violent explosion.

- Handling:
  - Perchloric acid should be handled in a fume hood designed for perchloric acid use if perchloric acid vapors are not being captured and scrubbed. These hoods must have a washdown system to prevent accumulation of shock-sensitive crystals on the inner wall of the duct. Ductwork must be coated with material designed for perchloric acid use.
- Incompatibles:
  - Perchloric acid must be stored away from reducing agents and from organic and other combustible materials, including wood, paper, absorbent pads, cardboard, and cloth.

3.7 Peroxidizable Materials

Some chemicals can form shock-sensitive, explosive peroxides when exposed to air or light, such as many ethers, acetals, ketals, and aldehydes. Examples include isopropyl ether, diethyl ether, dioxane, tetrahydrofuran, glyme (dimethoxyethane), and diglyme. Since these chemicals are packaged in an air atmosphere, peroxides can form even if the containers have not been opened. A representative list of common peroxidizable and other unstable materials is available in the EHS Lab Safety Guideline: Peroxide-Forming Chemicals document.

- Storage time limit:
  - Peroxide-forming chemicals have different storage timelines depending on which class of peroxide former they are.
  - Most common ones found in labs should be used up or discarded within six months after they are first opened, while unopened containers should be stored no more than one year.
  - Refer to EHS Lab Safety Guideline: Peroxide-Forming Chemicals for detailed information on timelines for different classes.
- Container inspection:
  - Containers should be inspected for peroxide formation before opening or moving them.
  - If crystals are present around the lip of the container or the liquid appears cloudy, do not move or open it. Immediately contact EHS for guidance.
  - Colorimetric strips are available to test for peroxide formation.
  - Although some solutions have a peroxide inhibitor, they should still be inspected before opening as the inhibitors do not completely stop peroxide formation.
- Dating containers:
  - To ensure storage time limits are not exceeded, containers of peroxidizable materials should be dated when received, when first opened, and when tested for peroxide formation.
  - A sample dating label is shown in Appendix II-C and can be requested using the EHS Chemical Waste Pickup/Services Online Request form.

3.8 Corrosive Materials

Corrosive substances are some of the most hazardous substances commonly encountered in the laboratory. In general, corrosive substances cause destruction of living tissue very rapidly at the site of contact (skin, eyes, respiratory tract, and gastrointestinal tract). For this reason, proper selection and use of PPE is critical when

working with corrosives. See Section 5.0: Personal Protective Equipment for more specific guidance regarding PPE.

- Containers:
  - Whenever practical, corrosive materials should be purchased and stored in break-proof or break-resistant containers.
- Storage:
  - Many acids and alkalis are corrosive to their containers and other materials in a storage area.
  - In general, they should be stored in a cool, dry area, equipped with corrosion-resistant shelving, preferably in a corrosive storage cabinet.

3.9 Toxic Materials

Toxic materials are those that can cause acute or chronic adverse health effects. Toxic materials, which are simultaneously hazardous because of another attribute such as flammability or corrosivity, should be evaluated to determine which hazard is the most significant and stored accordingly.

Access to these materials should be restricted to those involved in the experiment and those who have been informed of the hazardous properties of the chemical. These chemicals should not be stored in a hallway, stairway, or any other emergency egress path regardless of whether they are contained in a storage can or cabinet. Additional precautions for working with PHSs are contained in Part II of this CHP. Lists of carcinogens are referenced in Appendix II-A.

If the toxicity of the chemical is the primary hazard, the chemical should normally be stored in a dedicated cabinet or shelf storage area away from other storage groups or in a standard chemical storage refrigerator or freezer. If they are also flammable and require cold storage, use a refrigerator or freezer designed for flammable storage. Chemicals with a high acute toxicity may require a secure cabinet or, if they have a high volatility, a mechanically-vented cabinet.

3.10 Compressed Gas Cylinders

Compressed gas cylinders may have both mechanical and chemical hazards. For any compressed gas cylinder, the large amount of potential energy resulting from the compression of the gas makes them a potential rocket. Asphyxiation can be caused by high concentrations of even inert gases such as nitrogen. Some have additional chemical hazards, with a high risk of fire or explosion from flammable and oxidizing gases and health hazards from toxic gases. Additional risks arise for reactive gases.

- Identification:
  - The contents of the cylinder should be clearly marked.
  - Gas lines from the cylinder should be labeled as to the gas and the laboratory served.
  - A tag should be attached to the cylinder to indicate whether the cylinder is full, in use, or empty.
- Handling:
  - During transport cylinders should be secured to appropriate handcarts.
  - Highly toxic gases should not be moved through corridors in areas where occupants not knowledgeable in the hazards of the gases may be present.
  - Cylinder valves should be opened slowly, using a hand wheel or wrench while standing away from the valve opening.
  - Compressed Gas Association (CGA) approved valves, fittings, and other connections of the proper configuration for the gas being used should be employed at all times.
- Storage:
  - All cylinders, regardless of whether they are full or empty, must be firmly secured at all times, using either a cylinder stand or a clamp or bracket and a strap or chain.
  - They should be stored in a cool, dry, well-ventilated area free from sources of ignition.

  - Oxidizing gases should be stored separately from flammable gases, either by maintaining at least 20 feet of separation or by using a non-combustible barrier that meets fire code requirements. Consult EHS for a review before using a barrier.
  - A cylinder cap or regulator valve should always be in place.

- Empty cylinders:
  - Cylinder caps should always be secured and cylinders should be clearly marked “empty”. Empty cylinders should be kept secured as noted in this section.

Refer to the Hazardous Gas Manual for detailed information related to hazardous gas monitoring systems for toxic, flammable, and pyrophoric gases.

4.0 Safety Procedures for Particularly Hazardous Substances

Additional protection is required for work with PHSs such as carcinogens, reproductive toxins (mutagens and teratogens), and substances with a high degree of acute toxicity**.** Some of these materials are referenced in Appendix II-A. When working with these particularly hazardous materials the following general procedures must be followed:

- Obtain approval from the PI, Supervisor, Core Manager, or their designee (for example, senior member of the lab, lab supervisor, or CHO) to use these PHSs.
- Order the smallest quantity of the chemical necessary to perform the procedure or experiment.
- Wear appropriate PPE, paying close attention to permeation resistance of gloves or protective clothing to be used.
- Work should be performed in a properly functioning chemical fume hood. This area should be posted or labeled as a “Designated Area” for the use of particularly hazardous materials. Only permit authorized personnel to use any Designated Area.

- Determine, in consultation with the PI, Supervisor, Core Manager, or their designee (for example, senior member of the lab, lab supervisor, or CHO) and EHS whether fume hood exhaust air should be filtered prior to discharge.
- Consult the SDS for exposure and emergency information before beginning work with these materials.
- Label all containers with the contents and hazardous properties of the material or materials in the containers.
- Transfer PHS in tightly closed containers placed within a durable outer container.
- Limit traffic through the immediate area.
- Decontaminate the work surface immediately after working with these materials. To facilitate decontamination, work surfaces may be covered with stainless steel or plastic trays, absorbent paper with moisture-proof lining, or other impervious material, which can be cleaned or disposed of as hazardous waste after completing the procedure.
- Securely store these materials immediately after use.
- Label all waste materials per Harvard's waste management guidelines. with the corresponding chemical classification such as "Toxic".

Where the standard procedures in this CHP do not provide sufficient protection for given PHSs (e.g., due to toxicity, volatility, quantity, or operation), laboratories should develop and document lab specific SOPs for these materials and include them in Part III of this CHP. Additional information about carcinogens, reproductive toxins, biotoxins and acutely toxic substances is contained in Appendix II-A.

This section excludes Select Agent Toxins, which are categorized as such due to their potential for use in biological terrorism or warfare. Only permissible amounts of select toxins are permitted at Harvard and require approval from the Committee on Microbiological Safety (COMS) before purchase and use. Review EHS Select Agents guidance for appropriate handling, storage, and disposal of select toxins.

5.0 Personal Protective Equipment

The Harvard University Laboratory PPE Policy requires each PI, or Designee selected by the PI, to assess PPE needs annually. In addition, the PI must ensure that all required PPE is readily available to researchers and that all PPE is properly used in the laboratory. EHS has created a PPE Assessment tool to aid in the assessment process.

5.1 Body and Foot Protection

When working with chemicals, a lab coat or an apron and closed-toe shoes should be worn at all times. The combination of clothing and shoes should fully cover the legs and feet, particularly when working with hazardous chemicals. Hair and loose clothing should be restrained.

5.2 Hand Protection

Hands are the most likely part of the body to come in contact with chemicals. This contact may result in irritation, burns, or absorption of the chemical into the bloodstream. Glove materials must be compatible with the chemical or chemicals used. Consult the information on the Harvard EHS Chemicals and Hazardous Materials webpage, the EHS Lab Glove Selection Guide, the glove manufacturer's literature, or EHS when choosing gloves for a specific application.

5.3 Eye Protection

Safety glasses, goggles, or face shields should always be worn when there is a risk to the eyes. Laboratory personnel and visitors should be provided with eye protection before entering a laboratory.

- Safety glasses are the minimum requirement when there is a risk to the eyes. They provide basic protection from splashes or flying objects. Safety glasses should comply with the American National Standards Institute (ANSI) Occupational and Educational Eye and Face Protection Standard (Z87.1). Standard eyeglasses with side shields are generally not sufficient.

- Chemical splash goggles must be used when a significant splash hazard exists or where there is a greater risk of flying particles. It is best practice to wear them whenever there is a risk to the eyes, such as working with corrosive liquids. These generally can be worn over regular eyeglasses. Goggles equipped with indirect vents should be used to prevent fogging. Do not use direct vent goggles with chemicals.
- Face shields must be worn when maximum protection from flying particles and harmful liquids is needed. Eye protection should be worn under face shields. Use the face shield in combination with chemical splash goggles for maximum protection from corrosives and hot chemicals.

5.4 Respirators

When chemical substitution and effective engineering controls are not possible, respirators should be used. OSHA's Respiratory Protection Standard 29 CFR 1910.134 must be complied with for all personnel who are required or volunteer to wear a respirator. For required use, the standard specifies a medical evaluation, training, fit testing, selection, and guidelines for proper use. For voluntary use, at a minimum users must complete voluntary-use training. EHS must be contacted before purchasing or using respiratory protection.

EHS offers training and fit testing services for Harvard personnel. In addition, EHS is available to assist laboratories in establishing an OSHA-compliant Respiratory Protection Program.

6.0 Other Safety Equipment

6.1 Fume Hoods and Ventilation

The laboratory fume hood is one of the most important safety devices in the laboratory.

- Use:
  - The ventilation system in the laboratory has been carefully balanced to ensure proper airflow and comfortable working conditions.
  - To prevent cross drafts, laboratory doors should be kept closed whenever possible.

- The EHS Lab Fume Hood Recommended Work Practices document provides a complete guide to proper use of laboratory fume hoods.
- Each fume hood is registered by EHS and a registration sticker is affixed to the hood.

- Maintenance:
  - Laboratory fume hoods are evaluated by EHS or outside contractors at least annually. During these evaluations, average face velocity of the hood is measured and hood containment is evaluated using flow visualization.
  - Fume hoods passing evaluation are labeled at an 18-inch sash height with a fume hood inspection sticker indicating the date of evaluation.
  - Fume hoods failing evaluation are posted with a failure notification form, and the hood operators are informed of the failure. Failed hoods are reported to Building Managers for service and are reevaluated after service has been completed.

6.2 Eyewash Stations

Eyewash stations are required in any lab where there is the potential for eye injury from exposure to hazardous chemicals.

- Requirements:
  - The eyewash station must be capable of providing a continuous, soft stream of tepid water for at least 15 minutes. Drench hoses may support eyewash stations, but do not replace them unless meeting ANSI standards for a combination drench hose eyewash unit.
- Location:
  - Eyewash stations should be located no more than 10 seconds travel time from the hazard, about 50 feet.
  - The location should be marked with a highly visible sign.

- Maintenance:
  - Eyewash stations should be flushed weekly for 1 minute to assure function and avoid build-up of bacteria and minerals.
  - The path to the eyewash station must be free from obstructions.
- Use:
  - Refer to the Lab Emergency Response Guide for information on use of eyewashes following an exposure.

6.3 Safety Showers

Safety showers should be provided where chemicals are handled. The showers provide first aid for chemical splashes.

- Requirements:
  - Safety showers should provide at least 20 gallons of water per minute.
  - The valve should be simple to activate and should remain activated until intentionally shut off.
  - The valve or activation ring should be within reach, not more than 69 inches above the floor.
- Location:
  - Safety showers should be in an accessible location no more than 10 seconds travel time, about 50 feet from the hazard.
  - The location should be marked with a clearly visible sign and, if possible, markings on the floor such as a large yellow circle.
- Maintenance:
  - Safety showers should be flushed every six months, typically by facilities personnel.
  - The path to the safety shower must be kept free from obstructions.

- Use:
  - Refer to the Lab Emergency Response Guide for information on use of safety showers and related procedures following an exposure.

6.4 Fire Extinguishers

Portable fire extinguishers are necessary to rapidly suppress small fires. Only people trained to use a fire extinguisher should operate one. Never try to fight a fire that is larger than a person.

Types of Fires

Fires are classified according to the type of material that is burning. The main fire classes relevant to laboratory work include:

- Class A fires, involving combustible materials, such as wood, cloth, paper, and many plastics.
- Class B fires, involving flammable and combustible liquids or gases.
- Class C fires, involving energized electrical equipment such as appliances, instruments, and wiring. When the electrical equipment is de-energized, the fire may continue to burn as a Class A or B fire.
- Class D fires, involving combustible metals, such as magnesium, titanium, sodium, zirconium, and potassium.

Types of Extinguishers

There are several types of fire extinguishers. An extinguisher is rated as to the type of fire it can put out. The type of fire the extinguisher is designed to extinguish is printed on the cylinder.

- Class A: A triangle with an “A” denotes Class A.
- Class B: A square with a “B” denotes Class B.
- Class C: A circle with a “C” denotes Class C.
- Class D: A star with a “D” denotes Class D.

The most common fire extinguishers in labs are a combination Class ABC. Contact EHS if a different type of fire extinguisher may be warranted in a space.

Location

Fire extinguishers are generally mounted either near an exit, at the back of the laboratory, or in hallways next to laboratories. There should be at least one extinguisher for each laboratory.

Maintenance

All extinguishers must be inspected annually. An inspection tag must be attached to each extinguisher and must indicate the date of the last inspection.

Training

EHS offers Fire Extinguisher training through the Harvard Training Portal.

Use

Before using a fire extinguisher, use a pull station to activate the fire alarm, call 911, and then call the Harvard Operations Center to report the fire.

- Cambridge, Allston, and Harvard School of Public Health (HSPH): Call 617-495-5560.
- Harvard Medical School (HMS) and Harvard School of Dental Medicine (HSDM): Call 617-432-1901.

If the fire is small and an individual has taken the training to use a fire extinguisher, they may choose to use an extinguisher. Steps include:

- Choosing the correct fire extinguisher by checking the label.
- Pointing the nozzle at the base of the flame with a side-to-side motion.
- Fully discharging the fire extinguisher without interruption.

If the fire becomes larger than a person, or the contents of the extinguisher have been discharged and the fire is still burning, evacuate the building, closing doors on the way out. Keep doors unlocked if possible.

7.0 Chemical Waste Management

This section outlines the key elements of the Harvard University Laboratory Hazardous Waste Program. Additional information is available on the EHS Waste Management and Disposal site or by contacting the EHS office.

Waste Identification: Hazardous waste regulations require that hazardous waste be accurately identified. Common laboratory wastes include:

- Spent solvents, acids, bases, and oxidizers used in extractions, cleaning, or other processes.
- Unused reagents and other chemicals that are no longer needed, do not meet specifications, are contaminated, have exceeded their storage life, or are otherwise unusable in the lab.
- Waste oils.
- Other miscellaneous materials such as broken thermometers, heavy metal salts, and toxic chemicals.

These wastes may be identified as hazardous because they are:

- Listed wastes appearing on federal or state lists of specific hazardous wastes.
- Characteristic wastes that exhibit one or more hazardous characteristics, including ignitability, corrosivity, reactivity, and toxicity, as defined by the Massachusetts Department of Environmental Protection (MassDEP) and applicable federal regulations.

EHS is available to assist with waste identification.

7.1 Storage and Disposal

Regulations require that hazardous wastes be accumulated and stored in properly managed containers on sufficiently impervious surfaces that are free of cracks, gaps, or other damage.

- Storage: Hazardous waste in laboratories is stored in SAAs.
- Disposal: Once an SAA area container is filled, it must be dated and transferred to a main accumulation area or shipped off-site within three days. EHS provides waste pickup services upon request through an

online waste pickup form. If a lab has a mini main accumulation area, dated waste is brought to this location. Disposal of hazardous waste in laboratory sinks is prohibited by regulation.

- Labeling: Containers that accumulate and store hazardous waste must be labeled with the following information:
  - The words “Hazardous Waste”.
  - Full chemical name with no formulas or abbreviations (example: ethanol, not EtOH; water, not H_2O).
  - The associated hazard or hazards in words (ignitable, toxic, corrosive, oxidizer). Check off the appropriate box(s) on the label.
  - The date upon which the container became filled.
  - Note: EHS provides hazardous waste labels that fulfill these required elements. Containers must be labeled and situated so that labels are clearly visible.
- Closure: Containers must be closed at all times unless waste is being added or removed. Open-top funnels may not be left in open containers.
- Condition: Containers must be in good condition. For instance, no severe rusting, dents, or other conditions that could cause leaks.
- Compatibility: Containers must be compatible with the hazardous waste stored within them. When in doubt, use the original container.
- Inspections: Containers must be inspected weekly by laboratory personnel to ensure that they are properly labeled, in good condition, and meet the criteria described in this section.

7.2 Training

Laboratory personnel whose duties or activities involve the management of hazardous waste receive hazardous waste training as part of the online General Laboratory Safety course.

7.3 Waste Minimization

Laboratory waste minimization techniques include:

- Process or equipment adjustment or modification.
- Toxic material substitution.
- Waste segregation and separation.
- Recycling.

The exercise of prudence in ordering new chemicals will also ensure that excess chemical does not become subject to disposal as hazardous waste. Contact EHS for more information regarding waste minimization.

8.0 Emergency Procedures

Red signs with emergency numbers should be located in all lab spaces. More detailed information on emergency procedures for labs can be found in the EHS Lab Emergency Response Guide. The guide includes emergency contact numbers and procedures to implement during situations that include medical emergencies, fires, hazardous material spills, hazardous gas and oxygen deficiency incidents, and bomb threats or suspicious mail.

9.0 Appendices

9.1 Appendix II-A: Particularly Hazardous Substances Information

A partial list of common PHSs is available in Chemical List: Particularly Hazardous Chemicals. PHSs include carcinogens, reproductive toxins, and acutely toxic substances.

Select Carcinogens

Select carcinogens are substances that meet any of the following criteria:

- Regulated by OSHA as a carcinogen. Guidance on these regulated carcinogens can be found in OSHA 1910.1003 - 13 Carcinogens (4-Nitrobiphenyl, etc.).
- Listed under the category 1 “Known to be carcinogens” in the National Toxicological Program (NTP) Annual Report on Carcinogens.
- Listed under Group 1 “Carcinogenic to humans” by the International Agency for Research on Cancer (IARC) Monographs.
    - These chemicals can be found in the IARC Monographs.
    - The current IARC carcinogen listing, including group, can be found on IARC List of Classifications: Agents Classified by the IARC Monographs.
- Listed in either Group 2A or 2B by IARC or under the category “reasonably anticipated to be carcinogens” by the NTP, and cause statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:
    - Inhalation exposure of six hours to seven hours per day, five days per week, for a significant portion of a lifetime to airborne concentrations of less than 10 milligrams per cubic meter of air (mg/m3).
    - Repeated skin application of less than 300 mg/kg body weight per week.
    - Oral doses less than 50 mg/kg body weight per day.

The current IARC carcinogen listing of chemicals can be found in the IARC List of Classifications: Agents Classified by the IARC Monographs.

The current NTP listing of reasonably anticipated human carcinogens can be found in the NTP Completed Report on Carcinogens Evaluations.

Reproductive Toxins

Reproductive toxins are chemicals that adversely affect the reproductive process. These toxins include mutagens that can cause chromosomal damage and teratogens which can retard fetal growth and cause birth defects, fetal malformations, and fetal death.

Knowledge of how chemicals affect reproductive health is missing for many chemicals. Manufacturers were not required to test chemicals other than drugs for their effects on reproductive health until the 1973 passage of TSCA.

Although a few well-controlled studies have been conducted, the evidence for most chemicals is limited to case reports or studies done on a small group of exposed people after a problem emerged. Of the over 100,000 chemical substances and mixtures in commercial production, only a limited number have been tested thoroughly on animals for reproductive effects with the exceptions of drugs, pesticides, and food additives.

Sources of information about chemicals that pose a risk to human reproduction include:

- The chemical list generated pursuant to the State of California's Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65). This list, which includes chemicals known to the State of California to cause reproductive or developmental toxicity and cancer, can be found on the Office of Environmental Health Hazard Assessment Proposition 65 List.
- SDSs for those chemicals.
- The EHS Office.

Acutely Toxic Substances

Acutely toxic substances are defined in Appendix A of the OSHA Hazard Communication Standard. Any substance or mixture classified as acutely toxic by ingestion, skin absorption, or inhalation Category 1 or Category 2 must be treated as a PHS.

- Substances with a median oral lethal dose (LD_{50}) in rats of 50 mg/kg or less of body weight.
- Substances with a median skin contact lethal dose (LD_{50}) in rabbits of 200 mg/kg or less of body weight.
- Substances with a median inhalation lethal concentration (LC_{50}) of 500 parts per million (ppm) or less by volume of gas, vapor or 2 mg/l or less of vapor and 0.5 mg/l dust or mist.

Information concerning lethal doses and other measures of acute toxicity for particular substances is available on the SDS for a particular substance, from the manufacturer, or the EHS Department.

Excluded Select Agents Toxins

The Department of Health and Human Services has identified a group of biotoxins as Select Agents, which are considered particularly hazardous and acutely toxic to humans or animals. These toxins are exempted from most of the Select Agent regulations if the toxin amount does not exceed a designated threshold quantity.

If the threshold quantity is exceeded, all Select Agent regulations must be followed. Additionally, transfers of these toxins, even in exempted amounts, require special safety and security procedures.

Note that PIs, Supervisors, and Core Managers must register and receive approval from COMS before using Select Agent Toxins. Please contact EHS regarding COMS registration and for information regarding safe and secure use, threshold quantities exempted from the regulations, and transfer procedures, when applicable.

9.2 Appendix II-B: Chemical Compatibility Information

Examples of incompatible chemicals are listed in this section. The material in the “Chemical” column should be stored and handled so that it does not contact the incompatible chemical or chemicals in the “Is Incompatible

and Should Not be Mixed or Stored With" column. Contact with incompatible chemicals could result in a violent reaction or generation of toxic reaction products.

Examples of Incompatible Chemicals

Chemical	Is Incompatible and Should Not be Mixed or Stored With
Acetic acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Alkali and alkaline earth metals, such as powdered aluminum or magnesium, calcium, lithium, sodium, potassium	Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, halogens
Ammonia (anhydrous)	Mercury, chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid (anhydrous)
Ammonium nitrate	Acids, powdered metals, flammable liquids, chlorates, nitrates, sulfur, finely divided organic or combustible materials
Aniline	Nitric acid, hydrogen peroxide
Arsenical materials	Any reducing agent
Azides	Acids
Bromine	See Chlorine
Calcium oxide	Water
Carbon (activated)	Calcium hypochlorite, all oxidizing agents
Carbon tetrachloride	Sodium

Chemical	Is Incompatible and Should Not be Mixed or Stored With
Chlorates	Ammonium salts, acids, powdered metals, sulfur, finely divided organic or combustible materials
Chromic acid and chromium trioxide	Acetic acid, naphthalene, camphor, glycerol, alcohol, flammable liquids in general
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane or other petroleum gases, hydrogen, sodium carbide, benzene, finely divided metals, turpentine
Chlorine dioxide	Ammonia, methane, phosphine, hydrogen sulfide
Copper	Acetylene, hydrogen peroxide
Cumene hydroperoxide	Acids (organic or inorganic)
Cyanides	Acids
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
Fluorine	Everything
Hydrocarbons, such as butane, propane, benzene	Fluorine, chlorine, bromine, chromic acid, sodium peroxide
Hydrocyanic acid	Nitric acid, alkali
Hydrofluoric acid (anhydrous)	Ammonia (aqueous or anhydrous)
Hydrogen peroxide	Copper, chromium, iron, most metals and their salts, alcohols, acetone, organic materials, aniline, nitromethane, combustible materials

Chemical	Is Incompatible and Should Not be Mixed or Stored With
Hydrogen sulfide	Fuming nitric acid, oxidizing gases
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen
Mercury	Acetylene, fulminic acid, ammonia
Nitrates	Sulfuric acid
Nitric Acid (concentrated)	Acetic acid, aniline, chromic acid, hydrogen sulfide, flammable liquids, flammable gases, copper, brass, any heavy metals
Nitrites	Acids
Nitroparaffins	Inorganic bases, amines
Oxalic acid	Silver, mercury
Oxygen	Oils, grease, hydrogen, flammable liquids, solids, or gases
Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, grease, oils
Peroxide, organic	Acids (organic or mineral), avoid friction, store cold
Phosphorus (white)	Air, oxygen, alkalis, reducing agents
Potassium	Carbon tetrachloride, carbon dioxide, water
Potassium chlorate	Sulfuric and other acids
Potassium perchlorate (see also chlorates)	Sulfuric and other acids
Potassium permanganate	Glycerol, ethylene glycol, benzaldehyde, sulfuric acid
Selenides	Reducing agents

Chemical	Is Incompatible and Should Not be Mixed or Stored With
Silver	Acetylene, oxalic acid, tartaric acid, ammonium compounds, fulminic acid
Sodium	Carbon tetrachloride, carbon dioxide, water
Sodium nitrate	Ammonium nitrate and other ammonium salts
Sodium peroxide	Ethyl or methyl alcohol, glacial acetic acid, acetic anhydrite, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural
Sulfides	Acids
Sulfuric acid	Potassium chlorate, potassium perchlorate, potassium permanganate and similar compounds of light metals, such as sodium and lithium
Tellurides	Reducing agents

9.3 Appendix II-C: Peroxidizable Materials Label

Labels for peroxide-forming chemicals can be obtained from EHS using the EHS Chemical Waste Pickup/Services Online Request form.

Peroxide materials labels include these fields:

- Title: Peroxide Former.
- Date received (month/day/year).
- Date opened.
- Expiration date (date to dispose).
- Date tested and peroxide concentration (if you're unwilling or unable to test the chemical for peroxides, then it must be disposed of as hazardous waste).
- Fields to indicate the applicable Class and state and the corresponding storage requirements:
    - If Class A, once opened don't keep longer than three months or the manufacturer's expiration date if no peroxides are detected when (check applicable) liquid tested every three months or solid checked visually every three months.
    - If Class B or C, once opened don't keep longer than six months or the manufacturer's expiration date unless tested every three months and no peroxides are detected.

PEROXIDE FORMER

RECEIVED: _____/_____/_____ month/day/year

OPENED: _____/_____/_____

EXPIRATION: _____/_____/_____ (date to dispose)

DATE TESTED	PEROXIDE CONCENTRATION

NOTE: If you are unwilling or unable to test the chemical for peroxides, then it must be disposed as hazardous waste.

ehs.harvard.edu/node/7689

Check off Applicable Class/State and Follow Storage Guidelines Below

Peroxide Former	Once Opened, Keep No Longer Than:
☐ Class A	**3 Months** or manufacturer's expiration date if no peroxides detected when: ☐ **Liquid** tested every 3 months ☐ **Solid** checked visually every 3 months
☐ Class B or C	**6 Months** or manufacturer's expiration date if tested every 3 months & no peroxides detected

9.4 Appendix II-D: Abbreviations

- ACGIH: American Conference of Governmental Industrial Hygienists
- AL: Action Level
- ANSI: American National Standards Institute
- CGA: Compressed Gas Association
- CFR: Code of Federal Regulations
- CHP: Chemical Hygiene Plan

- CHO: Chemical Hygiene Officer
- COMS: Committee on Microbiological Safety
- DOT: Department of Transportation
- PI: Principal Investigator
- EHS: Environmental Health and Safety
- EPA: Environmental Protection Agency
- ERCC: Exposure Response Call Center
- ESCO: Environmental and Safety Compliance Officer
- HMS: Harvard Medical School
- HSDM: Harvard School of Dental Medicine
- HSPH: Harvard Chan School of Public Health
- IARC: International Agency for Research on Cancer
- LSO: Lab Safety Officer
- MassDEP: Massachusetts Department of Environmental Protection
- OSHA: Occupational Safety and Health Administration
- PEL: Permissible Exposure Limit
- PHS: Particularly Hazardous Substance
- PPE: Personal Protective Equipment
- ROM: Research Operations Manager
- SAA: Satellite Accumulation Area
- SDS: Safety Data Sheet
- SOP: Standard Operating Procedure
- TLV: Threshold Limit Values
- TSCA: Toxic Substances Control Act

9.5 Appendix II-E: Environmental Protection Agency Toxic Substances Control Act-Regulated Chemicals

TSCA is a U.S. law that gives the EPA the authority to regulate the use of chemicals that pose a health risk to individuals. Labs may continue to use most TSCA-regulated chemicals if following specific procedures as outlined in each rule. Refer to the EHS TSCA Regulated Chemical Information document for information on current TSCA-regulated chemicals and Harvard requirements for use.

Part III. Laboratory-Specific Standard Operating Procedures

1.0 Introduction

Part III of the Harvard University CHP is intended to address hazards that are specific to a department, laboratory, research group, procedure, or hazardous substance. Part III is designed to contain Lab-Specific SOPs developed by laboratory personnel, with the assistance of EHS as needed. A lab SOP must be developed for any operation or hazardous material for which the general safety procedures contained in Part II of the CHP are inadequate to address hazards. These procedures must be written to clearly identify additional or special precautions, controls, PPE, and emergency procedures that are required, as well as the nature of the hazards the procedure is intended to minimize. Each lab SOP must be reviewed by the PI, supervisor, core manager, or CHO for the area where the procedure will be implemented. The PI, supervisor, core manager, or designee should review lab SOPs each year for active procedures and update them if necessary.

A lab SOP that addresses the requirements noted in this section must be documented and maintained in Part III of the CHP. In addition, personnel authorized to perform operations for which a lab SOP has been established must be trained in the specific procedure. The PI, supervisor, or core manager, during the annual review of lab SOPs, will determine if refresher training is warranted at that time.

There are multiple approaches that can be used to document lab-specific safety procedures. SDSs don’t meet this requirement. They are helpful, but as standalone documents sometimes do not provide enough specifics

or are not as frequently reviewed as the lab protocols. For example, some SDSs merely provide a general statement like "Use appropriate gloves" for glove use. Acceptable methods include the following.

- **Use the questions and categories in the EHS Lab SOP: Hazardous Chemical or Procedure Template to ensure that the safe work practices are incorporated into the standard lab protocols.**
    - Include work practices to minimize exposure to specific hazards such as working in chemical fume hoods and specific PPE to use during normal operations and emergency procedures. For instance, polyvinyl alcohol (PVA) gloves should be used in the case of immersion into phenol chloroform since chloroform would easily degrade standard latex or nitrile gloves.
- **Create separate chemical-specific procedures using the lab SOP template or comparable format.**
- **Group similar chemicals**, such as aldehydes or halogenated hydrocarbons, into one safety procedure using the lab SOP template or comparable format.

Instructions regarding use of the lab SOP template are contained in Section 2.0: Lab Standard Operating Procedure Template Instructions. Examples of lab SOPs for commonly used PHS are available on EHS Lab Safety Guidelines and SOPs. EHS is available to assist laboratory personnel in the development of lab SOPs.

2.0 Lab Standard Operating Procedure Template Instructions

2.1 Title of Procedure

Should indicate the specific chemical, task, or experiment for which it was written.

2.2 Description

Include a general description of what activities are covered under this procedure. List any specific examples of when the procedure must be implemented or any exemptions when the procedure is not required. If authorization for this procedure is limited to designated personnel, that fact should be noted in this section.

2.3 Procedure

Enumerate or list the safety steps to be followed in performing the procedure. The steps should be sufficiently detailed and should include any prohibited activities or any potentially dangerous conditions.

2.4 Potential Hazards

Complete the hazard description table for each of the principle materials utilized in this procedure. SDSs, when available, should be obtained and attached to the procedure's SOP. Many operations can result in secondary materials or hazardous by-products. A discussion of these materials should be included in this section if they represent a significant but different hazard than the other materials.

2.5 Engineering Controls Including Ventilation

Identify the engineering controls, such as lab chemical fume hoods, implemented to minimize exposures to hazardous materials and processes.

2.6 Required Personal Protective Equipment

Conduct a comprehensive PPE evaluation for the referenced materials or operation. The determination should include both the type of equipment and the clothing materials. Refer to the Lab's PPE Assessment Report. Questions regarding the selection or procurement process should be directed to the lab's LSO.

2.7 Additional Precautions

Indicate and describe any management approvals, medical surveillance, training, or specific permits that must be obtained to conduct this procedure. Questions regarding applicability of these categories should be directed to the lab's LSO or EHS.

2.8 Safety References

Additional chemical safety information, including SDSs and other information, is available electronically as tools on the EHS Chemicals and Hazardous Materials webpage. Add any lab-specific information as appropriate.

2.9 Waste Disposal

Refer to the EHS Laboratory Waste Guide. As appropriate, list any additional equipment, supplies or procedures that are unique to the referenced materials or operations.

2.10 Emergency Procedures

Generic information related to emergency response activities is already addressed in Part II of the CHP. Refer also to the EHS Waste Management and Disposal webpage and the red emergency number signs posted in labs. List any additional emergency equipment, supplies, or procedures that are unique to the referenced materials or operations. For example, an antidote such as calcium gluconate should be present wherever hydrofluoric acid is used or stored.