Vanderbilt University

CHEMICAL HYGIENE PLAN

April 21, 2020

1.0 INTRODUCTION

Vanderbilt University (VU) has developed a written Chemical Hygiene Plan (CHP) which complies with applicable federal and state regulations as described in Section 2.0

The purpose of the CHP is to describe proper chemical handling practices and procedures to be followed by faculty, employees, students, visitors, and other personnel when in laboratories at VU. These practices protect laboratory personnel from potential injury and illness associated with hazardous chemicals.

While the CHP establishes work practices to promote safety in the laboratory, each individual has the primary responsibility for ensuring that good health and safety practices are followed and implemented in the laboratory.

2.0 THE LABORATORY STANDARD

The Tennessee Occupational Safety and Health Administration (TOSHA) adopted the Laboratory Standard as it was written by the United States Occupational Safety and Health Administration (OSHA), including the numbering (29 CFR 1910.1450). The standard is contained in TOSHA's Occupational Safety and Health Standards for General Industry. The laboratory standard applies to all employers engaged in the laboratory use of hazardous chemicals.

3.0 SCOPE AND APPLICATION

The CHP serves as a written guide for compliance with the TOSHA Laboratory Standard and the requirements specified within this regulation. All laboratories at VU engaged in the laboratory use of hazardous chemicals are required to comply with this document.

The primary objective of the CHP is to provide a general guide for handling hazardous chemicals in laboratories. It establishes the basic safety principles for laboratory procedures, equipment and work practices that are capable of protecting employees from the physical and health hazards of hazardous chemicals in laboratories.

Where the scope of chemical hazards is not adequately addressed by this document, laboratory specific safe work practices including Chemical Safety Protocols (CSP's) must be developed and implemented to ensure a safe laboratory. (See Section 5.2)

4.0 ROLES AND RESPONSIBILITES

4.1 PRINCIPAL INVESTIGATOR (PI) / LAB INSTUCTOR (LI) / LAB SUPERVISOR

The Principal Investigator (PI, for research labs, Lab Instructor (LI, for teaching labs), or Lab Supervisor (for Cores)is responsible for the health and safety of laboratory personnel doing work in his/her laboratory and complying with the CHP in his or her laboratory. The PI or LI may delegate these responsibilities to a laboratory worker who is suitably experienced and trained. These responsibilities may not be shifted to inexperienced or untrained personnel.

The PI / LI must assure that:

- Lab personnel understand and follow the requirements in the general Chemical Hygiene Plan, lab-specific CHP, standard operating procedures, and other laboratory rules

- A written lab specific CHP is drafted for the laboratory, maintained in the laboratory, reviewed annually, and revised whenever new hazardous chemicals or processes are introduced.
- A Laboratory Chemical Hygiene Officer (CHO) is designated for the lab with responsibility for ensuring the provisions of the CHP are implemented in the lab. This could be the PI/LI or her/his designee.
- Research protocols and special projects involving particularly hazardous substances (PHS) are reviewed and that Standard Operating Procedures / Chemical Safety Protocols (CSP's) are established for PHS items.
- Laboratory facilities maintain appropriate hazard signage
- Appropriate laboratory attire is worn.
- Visitors and other non-laboratory workers comply with all laboratory safety procedures.
- Appropriate personal protective equipment is provided.
- Appropriate training has been provided per the Laboratory Standard.
- Safety Data Sheets (SDS) are available either in electronic form or hard copy form for hazardous chemicals
- Chemical inventories are established and kept up to date.
- Chemicals are stored and maintained safely.
- Laboratory facilities are secure from unauthorized access.
- Actions are initiated to remediate any problems related to health and safety in the laboratory including non-compliance of state and federal regulations.
- Non-compliance issues, unsafe conditions and inadequate facilities are reported to their Department Chair or to OCRS.
- Appropriate compliance, health and safety audits are conducted with follow-up of findings in a timely manner.
- Approval is granted, when necessary, prior to work with particularly hazardous substances.

4.2 LABORATORY WORKERS / STUDENTS

Individual Laboratory Workers are responsible for:

- Completing all necessary trainings
- Planning and conducting each operation in accordance with the Chemical Hygiene Plan.
- Wearing appropriate attire and personal protective equipment in the laboratory.
- Following proper safety guidelines / Chemical Safety Protocols (CSP's).
- Knowing how to access chemical safety information such as Safety Data Sheets (SDS).
- Obtaining prior approval before conducting research that falls within the scope of prior approvals in Section 7.13
- Reporting accidents, unsafe acts or conditions to their PI / LI.

4.3 CHEMICAL HYGIENE OFFICERS (CHO)

<u>Laboratory Chemical Hygiene Officer</u>

Each laboratory should have a Laboratory Chemical Hygiene Officer that is qualified by training and/or experience to ensure the CHP is implemented in the laboratory. The PI/LI can serve as the Laboratory CHO or can designate someone else in the lab to fulfill that role.

University Chemical Hygiene Officer

The University Chemical Hygiene Officer resides in the Office of Clinical and Research Safety (OCRS). The University CHO is responsible for:

- Providing technical assistance and guidance to the VU Chemical Safety Committee, PIs, research personnel, and university departments, schools, Provost's office and EHS functions.
- Working with VU Chemical Safety Committee to maintain and implement the VU CHP.
- Serving as the liaison with external regulatory agencies regarding chemical safety in the laboratories.
- Overseeing the development, implementation, and tracking of laboratory safety training provided by OCRS.
- Overseeing the OCRS Laboratory Compliance Assistance Program.

4.4 ENVIRONMENTAL HEALTH AND SAFETY (EHS) GOVERNANCE COMMITTEE

The EHS Governance Committee is responsible for:

- Providing a governance structure, comprehensive leadership and oversight for the various environmental health and safety research-related activities for VU.
- Reviewing and approving policies and practice guides for research and teaching labs pertaining to the safe handling, transport and use of chemicals including this Chemical Hygiene Plan.
- Reviewing annual report on chemical safety provided by the VU Chemical Safety Committee and ensuring appropriate corrective actions are taken for any issues identified including those related to incidents or inspections.

4.5 CHEMICAL SAFETY COMMITTEE

The Chemical Safety Committee (CSC) is responsible for:

- Considering policies for research and teaching labs pertaining to the safe handling, transport and use of chemicals and recommending the adoption of new or revised policies VU.
- Reviewing and approving procedures and practice guides relating to the management of a chemical safety program.
- Reviewing proposed or enacted legislation concerning chemical safety that may affect the Vanderbilt University community and informing Departments, Schools and Colleges of potential implications and business impact.
- Reviewing research protocols and special projects involving particularly hazardous substances (PHS) as needed.
- Assisting VU Departments, Schools and Colleges with their internal chemical safety committees and/or programs, in conjunction with the Office of Clinical and Research Safety (OCRS).
- Establishing a system for auditing laboratories for EHS issues, reviewing audit findings, and ensuring that appropriate follow-up is conducted.
- Developing and maintaining this Chemical Hygiene Plan (CHP).
- Reviewing at least annually a summary of the training status of all personnel working with chemical materials in teaching and research laboratories.
- Reviewing at least annually all incidents involving chemical materials with respect to cause and subsequent actions taken.

- Providing an annual report on the status of chemical safety in research and teaching labs to the EHS Governance Committee.

4.6 SCHOOL/DEPARTMENTAL SAFETY COMMITTEES

Each Department and/or School determines the need for the establishment of a Departmental Safety Committee to develop the elements of Lab or Department-specific Chemical Hygiene Plans. Membership in the Departmental Safety Committee may include select faculty and administration, graduate students, and representatives from the university EHS functions and/or the Office of Clinical and Research Safety (OCRS).

Where a Departmental Safety Committee has not been established, the responsibility for implementation and development of the Lab-specific CHP falls to the Principal Investigator (PI) or Lab Instructor (LI).

The Departmental Safety Committee, with oversight from the Chemical Safety Committee, may take on any or all of the following responsibilities:

- Development and approval of departmental specific safety protocols, policies and requirements
- Administering department or school-level laboratory safety training.
- Establishing a system for inspections of laboratories for safety and compliance issues. This system could be in addition to the system in place for all VU laboratories or in place of the VU system with approval from the Chemical Safety Committee.
- Ensuring that all safety deficiencies are corrected in a timely manner.

4.7 OFFICE OF CLINICAL AND RESEARCH SAFETY (OCRS)

The Office of Clinical and Research Safety (OCRS). is responsible for:

- Designating a qualified person to be the University Chemical Hygiene Officer (CHO).
- Assisting the PI / LI and Safety Committees with Environmental, Health and Safety policy development and technical guidance.
- Monitoring and interpreting regulations and/or guidelines of the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), National Institutes of Occupational Safety & Health (NIOSH) and other policies pertaining to hazardous chemicals and communicating this information.
- Providing technical assistance in reviewing lab operations for compliance, health and safety concerns, and evaluating protective measures.
- Monitoring chemical exposure levels when necessary.
- Maintaining a respiratory protection program for laboratory personnel, as necessary.
- Establishing and updating laboratory signage.
- Assisting with the procurement of Safety Data Sheets (SDS).
- Maintaining a web-based source of information on laboratory safety https://www.vumc.org/safety/.
- Assisting PI/LI with development of Chemical Safety Protocols (CSP) and Personal Protective Equipment (PPE) recommendations.
- Assisting the PI/LI in maintaining inventories of laboratory chemicals.
- Assisting with chemical storage and compatibility issues in the laboratory.

- Providing waste management service of laboratory chemicals and maintaining all required records.
- Producing and posting hazard identification signs.
- General laboratory safety training for the PI/LI and all laboratory workers in VU laboratories.
- Facilitating and participating in Departmental laboratory safety training as needed.
- Evaluating chemical fume hood flow and performance.

5.0 CHEMICAL HYGIENE MANAGEMENT SYSTEM

5.1 LABORATORY-SPECIFIC CHEMICAL HYGIENE PLAN

While this Chemical Hygiene Plan addresses general safety rules and policies applicable to all laboratories, each laboratory should develop laboratory-specific safety procedures to address issues that are unique to the lab and not addressed by this Chemical Hygiene Plan. Laboratory-specific emergency response procedures, if applicable, should also be developed. The lab-specific safety plan should include:

- Chemical Safety Protocols (CSP) for all lab-specific processes involving particularly hazardous physical/chemical hazards or hazardous materials not covered under the university CHP. (See Section 5.2)
- Laboratory-specific safety procedures, if applicable.
- Laboratory-specific emergency response procedures, if applicable.

5.2 CHEMICAL SAFETY PROTOCOLS

Chemical Safety Protocols (CSP) are written procedures used to identify the safety and health concerns and control measures for specific laboratory processes that involve chemical hazards. Most procedures involving Particularly Hazardous Substances (PHS) require a CSP. PHSs are defined in Appendix D. A CSP can be developed for a process, a chemical, or a class of chemicals (such as flammable liquids, peroxides, etc…). CSP's should be reviewed and approved by the Principal Investigator prior to implementation in the lab (OCRS and/or the Chemical Safety Committee may be consulted, if needed).,

CSP's include the following elements:

- Potential hazards associated with the process, chemical, or class of chemicals.
- Required personal protective equipment to be used.
- Required engineering controls (such as fume hoods) to be used.
- Special handling or storage requirements.
- Spill and accident procedures.
- Decontamination procedures for personnel and equipment.
- Waste disposal procedures.

OCRS maintains a library of Chemical Safety Protocols approved by the VU Chemical Safety Committee on the OCRS website. New CSP's are added, as necessary. Principal Investigator's (PI's) may utilize an existing CSP after confirming it is applicable to their work. Additionally, a PI may amend an existing CSP or utilize the blank CSP template on the website to create a CSP for a specific process in their lab. The Chemical Safety Protocol website page is located at: https://www.vumc.org/safety/chem/chp

5.3 TRAINING

All faculty, students, and lab workers that perform research involving chemicals or that supervise others that perform research work in chemical laboratories must undergo general lab safety training that includes the contents of this Chemical Hygiene Plan before performing this work. OCRS provides this training in both live and online formats. Records for this training are maintained in the VU Learning Management System. The PI/LI is responsible for determining the appropriate refresher training frequency for her/his lab workers to ensure all workers are knowledgeable in the content of this training.

Additionally, Principal Investigators/Lab Instructors must ensure that all workers performing research with chemicals under their supervision have received training on laboratory-specific procedures and safety rules including the Chemical Safety Protocols in the Laboratory-Specific CHP. This training should include the location of Safety Data Sheets (SDS); location, availability, and use of personal protective equipment (PPE) and emergency response equipment; emergency procedures; and identified hazards in the laboratory. This training should be conducted at the time of a worker's initial assignment to a work area where hazardous chemicals are present and prior to assignments involving new exposure situations. Refresher training for this lab-specific safety training should be provided annually. Training should be documented and maintained by the PI / LI by including the date, time, who attended and what material was covered.

On-the-job training should be provided as necessary prior to allowing a student or lab worker to begin a new process or use equipment for the first time. PIs/Lis and/or Lab CHOs are encouraged to document this training with at least a sign-off sheet or other means of tracking lab-specific training.

Additional training may be required for special lab processes or work with certain equipment or hazardous materials. Examples include working with radioactive materials or equipment, animals, biological materials, or lasers.
Check the following link for information on training requirements for working with these materials
https://www.vumc.org/safety/training

Also see Appendix A of the CHP for an outline of Laboratory-Specific Safety Training suggested for laboratories which is also available at https://www.vumc.org/safety/chem/chp

5.4 LABORATORY SAFETY AUDITS

The VU Chemical Safety Committee is responsible for development of a university-wide lab inspection/audit system of procedures and processes included in the Chemical Hygiene Plan. This responsibility can be delegated to individual School or Departmental Safety Committees as approved by the university Chemical Safety Committee with requirements being at least as stringent as the university-wide system. Inspections will be conducted as follows:

- Inspections will be conducted on a periodic basis (OCRS, departmental, peer and/or self-inspection).
- Results of inspections will be documented and made available to the PI / LI, Department Chair, Chemical Safety Committee, VU EHS, and OCRS.
- The Chemical Safety Committee in consultation with OCRS and university leadership will determine a plan for addressing delinquent and serious findings. The CSC will periodically review inspection results including corrective actions proposed and taken.

- Safety Hub (Bioraft) will be used for inspection checklists, documenting inspection findings, and as a tracking system for corrective actions. For assistance with Safety Hub (https://vanderbilt.bioraft.com/), contact OCRS

The Laboratory Inspection procedure and checklist are available at Safety Hub and a printable version is in Appendix B of the CHP – **Laboratory Safety Audit Checklist** (https://www.vumc.org/safety/chem/chp)

The audit checklist includes sections on

- General Safety and Training
- Chemical Safety
- Fire and Electrical Safety
- Fume Hoods
- Laboratory Waste

5.5 CHEMICAL HYGIENE PLAN REVIEW

The VU Chemical Safety Committee will review and/or amend the Chemical Hygiene Plan (CHP) under the following circumstances:

- At least annually.
- Any time policies or procedures are changed that may affect the Chemical Hygiene Plan.
- Any time the Chemical Hygiene Plan is shown to not adequately address a chemical safety issue relative to Vanderbilt University as determined by the VU Chemical Safety Committee.

This review should include checking all links to external documents/websites to ensure they are valid and up-to-date.

6.0 CHEMICAL HAZARD INFORMATION

6.1 CHEMICAL HAZARD INFORMATION

The PI / LI must ensure that lab workers have access to information about hazardous materials used and stored in the lab. This information must include at a minimum:

- Safety Data Sheets (SDS) for all hazardous chemicals used or stored in the lab. These must be maintained in the lab either on paper or in electronic form on a disk or local hard drive.
- Proper labeling. Incoming chemicals must not have their labels removed or defaced. Chemical containers must be labeled with the common name of the chemical. Abbreviations, formulas, and/or symbols should not be used as the sole means to identify a chemical.
- Up-to-date inventories of hazardous chemicals used and stored in the lab. Inventories should include the chemical name, physical state, quantity, and general location. Contact OCRS for assistance with chemical inventories.
- Hazard information for chemicals synthesized in the lab. Synthesized chemicals must be addressed in accordance with this Chemical Hygiene Plan including the requirements for preparation of hazard information and labeling. For hazard determination, training requirements, and domestic shipping requirements for chemicals synthesized in the laboratory, see the fact sheet in Appendix C of the CHP - **Newly Synthesized Chemicals** (https://www.vumc.org/safety/chem/chp)

6.2 PARTICULARLY HAZARDOUS SUBSTANCES

Particularly hazardous substances (PHS) are defined to include select carcinogens, reproductive toxins, and substances that have a high degree of acute toxicity. Particularly hazardous substances must be easily recognized by laboratory personnel and exposure to these substances must be controlled. A more detailed reference source for PHS and proper handling procedures can be found in Appendix D of the CHP – **Particularly Hazardous Substances (PHS**) (https://www.vumc.org/safety/chem/chp)

6.3 COMPRESSED GASES

Compressed gases pose both chemical and physical hazards for the laboratory worker. Safe storage, proper labeling, and monitoring are essential practices for use of compressed gases. Precautions are necessary when handling compressed gas cylinders, the regulators used to control their flow, the piping used to confine them during flow, and the vessels in which they are ultimately used. More detailed safe work practices and control measures for compressed gases can be found in Appendix E of the CHP- **Compressed Gases** (https://www.vumc.org/safety/chem/chp)

6.4 EXPOSURE MONITORING

OSHA has established Permissible Exposure Limits (PEL) to regulate personal exposures for specific chemicals. These limits are listed in 29 CFR 1910 Subpart Z. These regulatory limits are adopted by TOSHA. In addition, the American Conference of Governmental Industrial Hygienists (ACGIH) publishes annual exposure limits for specific chemicals. These guidelines are called Threshold Limit Values (TLVs). TLVs offer guidance on many chemicals not regulated by TOSHA.

The TOSHA Laboratory Standard requires that employers assure that employee exposures are kept below the PELs listed in 29 CFR 1910 Subpart Z. To determine and document employee exposures, employers may need to conduct air monitoring of employees' exposures whenever there is a reasonable possibility that exposure levels for a particular substance may exceed the PEL.

The PI / LI in consultation with OCRS will determine the requirements for exposure monitoring. A combination of factors are used to determine the need for exposure assessment including the chemicals involved, protective measures in place, and employee input on odors and health symptoms. Emergency exposure monitoring may be performed any time health complaints are received which can be attributed to exposure to hazardous chemicals.

Exposure monitoring records will be maintained by the PI / LI, Occupational Health, and/or OCRS as appropriate. Employees will be notified of the results of their exposure monitoring within 15 working days after receipt of the sampling results. Employees and their representatives can have access to results from their personal monitoring by contacting the PI / LI. Please contact OCRS to get further information regarding exposure monitoring.

6.5 MEDICAL CONSULTATION AND EXAMINATIONS

All employees working with hazardous chemicals can receive immediate medical attention at the Vanderbilt Occupational Health Clinic in Room 640 of the Medical Arts Building (OHC), Zerfoss Student Health Center, or at the Emergency Department at VUMC according to the following guidelines:

- When an employee develops signs or symptoms potentially associated with a hazardous chemical to which the employee has been exposed in the laboratory, the employee should receive an appropriate medical examination. For non-life threatening exposures the employee should go to the Occupational Health Clinic (for employees of VU) or Student Health Services (for Vanderbilt students) during normal working hours. For emergencies or after hours incidents, all should go to the Vanderbilt Emergency Department at VUMC.
- When exposure monitoring reveals an exposure level routinely above the action level or the Permissible Exposure Limit (PEL) for a TOSHA regulated substance for which there are exposure monitoring and medical surveillance requirements, medical surveillance will be established for the affected employee as prescribed by the regulation. Contact OCRS or Occupational Health regarding TOSHA regulated substances.
- When an event takes place in the work area such as a spill, leak, explosion, or other occurrence resulting in the likelihood of exposure to a hazardous substance, the affected lab worker will be provided an opportunity for a medical consultation. The medical consultation will be used to determine the need for a medical examination.

All medical examinations and consultations will be performed by or under the direct supervision of a licensed physician and will be provided without cost to the employee, without loss of pay, and at a reasonable time and place.

The PI / LI provides to the health care provider:

- The identity of the hazardous chemical(s) to which the employee may have been exposed.
- A description of the conditions under which the exposure occurred including quantitative exposure data, if available.
- A description of the signs and symptoms of exposure that the employee is experiencing, if any.

The physician provides a written opinion to the PI / LI based on the medical consultation or examination. The written opinion does not contain specific findings of diagnoses unrelated to occupational exposure to hazardous chemicals. The written opinion typically contains the following information:

- The results of the medical examination and any associated tests;
- Any medical condition which may be revealed in the course of the examination which may place the employee at increased risk as a result of exposure to the hazardous chemical in the laboratory;
- A statement that the employee has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.
- Any recommendation for further follow-up

6.6 EMERGENCY RESPONSE PROCEDURES

Chemical Spills

Quick cleanup of chemical spills in the laboratory helps reduce airborne concentrations in the work area and reduces the potential for dermal contact and contamination of experiments. This is especially true of chemicals with high vapor pressures. Safe work procedures should always be followed after a chemical spill has been detected:

- No lab worker should ever attempt to clean up a chemical spill when the nature of the chemical is unknown. Whenever a spill is discovered where the chemical composition and airborne concentrations are unknown, clear the area and contact OCRS.
- Each laboratory using hazardous chemicals must maintain appropriate clean-up materials readily accessible to laboratory personnel. The kits should be specific for the type of chemicals in use in the laboratory. Kits typically include absorbent pads, socks, and “Safety Sorbent” particulate material. Instructions for using the materials should be reviewed by laboratory staff. Labs should supplement these spill kits with other materials needed for response to specific chemicals that cannot be handled with these basic kits.
- Lab workers should only clean up small chemical spills of known origin that they are comfortable cleaning up and for which they have the proper spill clean-up materials and personal protective equipment. In general, spills of chemicals that are highly volatile, highly corrosive, or highly toxic by inhalation should not be cleaned up by laboratory personnel. Anytime workers experience dizziness or nausea during a chemical clean up, the laboratory should be evacuated and OCRS should be notified.
- Used spill clean-up materials must be disposed of as chemical waste through OCRS.

Chemical Exposures and Medical Emergencies

- For medical attention visit the Occupational Health Clinic (for employees of VU) or Student Health Services (for Vanderbilt students) or the Vanderbilt Emergency Department for emergencies or after hours visits.
- Persons suffering from chemical exposures should be escorted to the appropriate medical facility. The safety data sheet (SDS) for the chemical involved should be taken if readily available.
- For ingestion of chemicals, refer to the chemical’s SDS for immediate treatment procedures and seek medical attention promptly.
- For spills covering small amounts of skin, immediately flush with flowing water for no less than 15 minutes. If there is no visible burn, wash with warm, soapy water.
- For spills on clothes, do not attempt to wash or wipe the clothes. Quickly remove all contaminated clothing, personal protective equipment, jewelry, etc. and utilize the safety shower. It may be necessary to cut off some garments to prevent further contamination during removal. Immediately flush the affected area for at least 15 minutes. Resume if pain exists. Do not be concerned with flooding of the building or modesty. Seek medical attention as soon as possible.
- For splashes into the eye, immediately flush the eye in an eye wash station for at least 15 minutes. Hold the eyelids away from the eyeball and move the eye up and down and sideways to wash thoroughly under the eyelids. Seek medical attention as soon as possible.
- Certain chemicals may require special immediate treatment other than a water rinse. Necessary treatment materials should be available for these chemicals and lab staff trained on their use. An example might be a chemical that needs to be rinsed with an alcohol rinse or the use of a calcium gluconate gel to treat an exposure to hydrofluoric acid.
- For non-chemical medical emergencies or illnesses, seek prompt medical attention. Minor injuries requiring first aid treatment may be treated by in house personnel trained in first aid procedures. Bandage small cuts, burns, or abrasions with first aid kits.
- All chemical exposures (even minor ones) should be reported to the PI / LI for appropriate follow-up.

Fire and Fire Alarms

- Fires contained in small vessels can usually be suffocated by covering the vessel. Do not pick up the vessel. Remove nearby flammable materials to avoid spread of the fire.
- If the fire is burning over an area too large to suffocate the fire, all persons should evacuate except for those trained and qualified to fight the fire.
- Persons trained on using a fire extinguisher may attempt to fight small fires that they are confident they can extinguish.
- Fight fires from a position from which you can escape.
- To use a fire extinguisher, **P**ull the pin, **A**im at the base of the fire, **S**queeze the handle, and **S**weep back and forth. The acronym **PASS** can be used to help remember these actions.
- Always start from 8 to 10 feet away and move in closer to avoid spreading the fire from the force of the extinguisher spray.
- If a fire is not out by the time one extinguisher has been discharged, then evacuate.
- The fire extinguishers provided in the labs are appropriate for all fires except those involving metals such as sodium or magnesium. Class D fire extinguishers should be used for metal fires.
- In the event a fire cannot be extinguished, evacuate the building in accordance with the Building or Departmental Emergency Response Plan. Rescue and remove other occupants only if this can be done without endangering yourself. Pull the fire alarm if necessary. Close doors and lower hood sashes if this can be done safely. Use stairs and stay low in smoky areas.
- If the fire alarm is sounding, all occupants must evacuate the building according to the Building or Departmental Emergency Response Plan. Assist and instruct visitors. Do not assume it is a false alarm.

Hood Failure

In the event of a hood failure (loss of adequate ventilation) where hazardous chemicals are being used or stored, move the materials to a nearby working hood if feasible. Lower the sash to the hood and immediately report the problem to VU Facilities (Vanderbilt University buildings) at 615-343-9675 or VUMC Facilities (VUMC buildings) at 615-343-4443.

Other Emergencies Requiring Building Evacuation

For other emergencies requiring building evacuation (bomb threats, explosions, etc.), follow the Building or Departmental Emergency Response Plan.

6.7 CHEMICAL WASTE DISPOSAL

All chemical wastes must be properly disposed of in accordance with the “Laboratory Guide for Managing Chemical Waste” provided by OCRS and available at https://www.vumc.org/safety/waste

Questions regarding chemical waste handling and disposal should be directed to OCRS (615-322-2057).

General Waste Requirements

Training

- Every laboratory that generates chemical waste must have a copy of the "**Laboratory Guide for Managing Chemical Waste**" available. This can be found on the web at: https://www.vumc.org/safety/waste
- Every laboratory that generates chemical waste must have a "**Hazardous Chemical Waste Management Area**" **sign** posted near their chemical waste storage location or in another conspicuous location in the lab. This sign is provided by OCRS or can be printed from https://www.vumc.org/safety/waste
- Laboratory staff that handle chemical waste must be trained in proper chemical waste management procedures. General lab safety training provided by OCRS includes basic procedures for handling chemical waste for VU labs.

Storage

- Every laboratory that generates chemical waste must have at least one area designated for chemical waste storage that is known by lab staff handling chemical waste.
- Store chemical waste in containers that are compatible with the chemicals and that are in good condition and free of leaks or chemical residue.
- Store all chemical waste containers that hold liquid chemical wastes in secondary containment so that spills cannot reach sink or floor drains or containers of incompatible chemicals. The secondary containment should be adequate to hold the entire contents of the largest container stored. Contact OCRS (615-322-2057) to obtain secondary containment equipment.
- Segregate chemical wastes by compatibility, and never store incompatible wastes in the same secondary containment.
- Store halogenated solvents in separate containers from non-halogenated solvents.
- Store chemical wastes in the same laboratory where they are generated such that the wastes do not have to be transported through offices, hallways, corridors or other public areas for storage.
- Never store more than 55 gallons of waste in one storage location.

Labeling

- Label chemical waste containers with waste tags provided by OCRS as soon as waste accumulation begins even if more waste will be added later. There should never be a chemical waste container in your lab that has waste in it and that is not labeled with a OCRS waste tag. These tags can be requested through the web at https://www.vumc.org/safety/waste

Closed Containers

- Keep chemical waste containers closed at all times except to temporarily add more waste. No open funnels are allowed unless waste is actively being poured into the container.
- Chemical waste containers must be closed with a screw-type lid or a screw-on funnel equipped with a lid that snaps closed and has a latch to prevent it from opening accidentally.

Spills

- Clean up chemical waste spills immediately. There should be no chemical waste residue on chemical waste containers or in secondary containment tubs.

Disposal

- Submit an online chemical waste collection request form to OCRS when your chemical waste is ready for pickup. Request forms are available at: https://www.vumc.org/safety/waste/chemical-waste-collection
- Never pour chemical wastes down the sink or other drains unless it is approved by the "Laboratory Guide for Managing Chemical Wastes" guidelines or OCRS.
- Never evaporate chemicals in the fume hood as a method of waste disposal.

7.0 CHEMICAL SAFETY MANAGEMENT AND CONTROL

7.1 CHEMICAL STORAGE IN LABORATORIES

The quantities of hazardous chemicals stored in the laboratory should be kept to a minimum. Hazardous chemicals must be stored properly in the laboratories. Chemicals in storage areas should be segregated by hazard class to reduce the potential for incompatible mixing as specified in Appendix F of the CHP – **Managing Retention and Storage of Chemicals in Your Laboratory**. https://www.vumc.org/safety/chem/chp

If special storage is required, contact OCRS for assistance.

7.2 GENERAL LABORATORY VENTILATION

Vanderbilt laboratories are designed to provide adequate ventilation to prevent the buildup of hazardous vapors and gases. Most laboratories are designed to ventilate at a rate of 10 to 12 room exchanges per hour at normal operation. Do not block supply or exhaust registers and do not place equipment in the laboratory in such a way as to block airflow from the ventilation system.

Ventilation systems for laboratories are maintained by VU Facilities for campus laboratories and by VUMC Facilitiesin VUMC buildings. Report any ventilation problems to VU Facilities 615-343-9675 for campus buildings or to VUMC Facilities at 615-343-4443 for VUMC buildings.

7.3 CHEMICAL FUME HOODS

Chemical fume hoods in laboratories are used to minimize exposure to hazardous, offensive, or flammable gases and vapors and to prevent these vapors from mixing with the general room air. A hood sash can also act as a physical barrier between laboratory workers and chemical reactions.

Some laboratory hoods are equipped with air flow indicators -- either a digital flow monitor that displays the face velocity in feet per minute (fpm) or an analog flow monitor that uses colored lights to indicate flow status -- and a low flow alarm. The hoods are designed to operate with a face velocity in the range of 80 fpm to 120 fpm, with 100 fpm being the average velocity. OCRS performs routine inspections of the fume hoods to ensure adequate face velocity and proper air flow patterns. OCRS will also inspect fume hoods upon request if it is suspected that a hood is not operating properly.

Fume hoods for campus laboratories are maintained by VU Facilities (615-343-9675) for campus buildings and by VUMC Facilities(615-343-4443) for VUMC buildings.

7.4 GLOVE BOXES AND OTHER LOCAL EXHAUST VENTILATION

Glove boxes and other enclosed or special exhaust ventilation systems are used to prevent personnel exposure to hazardous, offensive, or flammable gases and vapors, to prevent these vapors from mixing with the general room air, and/or to provide a controlled atmosphere for the use and storage of certain chemicals.

Glove boxes are typically small units that have multiple openings in which arm-length rubber gloves are mounted. The operator works inside the box by using these gloves. Some glove boxes operate under negative pressure such that any leakage is into the box. If the material being used in the box is sufficiently toxic to require use of an isolation system, the exhaust air may require special treatment (scrubbing or adsorption) before release into the exhaust system.

Other glove boxes used at Vanderbilt operate under positive pressure. These boxes are commonly used for experiments for which protection from atmospheric moisture or oxygen is desired. If positive-pressure glove boxes are used with highly toxic materials, they should be thoroughly tested for leaks before each use. Also, a method to monitor the integrity of the system (such as a shutoff valve or a pressure gauge designed into it) is required.

The laboratory should design, install, and maintain glove boxes in accordance with manufacturer's recommendations and applicable government and industry standards.

OCRS should be contacted if Particularly Hazardous Substances are being handled in glove boxes in order to determine if any special precautions must be taken. See Appendix D of the CHP-**Particularly Hazardous Substances (PHS)** https://www.vumc.org/safety/chem/chp

7.5 EMERGENCY RESPONSE EQUIPMENT

Emergency Showers and Eyewash Stations

Emergency deluge showers and eyewash stations are provided in or near all laboratories. Pathways to and access to these areas should never be blocked or obstructed. Plumbed eyewash stations should be inspected and flushed monthly for 15 minutes. Eyewash stations should also be checked for adequate flow annually (1.5 liters of water/minute). These inspections should be documented in the laboratory.

Emergency showers are maintained by VU Facilitiesor VUMC Facilities in accordance with applicable standards. For maintenance issues, contact the VU Facilities at 615-343-9675for campus buildings or VUMC Facilities for VUMC buildings (615-322-2041).

Fire Extinguishers

Each laboratory is equipped with fire extinguishers of the ABC type which are designed to work for ordinary combustibles (wood, cloth, paper, etc.), liquids, greases, gases, and energized electrical equipment. These extinguishers are not appropriate for fires involving metals such as magnesium, sodium, or potassium. Laboratories that work with these metals should maintain Class D fire extinguishers or buckets of sand to use as an extinguishing agent. Pathways to and access to the

fire extinguishers should never be blocked or obstructed. The fire extinguishers provided by Vanderbilt are maintained by VU Facilities or VUMC Facilities depending on the building owner.

Chemical Spill Response Kits

Each laboratory is responsible for maintaining chemical spill response kits. The kits generally consist of personal protective equipment, absorbent pads and granular material that can be used on solvents or corrosive liquids. Special spill response material may be needed for certain materials (such as calcium gluconate gel for hydrofluoric acid). Contact OCRS for assistance with materials needed for chemical response kits. Pathways to and access to the chemical spill response kits should never be blocked or obstructed.

First Aid Kits

Each laboratory is responsible for procuring and maintaining at least one first aid kit. The first aid kit contains bandages and disinfectant wipes to treat minor cuts, scrapes, abrasions, and burns. Pathways to and access to first aid kits should never be blocked or obstructed.

7.6 LABORATORY ATTIRE

The laboratory attire restrictions described below apply to lab workers that are either performing work with hazardous materials or are spending an appreciable amount of time in the lab, including the desk areas in the lab.

Clothing and Hair

Clothing worn while working in the laboratory should offer protection from chemical splashes and spills, and should be easily removable in case of an accident. It is recommended to avoid wearing loose or flowing clothing and clothing made of flammable polymeric fabrics.

Clothing that completely cover the hands, arms and legs should be worn when working with any hazardous material that may cause skin irritation, burns, allergic reactions or has the ability to penetrate the skin. Long hair should be secured while working in the lab to avoid unintended contact with chemicals or unguarded equipment.

Footwear

High-heeled, open-heeled, and/or open-toed shoes, sandals, and shoes made of woven or porous material are not recommended while working in the laboratory, particularly if working with hazardous material that may cause skin irritation, burns, allergic reactions, or has the ability to penetrate the skin.

7.7 PERSONAL PROTECTIVE EQUIPMENT

Eye and Face Protection

Eye and face protection is required by regulatory standards anytime there is any potential exposure to flying particles, molten metal, liquid chemicals, acids / caustic liquids, hazardous chemical gases or vapors, or potentially hazardous light radiation (welding flash, burning flame, UV lights, lasers). Eye and face protection for a particular lab process should be selected based on the potential for exposure or damage to the eyes and face.

Protective eyewear must be worn any time there is a possibility of foreign objects entering the eyes, including liquid splashes and particulate matter. Safety glasses must conform to *American National Standards Institute (ANSI) Standard Z87.1*.

Safety goggles without ventilation or with indirect ventilation may be required for operations where the possibility of liquids contacting the eyes exists. Note that direct ventilation goggles that do not protect liquids from entering the vents should not be worn to protect against chemical splashes. Also, note that goggles without any ventilation tend to fog up and become difficult to see through. All goggles used must conform to *ANSI Standard Z87.1*.

If damage to the eye and face could occur, face shields may be required in addition to goggles or safety glasses. For instance, a mild corrosive might present an eye hazard, but a concentrated one could cause massive facial burns, requiring eye and face protection. Face shields must never be worn alone. Face shields must always be worn over either safety glasses (for impact hazards only) or safety goggles (for splash hazards). All face shields used must conform to *ANSI Standard Z87.1*.

Certain chemicals for which the Occupational Safety and Health Administration (OSHA) has developed regulations have specific regulatory requirements for eye protection based on exposure levels. For example, performing experiments with exposure to formaldehyde above the OSHA Permissible Exposure Limit requires the use of a full-face respirator or a half-mask respirator with gas-tight goggles. If work is to be performed with these chemicals, consult with OCRS to determine if any special regulations apply.

Special eye protection is available for working with lasers, ultraviolet light, welding and brazing or intense light sources. Consult OCRS for selecting appropriate eye protection for operations involving these eye hazards.

Laboratory Coats

Laboratory coats are recommended while working in the laboratory. Lab coats should be buttoned at all times. Lab coats should be removed immediately if they become contaminated and washed before reusing. Periodically launder reusable lab coats even if no known contamination has occurred. Do not take any laboratory coats home to wash when contaminated with particularly hazardous substances (**See Appendix D of the CHP**). Never wear lab coats into areas where food is consumed, stored, or prepared.

Laboratory Aprons

Working with highly caustic, corrosive or highly toxic chemicals that can be absorbed through the skin may require the use of a laboratory apron. Laboratory aprons must be constructed of a material that is chemically resistant to the specific chemical(s) being used and must be non-flammable. Consult the safety data sheet (SDS) for the substance being used for recommendations on material types. Other links for information on laboratory clothing can be found here:
https://www.vumc.org/safety/links/personal-protective-equipment

Gloves

Chemically protective gloves are designed to protect workers' hands and sometimes forearms from exposure to chemicals which may physically injure the skin or be absorbed through the skin and affect other areas of the body.

Most laboratories use disposable nitrile gloves for general lab operations. *To select the proper glove material for a particular process, review the safety data sheet (SDS) for the substance being used.* The SDS will usually list one or more glove materials that are recommended. Chemical glove manufacturers also publish permeation tables or compatibility charts for common chemicals with projected breakthrough times. Links for information on glove types can be found here: https://www.vumc.org/safety/links/personal-protective-equipment

Glove types range from wrist length to shoulder length and also range from disposable to varying degrees of thickness. To select the proper glove type for a particular process, evaluate the task and possible splash, immersion and contact hazards. Processes involving submersion of gloves in hazardous liquids for extended periods of time typically require the use of non-disposable gloves of greater thickness. Common latex gloves offer little or no protection against most hazardous chemicals and nitrile gloves provide a good alternative.

All safety gloves should be inspected prior to each use. Lab workers should look for holes, excessive wear, and tears prior to donning gloves. After each use of non-disposable gloves, the exterior of the gloves should be rinsed thoroughly before removing the gloves. If gloves are observed to be compromised or damaged, they should be discarded. Non-disposable gloves should be discarded periodically. How often the gloves should be discarded will depend on the glove type, use in the laboratory, construction material, permeation times for chemicals handled, and inspection of the gloves.

Respirators

Respiratory protection in laboratories is typically provided by engineering controls in the form of chemical fume hoods and other local exhaust devices. Laboratory personnel should protect themselves from inhalation hazards by using product substitution, engineering controls, or process modifications whenever possible. The use of respirators for protection against inhalation hazards should be the last option.

Respirator use requires a written respiratory protection program, medical surveillance, and fit-testing. Wearing a respirator requires medical clearance from Occupational Health and fit-testing from OCRS. If respirator use is being considered, consult with OCRS about program requirements.

7.8 PERSONAL HYGIENE

Personal hygiene procedures are designed to protect laboratory workers from ingesting or otherwise being adversely exposed to hazardous chemicals, biological materials, or radioactive materials. The following personal hygiene procedures apply to all laboratory areas including desk areas in the laboratories. Break areas, offices, or other areas where these procedures do not apply must be separated from lab areas by floor to ceiling walls or have been designated as acceptable by OCRS inspection and documentation.

- Do not prepare, store, or consume food or beverages in the laboratory.
- Do not smoke, consume or store tobacco products in the laboratory.
- Do not store or use food preparation and storage equipment (such as microwaves, refrigerators, and coffee makers) in the laboratory.
- Refrigerators used for chemical storage should be conspicuously labeled on the outside with the words, “Chemical Storage Only.”

- Glassware or utensils used for laboratory operations should never be used to contain or prepare food or beverages.
- Wash hands and arms thoroughly before leaving the laboratory, even if gloves and a lab coat have been worn.
- Never wear or bring lab coats or aprons into areas where food is consumed, prepared, or stored.
- Never pipette by mouth. Always use a pipette aid or suction bulb.
- Confine long hair and loose clothing while working in the laboratory.
- Never wear gloves into non-laboratory areas including elevators.

7.9 HOUSEKEEPING

Good housekeeping is extremely important for laboratory safety:

- Keep aisle ways, exits, halls, stairways, and access to emergency equipment or controls free from clutter or obstructions. Lack of storage space is not an excuse for blocking aisleways.
- Keep lab benches, hoods, tables, etc. clean and uncluttered.
- After an experiment or class is completed, clean workspaces (including bench tops andfloors), dispose of waste properly, and return chemicals and equipment to their proper storage locations.
- Dispose of glass in an appropriate broken glass container and never in a regular trash can.
- Clean up spills immediately in accordance with the chemical response procedures for the laboratory.
- Keep floors and walkways dry and free from slip/trip/fall hazards at all times.
- Place electric cords, tubing, cables, etc. above walk spaces and thresholds.
- Work areas should be inspected at the beginning and end of each day to ensure proper housekeeping.

7.10 WORKING IN THE LABORATORY

General recommendations for laboratory workers:

- Never work alone in the laboratory without making provisions. Individuals working alone in separate laboratories should make arrangements to check on each other periodically. For hazardous processes, ensure that someone else is aware of what you are doing and is in constant contact with you. For non-hazardous processes, the presence of someone else in the vicinity is adequate.
- Do not engage in horseplay or practical jokes and avoid distracting or startling other workersin the laboratory.
- Use laboratory equipment only for its designated purpose.
- Pets and unapproved children are not allowed in laboratories where hazardous materials, processes, or instrumentation is stored or used.
- Make sure that all visitors to the laboratory are supervised and in proper attire and personal protective equipment if necessary.
- Make sure you are familiar with the chemicals you are working with including their hazardous properties and signs and symptoms of exposure.
- Handle and store laboratory glassware with care to avoid damage. Damaged glassware should be disposed of immediately.

- Only well understood processes will be allowed to run unattended. When unattended operations are required, leave the lights on, place a sign on the door, and provide adequate containment for any potential spillage in the event of failure of the system.
- Any apparatus that may discharge or release hazardous vapors, gases, or dust (vacuum pumps, distillation columns, etc.) must be vented into an appropriate local exhaust device.

7.11 LABORATORY SECURITY

The following are recommendations for maintaining laboratory security:

- Keep lab doors locked anytime no one is present in the lab. This includes after hours. Do not rely on building security to restrict access to the labs. Access must be restricted at the lab door.
- Question strangers in the lab. Report suspicious persons to VUPD.
- Require lab staff to have identification or proper credentials with them at all times while in the lab.
- If necessary, lock cabinets, refrigerators, or freezers where hazardous materials are stored for additional security.
- Restrict/control access to the lab by limiting the number of people with keys and combinations

7.12 LABORATORY RECORDKEEPING

The following documents should be maintained in the laboratory and available for review by laboratory personnel or other approved visitors (such as OCRS Personnel or Regulatory Agency Personnel):

- Copy of the Chemical Hygiene Plan.
- Laboratory-Specific Chemical Safety Protocols and other Standard Operating Procedures
- Training documentation for annual lab-specific safety training.
- Safety data sheets (SDSs) for all chemicals used or stored in the lab. These must be maintained in the lab or near where the chemicals are used either in paper form or in electronic form on a disk or local hard drive.
- An up-to-date chemical inventory for all hazardous chemicals (including gases) used or stored in the lab. The inventory should include the chemical name, quantity, and general location at a minimum. This inventory can be electronic.
- Any self-audits performed.

7.13 WORK REQUIRING PRIOR APPROVAL

Certain laboratory activities should be reviewed by the PI/LI prior to implementation in the lab. The PI/LI will ensure that all appropriate safety measures have been taken and that the work is being conducted in accordance with applicable regulations and policies. The PI/LI may consult with OCRS and/or the VU Chemical Safety Committee, if needed. Work requiring prior approval by the PI /LI includes the following:

- Work with Particularly Hazardous Substances (PHS) (See Appendix E of the CHP). Most often procedures for working with Particularly Hazardous Substances are developed as Chemical Safety Protocols (https://www.vumc.org/safety/chem/chp) or similar lab-specific Standard Operating Procedures (SOPs). Laboratory personnel working with PHS should have

documented evidence of training on the particular Chemical Safety Protocols that relate to their work in the laboratory.

- Work with hazardous biological materials, recombinant DNA, or human or primate biological materials (body fluids, tissues, cells, etc.). See the following link for more information: https://www.vumc.org/safety/bio
- Work with radioactive materials. See the following link for more information: https://www.vumc.org/safety/rad
- Work with Class 3b and 4 lasers. See the following link for more information: https://www.vumc.org/safety/rad

APPENDIX A

Lab-specific Safety Training Outline

LAB-SPECIFIC SAFETY TRAINING OUTLINE

The topics listed below should be covered at least annually by each laboratory group with participation documented by signature on the attached sheet. Documentation of participation in this training should be maintained and kept up-to-date in each laboratory, either in writing or electronically, for all workers who currently utilize the laboratory. Additional information regarding these topics can be found in the Chemical Hygiene Plan (CHP).

1. Location of Safety Data Sheets (SDS's)
2. Information on Particularly Hazardous Substances (PHS) or other highly hazardous materials used in the lab
    a. Identification
    b. Hazards
    c. Special procedures for handling or storing
    d. Designated work areas for using
    e. Specific emergency response procedures
3. Special hazards in the laboratory
    a. Procedures for working with or around
    b. Specific emergency response procedures
4. Personal protective equipment (PPE) used in the lab
    a. Types available (*Eye/Face Protection, Use of Lab Coats, Use of Gloves, Respirators, etc.*)
    b. Proper use
    c. Storing and caring for PPE
5. Laboratory and building alarms
    a. Identification of various alarms
    b. Response to various alarms
6. Emergency contact information
    a. Lab contacts
    b. Medical
    c. Vanderbilt Police Department
    d. OCRS
7. Emergency response equipment – location and use
    a. Chemical spill response kits
    b. Fire extinguishers
    c. First aid kits
    d. Emergency showers
    e. Eye washes
    f. Lab-specific response equipment/kits (if any)
8. General emergency response procedures
    a. Chemical spills/releases
    b. Chemical exposures
    c. Personal injuries
    d. Fire
    e. Evacuation
    f. Severe weather
9. Additional Laboratory Specific Safety Rules and Procedures

LAB SPECIFIC SAFETY TRAINING DOCUMENTATION

Date: _____

Rooms included: _____

Name (please print)	Signature

APPENDIX B

Laboratory Safety Audit Checklist

Vanderbilt University
Laboratory Inspection

Inspector(s):		**Date :**	
Department:			
Building:		**Room #:**	
PI (Last, First):		**Lab Contact:**	
Laboratory Room Description:			
Research Description:			
# of Chemical Containers:			
Fume Hoods:		**# of Fume Hoods:**	
Compressed Gas:		**List Gas(es):**	
Radiation:		**List Isotopes:**	
Laser:		**Class:**	
Biosafety Level:			

Lab Inspection Checklist **PI:** _____ **Room:** _____

	General Safety	YES NO N/A
1	Are Lab Hazard Signs posted and do they contain accurate information?	
2	Have personnel been trained in appropriate lab safety, hazardous waste, spill, and emergency evacuation procedures?	
3	Does the lab have appropriate personal protective equipment available?	
4	Are lab personnel wearing appropriate personal protective equipment for the tasks being performed?	
5	Are work areas clean, orderly, and floors free of slip/trip hazards?	
6	Is a fully stocked first aid kit available?	
7	Is an eyewash station and/or emergency shower available and in working condition?	
8	Is the lab free of evidence of food consumption and smoking?	
	Chemical Safety	
9	Does the lab have a Chemical Hygiene Plan?	
10	Does the lab have a current chemical inventory available?	
11	Does the lab have an administrator for the inventory?	
12	Are inventory tags (bar codes) removed from empties and given to the storeroom personnel?	
13	Are safety data sheets (SDS's) available for all chemicals used and stored in the lab?	
14	Does the lab have procedures for working with Particularly Hazardous Substances (carcinogens, mutagens, highly acute toxins, peroxide forming chemicals)?	
15	Are unattended reactions labeled with a description of the experiment and contact person?	
16	Are hazards and shipping requirements for newly synthesized chemicals properly documented and communicated to lab personnel?	
17	Are chemical containers and compressed gases properly labeled?	
18	Is the lab free of unnecessary, outdated, or unusable chemicals?	
19	Are incompatible chemicals and compressed gases segregated according to hazard class?	
20	Are compressed gas cylinders properly secured?	
21	Are refrigerators/freezers/ used for chemical storage properly maintained and clearly labeled for chemical storage only?	
22	Does the lab have a chemical spill response kit that is easily accessible and properly stocked?	
	Fire and Electrical Safety	YES NO N/A
23	Are all aisles and fire exits free from obstruction?	
24	Are flammable liquids used and stored away from potential ignition sources?	
25	Are quantities of flammable liquids stored outside of storage cabinets kept to a minimum?	
26	Are fire extinguishers unobstructed, tagged with a current inspection tag, properly pinned, and fully charged?	
27	Are electrical receptacles, switches, and controls located as not to be subjected to liquid spills?	
28	Are all tools, equipment, and instrumentation in good condition and electrically grounded?	
29	Are all machine hazards properly guarded?	
	Fume Hoods	
30	Are fume hoods operational, properly maintained, and not in alarm?	
31	Are lab personnel using fume hoods properly?	
	Laboratory Waste	
32	Is there a designated area to store chemical waste?	
33	Is the waste storage area at or near the point of generation?	
34	Are all waste streams known and properly segregated?	
35	Are all liquid wastes stored in adequate secondary containment?	
36	Are all waste containers in good condition, properly sealed, and free of leaks or residue?	
37	Are all waste containers properly labeled with chemical waste tags?	

Inspection Checklist Findings PI _____ **Room #** _____

Item #	Picture	Comments

APPENDIX C

Newly Synthesized Chemicals

Newly Synthesized Chemical Hazard Information For Your Laboratory

Office of Clinical and Research Safety
Telephone: 615-322-2057 After hours: 615-875-3779
https://www.vumc.org/safety

HAZARD COMMUNICATION FOR NEWLY SYNTHESIZED CHEMICALS

Before beginning laboratory research with a particular substance, the hazard properties of that substance should be determined so that appropriate personal protection and safe handling procedures can be developed.

Principal Investigators are responsible for ensuring that any known hazard properties for newly synthesized chemicals are communicated to laboratory personnel. The hazards for particularly hazardous substances (carcinogens, mutagens, highly acute toxins) and handling procedures for these substances are especially important to communicate.

Principal Investigators are also responsible for ensuring that newly synthesized chemicals used within their laboratories are properly labeled with the name and any particularly hazardous information.

If the hazards of a chemical synthesized in the laboratory are unknown, then the chemical must be assumed to be hazardous and the label should indicate the potential hazards of that substance have not been tested and are unknown.

OSHA Form 174 can be used to communicate hazard information about a newly synthesized chemical and will also serve as documentation of hazard determination for the material [similar to a Safety Data Sheet (SDS)]. This form is attached below.

DOMESTIC SHIPMENT FOR NEWLY SYNTHESIZED CHEMICALS

Shipments of newly synthesized chemicals or samples to locations within the U.S. Customs Territory must be accompanied with information that informs the receiver of potential or actual hazards. Please complete the TSCA Domestic Shipment Form and include with each shipment.

Procedures:

1. For all domestic shipments of chemicals or samples within the US Customs Territory, complete TSCA Domestic Shipment Form (attached below) and include a signed copy with the shipment.
2. Mark the words *"Contents To Be Used For Research And Development Purposes Only"* on the outside of the shipping package.
3. Maintain copies of this Form in your laboratory records for next three years. EPA inspectors may ask to see these forms during a regulatory inspection as proof of compliance.

APPENDIX D

Particularly Hazardous Substances

Identification and Management of Particularly Hazardous Substances (PHS) In Your Laboratory

Office of Clinical and Research Safety
Telephone: 615-322-2057 After hours: 615-875-3779
https://www.vumc.org/safety

INTRODUCTION

Before beginning laboratory research with a particular substance, the hazard properties of that substance should be known in order to determine appropriate personal protection and safe handling procedures. Certain substances are defined as "Particularly Hazardous Substances" (PHS) by the Occupational Safety and Health Administration (OSHA) because of their potential to cause severe adverse health effects. PHS items should be identified, evaluated, and managed in accordance with this guidance document to ensure that adequate protection from hazards for laboratory staff is provided.

IDENTIFICATION OF PARTICULARLY HAZARDOUS SUBSTANCES (PHS)

The OSHA Laboratory Standard (29 CFR 1910.1450) defines a Particularly Hazardous Substance as a select carcinogen, reproductive toxin, substance with a high degree of acute toxicity, or possessing some other high hazard physical property. The Globally Harmonized System of Classification and Labelling of Chemicals (GHS) has been adopted by OSHA as a means for identifying PHS items. Vanderbilt provides resources such as GHS-compliant Safety Data Sheets (SDS), Chemtracker, Chemwatch, and other chemical hazard information databases to determine if substances meet the definition of PHS under one or more classifications as defined below. GHS information is found in the Hazard Identification Section (Section 2) of the SDS:

- **Select carcinogens:** Those that are listed by OSHA (GHS), the International Agency for Research on Cancer (IARC), and the National Toxicology Program (NTP) as known or suspected human carcinogens:
  - GHS Carcinogenicity Category 1A or 1B or
  - IARC Group 1, or NTP Known to be Human Carcinogens or OSHA-listed carcinogens, or
  - GHS Category 2 AND IARC Group 2 (A or B), AND NTP Reasonably Anticipated to be Human Carcinogens.
- **Reproductive toxins:** Chemicals that may adversely affect male and female reproductive health and the developing fetus include:
  - GHS Category 1A or 1B for reproductive toxicity.
- **Chemicals having high acute toxicity** include the following GHS classifications:
  - GHS Category 1 or 2 Acute Toxicity by Inhalation, Dermal, or Oral exposure
  - GHS Category 1 Specific Target Organ Toxicity - Single Exposure
  - GHS Category 1A Skin or Respiratory Sensitizer
- **Reactive & Explosive Chemicals** considered Particularly Hazardous include the following GHS/UN classifications:
  - In contact with water emits flammable gas - Category 1
  - In contact with water liberates toxic gas
  - In contact with acids liberates toxic gas
  - Pyrophoric liquid or solid - Category 1
  - Self-heating - Category 1
  - Self-Reactive or Organic peroxides - Type A or B
  - Explosives - Divisions 1.1 - 1.3

MANANGEMENT OF PARTICULARLY HAZARDOUS SUBSTANCES (PHS)

If your laboratory is handling particularly hazardous substances, the following management practices are required:

- Maintain an accurate and clearly identified inventory of your PHS items.
- Prepare and implement written, lab-customized Chemical Safety Protocols / Standard Operating Procedures for PHS items as defined under Vanderbilt's Chemical Hygiene Plan (Vanderbilt Chemical Hygiene Plan)
- Provide documented training covering Chemical Safety Protocols for appropriate laboratory staff

APPENDIX E

Compressed Gases

Managing Compressed Gases in Your Laboratory

Office of Clinical and Research Safety
Telephone: 615-322-2057 After hours: 615-875-3779
https://www.vumc.org/safety

Recommended Safety Practices for Compressed Gases in the Laboratory

Labeling & Storage

- Compressed gas cylinders should be labeled as to their contents. Note that the manufacturer label may not be adequate to describe the contents of the cylinder.
- Store cylinders so that their content labels are clearly visible.
- Store all cylinders in a dry, well ventilated area away from extreme temperature changes, sources of ignition or heat, moisture, and mechanical shock.
- Keep incompatible classes of gases stored separately. Keep flammables from reactives, which include oxidizers and corrosives. Gas cylinders of fuels (for example, hydrogen) should be separated from gas cylinders of oxidizers (for example, oxygen) by at least 20 feet or by a wall with a minimum fire rating of 2 hours.
- Always make sure that cylinders are secured to a permanent structural support and secured with a chain or a strap at two thirds of their height from the floor. Contact Plant Services in VUMC (2-2041) or Plant Operations for VU-Campus (4-9675) for installation of brackets if necessary.
- For small cylinders or lecture bottles, utilize a stand or other appropriate mechanism to secure the cylinder to a stable surface.
- Segregate gas cylinder storage from the storage of other chemicals as much as possible.
- Cylinders ***that are in use*** must be secured individually so that no slippage or sliding occurs that could damage or alter the regulator.
- If cylinders must be ganged together for storage, only gang two cylinders together at a time, if possible.
- Cylinder carts are not a safe way of securing uncapped gases, even "only for a short time."
- Segregate empty cylinders from full cylinders and clearly mark the empty cylinders.

Usage

- Only Compressed Gas Association (CGA) standard combination of valves and fittings can be used in compressed gas installations.
- Gas lines and manifolds should be clearly marked with the identity of their contents and the direction of gas flow.
- When cylinders are no longer in use, shut the valves, relieve the pressure in the regulators, remove the regulators, and cap the cylinders.
- Make sure regulators are compatible with the gases they are being used with. Corrosive gases and carbon dioxide typically require regulators made of corrosive-resistant materials.
- Pressure regulators should be equipped with spring-loaded pressure relief valves to protect the low-pressure side. When used on cylinders of flammable, toxic, or

otherwise hazardous gases, the relief valve should be vented to a hood or other safe location.
- Regulators used for corrosive gases should be removed immediately after use and flushed with dry air or nitrogen.
- Cylinder discharge lines should be equipped with approved check valves to prevent inadvertent contamination of cylinders that are connected to a closed system where the possibility of flow reversal exists.
- For small cylinders or lecture bottles, utilize a stand or other appropriate mechanism to secure the cylinder to a stable surface.

Transportation

- Cylinders must always be handled as high energy sources.
- Always transport gas cylinders on wheeled cylinder carts with retaining straps or chains.
- Always transport lecture cylinders individually or in an approved carrier for transporting multiple cylinders.

Potential Leaks

- Only trained and designated persons may change or hook up gas cylinders.
- The laboratory faculty member must review and approve any new gas cylinder installation.
- Gas cylinders, hoses, tubing, and regulators must be maintained in good condition and replaced immediately if they become damaged or worn.
- Do not lubricate gas cylinder fittings and do not force tight fits.
- Open valves slowly, and do not stand directly in front of the gauges in case the gauge face blows out.
- Corrosive, toxic, and flammable gases must be connected with one continuous tube from the regulator to the apparatus.
- Cylinders, connections, and hoses should be checked regularly for leaks using an appropriate gas detector (if applicable), soapy water, or a 50 percent glycerin-water solution, can be used to look for bubbles.
- When the gas to be used in a procedure is a flammable, oxidizing, or highly toxic gas, the system should first be checked for leaks using an inert gas before introducing the hazardous gas.
- Laboratory personnel should never attempt to repair a leak at the junction of the cylinder valve and the cylinder or at the safety device. Contact the manufacturer or supplier for assistance.
- If a leak at the cylinder valve handle cannot be remedied by tightening a valve gland or a packing nut, contact the manufacturer or supplier for assistance.
- Use of internal bleed-type regulators should be avoided.

Managing Compressed Gases in Your Laboratory

Office of Clinical and Research Safety
Telephone: 615-322-2057 After hours : 615-875-3779
https://www.vumc.org/safety

Empty Cylinder Disposal

- Whenever possible, only purchase cylinders (including lecture cylinders) that can be returned to the distributor.
- If cylinders cannot be returned to the distributor (including lecture cylinders), contact OCRS for proper disposal.

Special Requirements for Highly Toxic Gases

Examples of highly toxic gases used at Vanderbilt University are (list not inclusive):

arsine	boron trifluoride	carbon monoxide	chlorine
diborane	dichlorosilane	fluorine	hydrogen chloride
hydrogen cyanide	hydrogen fluoride	hydrogen selenide	hydrogen sulfide
nitrogen dioxide	nitric oxide	ozone	phosgene
phosphine	sulfur dioxide		

Contact the Chemical Hygiene Officer/OCRS to review plans for using highly toxic gases to ensure adequate safety measures are in place.

Managing Compressed Gases in Your Laboratory

Office of Clinical and Research Safety
Telephone: 615-322-2057 After hours : 615-875-3779
https://www.vumc.org/safety

Engineering Controls and Requirements for Gas Use by Application

Controls	*Class 1*	*Class 2*	*Class 3*	*Class 4*	*Class 5*
Gas Cabinet	--	√ 1	√	√	--
Interlocks	√ 2	√ 2	√ 2	√ 2	√ 2
Emergency Off Button			√	√	
Equipment Enclosed and Ventilated	--	√ 1	√	√	√
Smoke Detection	--	√ 2	√ 2	√ 2	√ 2
Sprinkler Protection	--	√ 3	√ 3	√ 3	√ 3
Emergency Power to Exhaust Ventilation	--	--	√ 4	√ 4	√ 4
Pneumatic Shutoff Valve	--	√ 5	√	√	√
Scrubber	--	--	√ 2	√ 2	√ 2
Vacuum Pump Purge and Interlock	--	--	√	--	--
Flow Restricting Orifice	--	√	√	√	√
Ventilation Alarms	--	--	√	√	√
Eyewash and Showers	--	--	--	√ 6	√ 6
Purge Panel	--	--	√	√	√
Gas Monitor	--	√ 7	√ 7	√ 7	√ 7
Piping and Fittings	√	√	√	√	√
Hardware	√	√	√	√	√

Legend:

Class 1 Application - Use of Inert Gases - Gases which are non-flammable and non-toxic, but which may cause asphyxiation due to displacement of oxygen in poorly ventilated spaces

Class 2 Application - Use of Flammable, Low Toxicity - Gases which are flammable (at a concentration in air of 13% by volume or have a flammable range wider than 13% by volume), but act as non-toxic, simple asphyxiants (e.g. hydrogen, methane)

Class 3 Application - Use of Pyrophoric Gases and Liquids - Gases or liquids which spontaneously ignite on contact with air at a temperature of 130 F or below.

Class 4 Application - Use of Corrosive, Toxic, and Highly Toxic Gases - Gases which may cause acute or chronic health effects at relatively low concentrations in air

Class 5 Application - Use of Compressed Gases in Fume Hoods

1: Not required if flow restricting orifice is installed in a cylinder valve. May be required for semiconductor applications
2: Based on the outcome of hazard review
3: Required in lab and inside gas cabinet for new installations
4: For new installations
5: Typically not required, may be required for semiconductor applications
6: For corrosive gases
7: For gas monitoring consult OCRS for details and requirements.

APPENDIX F

Managing, Retention and Storage of Chemicals in your Laboratory

Managing Chemical Retention and Storage

In Your Laboratory

Office of Clinical and Research Safety
Telephone: 615-322-2057 After hours : 615-875-3779
https://www.vumc.org/safety

INTRODUCTION

Prudent chemical retention and storage practices are vital to maintain a safe laboratory working environment and to minimize the financial costs and environmental impact associated with the handling and disposal of unwanted chemicals. The American Chemical Society endorses the "Less Is Better" (1993) approach which emphasizes the safety and financial reasons for buying chemicals in small packages on an as needed basis: reduced risk of breakage, reduced risk of exposure following accidents, reduced storage costs, reduced wasted from decomposition during prolonged storage in partially empty bottles, and reduced disposal cost for unused materials. For chemicals likely to be used in the near future, a well-managed storage plan is necessary in order to reduce the risk of incompatible chemical reactions and unwanted exposures to particularly hazardous substances. This fact sheet focuses on proper guidelines for chemical retention and storage.

CHEMICAL RETENTION

Temperature, humidity, light, exposure to air and other substances are several factors that affect chemical purity and can contribute to chemical decomposition. Decomposition can lead to the formation of hazardous reactive chemical by-products. It may also affect the quality of research when decomposed chemicals turn into unknown or unintended compounds. The following are general recommendations for chemical retention:

- The date the material was received and the date the container was first opened should be recorded. This is especially important to track those chemicals that degrade rapidly and/or form explosive peroxides. Organic peroxides are a class of compounds that have unusual stability problems that make them among the most hazardous substances found in the laboratory. As a class, organic peroxides are considered to be powerful explosives and are sensitive to heat, friction, impact, and light, a well as to strong oxidizing and reducing agents. Please refer to the OCRS fact sheet - “Peroxide Forming Chemicals - Chemical Retention and Storage” for more detailed information for handling and storage of peroxide forming chemicals available on the OCRS website. www.vumc.org/safety
- Properly dispose of any chemicals or gas cylinders past an expiration date listed on the label or that have been stored beyond the shelf life recommendations given on the supplier SDS or technical datasheet. Submit collection request to the OCRS website at: https://www.vumc.org/safety/waste/chemical-waste-collection
- Properly dispose of any unlabeled chemical containers or gas cylinders. Unlabeled chemicals are not only a danger to lab staff but also to housekeeping and emergency personnel. Submit collection request to the OCRS website at: https://www.vumc.org/safety/waste/chemical-waste-collection
- Keep a current inventory of all chemical compounds and compressed gas cylinders in the laboratory. Vanderbilt University uses Chemtracker for assistance with maintaining chemical inventories. Contact OCRS for more information regarding the use of Chemtracker. (2-2057)

CHEMICAL STORAGE

FLAMMABLE LIQUID STORAGE

Flammable liquids should be stored in flammable liquid storage cabinets or inside a designated flammable liquid storage area. The maximum volume of flammable liquids allowed in laboratories outside flammable liquid storage cabinets are as follows (NFPA 45):

- 10 gallons (38 liters) of Class 1 flammable liquids per 100 sq. ft. area. (Flash point < 100˚F)
- 20 gallons (78 liters) of Class I, II, and IIIA flammable liquids. (Flash point > 100˚F for Class II and > 140˚F for Class IIIA).
- An additional 10 gallons of Class 1 flammable liquids can be stored in a flammable liquid storage cabinet. Combinations of Class 1, Class II, and Class IIIA flammable liquids may not exceed 40 gallons in a flammable liquid storage cabinet.
- Flammable-liquids storage cabinets are not intended for the storage of highly toxic materials, acids, bases, compressed gases or pyrolytic chemicals.
- The maximum quantity of flammable and combustible liquids allowed in a properly designed and protected flammable liquid storage room is 5 gallons (19 liters) per square foot of floor area (NFPA 30).
- Purchase the smallest volume container needed for research. This is especially important with glass containers storing flammable liquids since these are highly susceptible to breakage.
- Large bottles should be stored low to the ground in order to prevent large spills from dropping.

STORAGE OF PARTICULARLY HAZARDOUS SUBSTANCES (PHS)

- Particularly Hazardous Substances (PHS) should be segregated from other less hazardous chemicals in the laboratory. PHS includes regulated substances, known carcinogens, reproductive hazards, sensitizers, highly acute toxins, or highly corrosive chemicals.
- For more information, refer to the OCRS Fact Sheet on “Managing Particularly Hazardous Substances (PHS) In Your Laboratory” available on the OCRS website.

STORAGE OF CHEMICAL HAZARDOUS WASTE

- Storage of Hazardous Waste in the Laboratory: Each lab should have a designated location in which to store hazardous materials to be discarded (do not keep radioactive waste and hazardous chemical waste in the same place). This location should be out of the way of normal lab activities, but easily accessible and recognizable by OCRS staff.
- Refer to the Laboratory Guide for Managing Chemical Waste available on the OCRS website.

CHEMICAL STORAGE GROUPS

Chemicals are best segregated by hazard class to avoid incompatibilities. **DO NOT STORE CHEMICALS ALPHABETICALLY,** except within a hazard class. Plastic bins can be used to provide secondary containment and segregation on shelves. Recommended general hazard classes for storage are listed below. Chemtracker can assist with the designation of storage groups for particular chemicals:

A **Compatible Organic Bases**

Examples: hydroxylamine, tetramethylethylamine diamine, triethylamine, phenylhydrazine

B **Compatible Pyrophoric & Water Reactive Materials**

React with water to yield flammable or toxic gases. Examples include sodium, potassium, metal hydrides and hydrolysable halides (titanium tetrachloride, phosgene etc.) Keep away from water sources. Do not store above or below sinks. Use dry chemical extinguisher for fire.

C **Compatible Inorganic Bases**

Materials with a pH > 9. Examples include ammonium hydroxide, calcium hydroxide, and sodium hydroxide. Separate from acids. Store solutions of inorganic hydroxides in polyethylene containers.

D **Compatible Organic Acids**

Examples: propionic acid, trichloroacetic acid, acetic anhydride, acetyl bromide. Separate from inorganic acids.

E **Compatible Oxidizers including Peroxides**

React with water, fire, flammables and combustibles. Examples include inorganic nitrates (nitric acid), permanganates, inorganic peroxides, persulfates, and perchlorates (perchloric acid). Keep separate from flammables and other organic materials. Keep separate from reducing agents (i.e., zinc, alkaline metals, and formic acid). Do not store directly on wooden surfaces.

F **Compatible Inorganic Acids not including Oxidizers or Combustibles**

Materials with pH < 5. Examples include hydrochloric and hydrofluoric acid. Separate from active metals including sodium and potassium and from organic acids.

G **Not intrinsically Reactive or Flammable or Combustible**

Example: NaCl, buffer solutions

J* **Poison Compressed Gases**

Example: Hydrogen sulfide, chlorine

K* **Explosive or other highly unstable materials**

Example: Picric Acid, nitrocellulose

L **Non-Reactive Flammables and Combustibles, including solvents**

Flammable/Combustibles vapors ignite easily at room temperature. Examples include alcohols, esters, ketones, ethers and pyrophorics. Store flammable liquids in approved safety cans or cabinets. Keep away from heat, sun, flame, and spark sources. Separate from oxidizers. See **Flammable Liquid Storage** section.

X* **Incompatible with all other storage groups**

*** Storage Groups J, K, and X are particularly hazardous and are incompatible with all other storage groups or require special storage considerations. For assistance with these storage groups please contact OCRS (2-2057).**

STORAGE GROUPS

This storage system should be used in conjunction with specific storage recommendations from the manufacturer's label and MSDS.

When possible, isolate all storage groups in separate cabinets. If space does not allow, use the following cabinet scheme to combine storage groups. Use secondary containment as shown to prevent spilled materials from contacting containers of incompatibles that are in the same cabinet.

A. Compatible Organic Bases

B. Compatible Pyrophoric & Water Reactive Materials

C. Compatible Inorganic Bases

D. Compatible Organic Acids

E. Compatible Oxidizers including Peroxides

F. Compatible Inorganic Acids not including Oxidizers or Combustibles

G. Not Intrinsically Reactive or Flammable or Combustible

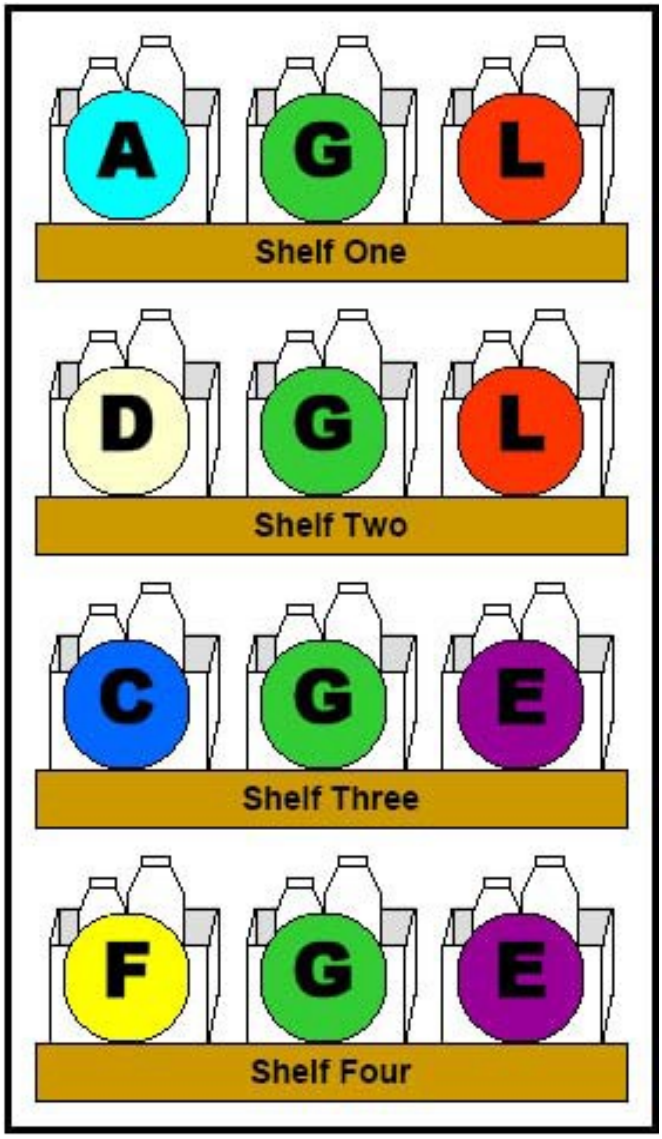
J. Poison Compressed Gases

K. Compatible Explosive or other highly Unstable Materials

L. Non-Reactive Flammables and Combustibles including solvents

X. Incompatible with ALL other storage groups

For Storage Groups J, K, and X: Contact VEHS



APPENDIX G

Definitions

DEFINITIONS

Action Level means a concentration designated in 29 CFR part 1910 for a specific substance, calculated as an 8-hour time weighted average (TWA), which initiates certain required activities such as exposure monitoring and medical surveillance.

Chemical Hygiene Officer (CHO) means an employee who is designated by the employer (PI), and who is qualified by training or experience to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan (CHP).

Combustible Liquid means any liquid having a flashpoint at or above 100°F (37.8°C), but below 200°F (93.3°C), except any mixture having components with flashpoints of 200°F, or higher, the total volume of which make up 99% or more of the total volume of the mixture.

Compressed Gas means:

- A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 pounds per square inch (psi) at 70°F (21.1°C), or
- A gas or mixture of gases having, in a closed container, an absolute pressure exceeding 104 psi at 130°F (54.4°C) regardless of the pressure at 70EF, or
- A liquid having a vapor pressure exceeding 40 psi at 100°F (37.8°C) determined by ASTM method D-323-72.

Designated Area means an area which may be used for work with select carcinogens, reproductive toxins or substances which have a high degree of acute toxicity. A designated area may be the entire laboratory, an area of the laboratory or a device such as a laboratory hood.

Emergency means any occurrence such as, but not limited to, equipment failure, rupture of containers or failure of control equipment which results in an uncontrolled release of a hazardous chemical into the workplace.

Employee means an individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments. At VUMC employees include staff members, graduate research assistants and teaching assistants and administrative support staff who work in laboratory areas. Students are not considered employees.

Flammable means a chemical that falls into one of the following categories:

> ***Aerosol Flammable*** means an aerosol that, when tested by the method listed in 16 CFR 1500.45, yields a flame protection exceeding 18 inches at full valve opening, or a flashback at any degree of valve opening.

Gas Flammable means:

- A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13% by volume or less, or
- A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12% by volume, regardless of the lower limit.

Liquid Flammable means any liquid having a flashpoint below 100°F (37.8°C), except any mixture having components with flashpoints of 100°F or higher, the total of which make up 99% or more of the total volume of the mixture.

Solid Flammable means a solid, other than a blasting agent or explosive, that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a flammable solid when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

Flashpoint means the minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite when tested by the Tagliabue Closed Tester, Pensky-Martens Closed Tester, or Setaflash Closed Tester using the appropriate American National Standard Method of Test. Organic peroxides, which undergo auto accelerating thermal decomposition, are excluded from the flashpoint determinations listed above.

Hazardous Chemical means a chemical for which there is statistically significant evidence that acute or chronic health effects may occur in exposed employees. The term health hazard includes particularly hazardous substances that are carcinogens, highly toxic agents, and reproductive toxins. Hazardous chemicals also include irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, or other chemicals that cause adverse health effects.

Highly toxic means a chemical falling within any of the following GHS (Globally Harmonized System of Classification and Labelling of Chemicals) categories: See Appendix C of the CHP- **Particularly Hazardous Substances (PHS)** https://www.vumc.org/safety/chem/chp

- GHS Category 1 or 2 Acute Toxicity by Inhalation, Dermal, or Oral exposure
- GHS Category 1 Specific Target Organ Toxicity - Single Exposure
- GHS Category 1A Skin or Respiratory Sensitizer

Laboratory means 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.

Laboratory Scale means work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person.

Laboratory Hood means a device located in a laboratory, enclosed on five sides with a movable sash or fixed partial enclosure on the remaining side; constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory; and allows chemical manipulations to be conducted in the enclosure without insertion of any portion of the body into the hood other than the hands and arms. Walk-in hoods with adjustable sashes meet the definition provided that the sashes are adjusted during use so that the airflow and the exhaust of air contaminants are not compromised and employees do not work inside the enclosure during the release of airborne hazardous chemicals.

Laboratory use of hazardous chemicals means handling or using hazardous chemicals in which all of the following conditions are met:

- Chemical manipulations are carried out on a “laboratory scale”.
- Multiple chemical procedures or chemicals are used,
- The procedures involved are not part of a production process, nor in any way simulate a production process, and
- Protective laboratory practices and equipment are available and in common use.

Organic peroxide means an organic compound which 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.

Oxidizer means 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.

Particularly Hazardous Substances are a group of select carcinogens, reproductive toxins, or substances with a high degree of acute toxicity. See **Appendix C** of the CHP for more information.

Physical hazard means a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive), or water-reactive.

Reactive and Explosive Chemicals means a chemical that causes a sudden, almost instantaneous release of pressure, gas, and/or heat when reacting with another chemical or subjected to sudden shock, pressure, or high temperature. These chemicals considered Particularly Hazardous include the following GHS/UN classifications: See Appendix C of the CHP- **Particularly Hazardous Substances (PHS)** https://www.vumc.org/safety/chem/chp

- In contact with water emits flammable gas - Category 1
- In contact with water liberates toxic gas
- In contact with acids liberates toxic gas
- Pyrophoric liquid or solid - Category 1
- Self-heating - Category 1
- Self-Reactive or Organic peroxides - Type A or B
- Explosives - Divisions 1.1 - 1.3

Reproductive toxin means chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis). See Appendix C of the CHP- **Particularly Hazardous Substances (PHS)** https://www.vumc.org/safety/chem/chp

- GHS Category 1A or 1B for reproductive toxicity.

Select carcinogen means any substance that are listed by OSHA (GHS), the International Agency for Research on Cancer (IARC), and the National Toxicology Program (NTP) as known or suspected human carcinogens: See Appendix C of the CHP- **Particularly Hazardous Substances (PHS)** https://www.vumc.org/safety/chem/chp

- GHS Carcinogenicity Category 1A or 1B or
- IARC Group 1, or NTP Known to be Human Carcinogens or OSHA-listed carcinogens, or
- GHS Category 2 AND IARC Group 2 (A or B), AND NTP Reasonably Anticipated to be Human Carcinogens

Unstable (reactive) means a chemical which in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shock, pressure or temperature.

Water-reactive means a chemical that reacts with water to release a gas that is either flammable or presents a health hazard.