CHEMICAL HYGIENE PLAN

VANDERBILT
UNIVERSITY

Environmental Health, Safety, and Sustainability (EHSS)

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CHEMICAL HYGIENE PLAN REVISION LOG

DATE	CHANGE DESCRIPTION	REVISED AND REVIEWED BY
1/18/2024	Reviewed CHP and added operational, contact, and definition updates	Revised by: Joe Hegarty, EHSS Approved by: Chemical Safety Committee
1/28/2025	Reviewed CHP and added revision log and dichloromethane exposure control plan	Revised by: Ed Krise, EHSS Approved by: Chemical Safety Committee
1/20/2026	Reviewed CHP and updated all weblinks to reflect new EHS website, updated Section 7.5, and updated Appendix H (ECP)	Revised by: Ed Krise, EHSS Approved by: Chemical Safety Committee

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. Definitions of terms used throughout the CHP are provided in Appendix G.

The purpose of the CHP is to describe protective chemical handling practices and procedures to be followed by lab occupants as defined in Appendix G to prevent injury and illness when using hazardous chemicals in laboratories at VU.

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 lab occupants 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)/ DIRECTOR/ SUPERVISOR

The Principal Investigator (PI) for research labs, Lab Instructor (LI) for teaching labs, or Director and/or Lab Supervisor for Cores and other areas is responsible for the health and safety of lab occupants and complying with the CHP in their laboratory. The PI/LI/Director/Supervisor may delegate these responsibilities to a lab occupant who is suitably experienced and trained such as a lab manager. These responsibilities may not be shifted to an inexperienced or untrained lab occupant.
The PI / LI/Director/Supervisor must assure that:

- Lab occupants understand and follow the requirements in the general university 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 at least annually with lab occupants, and revised whenever new hazardous chemicals or processes are introduced or whenever needed.
- 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/Director/Supervisor or their 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 work using PHS.
- Laboratory facilities maintain appropriate hazard signage.
- Appropriate laboratory attire is worn.
- Appropriate personal protective equipment is provided and worn by lab occupants when using hazardous chemicals.
- Appropriate training has been provided per the Laboratory Standard. It is recommended that lab occupants complete the general Oracle Learning Hub module "Initial chemical and Physical Safety for Research Labs", complete the "Refresher Chemical and Physical Safety for Research Labs" module as appropriate for their department and lab requirements, and are also sufficiently trained on any lab, protocol or chemical-specific procedure.
- Safety Data Sheets (SDS) for hazardous chemicals are available either in electronic form or hard copy form.
- 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 local, state and federal regulations.
- Non-compliance issues, unsafe conditions and inadequate facilities are reported to their Department Chair and to EHSS.
- Appropriate compliance, health and safety audits are conducted with correction of findings in a timely manner.
- Approval is granted, when necessary, prior to work with particularly hazardous substances.
- Laboratory injuries and property damage is reported to VU Risk Management through the Origami system in a timely manner.

4.2 LABORATORY OCCUPANTS

Individual laboratory occupants 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, spill/releases, unsafe acts or conditions to their PI/LI/Director/Supervisor.

4.3 CHEMICAL HYGIENE OFFICERS (CHO)

Laboratory Chemical Hygiene Officer

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/Director/Supervisor can serve as the Laboratory CHO or can designate another qualified person in the lab to fulfill that role.

University Chemical Hygiene Officer

The University Chemical Hygiene Officer resides in the Environmental Health, Safety, and Sustainability Department. The University CHO is responsible for:

- Providing technical assistance, support, and guidance to the VU Chemical Safety Committee, PIs/LIs/Directors/Supervisors, lab occupants, university departments, schools, Provost's office and EHSS functions.
- Working with the 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 EHSS.
- Management of the University's Chemical Waste Management program.

4.4 RESEARCH INTEGRITY AND COMPLIANCE COMMITTEE (RICC)

The RICC is responsible for:

- Providing a governance structure, comprehensive leadership and oversight for the various research-related EHSS safety and compliance functions for VU.
- Reviewing reports on chemical safety provided by the VU Chemical Safety Committee or EHSS 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 use, and disposal of chemicals and recommending the adoption of new or revised policies.
- Reviewing and approving the university Chemical Hygiene Plan.
- 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, programs or audits, in conjunction with EHSS.
- Establishing a system for auditing laboratories for EHSS issues, reviewing audit findings, and ensuring that appropriate follow-up is conducted.
- Reviewing at least annually a summary of the training status of those working with chemical materials in teaching and research laboratories and partnering with EHSS to develop methods to enhance training compliance when needed.
- Reviewing at least annually all incidents involving chemical materials with respect to cause and subsequent actions taken.

4.6 SCHOOL/DEPARTMENTAL SAFETY COMMITTEES

Each Department and/or School determines the need for the establishment of a Departmental or School Safety Committee to develop and manage the elements of department or school-specific Chemical Hygiene Plans. Membership in the Departmental or School Safety Committee is at the discretion of the department or school and may include PIs/LIs/Directors/Supervisors, lab occupants, administrative members, students, and representatives from EHSS.

Where a Departmental or School Safety Committee has not been established, the responsibility for implementation and development of the Lab-specific CHP falls to the Principal Investigator (PI), Lab Instructor (LI), or other Lab Director or Supervisor as defined above in section 4.1.

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

- Development and approval of departmental or school 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 VANDERBILT UNIVERSITY ENVIRONMENTAL HEALTH, SAFETY AND SUSTAINABILITY (EHSS)

EHSS is responsible for:

- Designating a qualified person to be the University Chemical Hygiene Officer (CHO).
- Assisting the PI / LI/Director/Supervisors and Safety Committees with Environmental Health, Safety, and Sustainability policy development, implementation, 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.
- Ensuring lab occupants become part of the VU respiratory protection program, as necessary.
- Establishing and updating laboratory hazard signage.
- Assisting with the procurement of Safety Data Sheets (SDS).
- Maintaining a web-based source of information on laboratory safety https://www.vanderbilt.edu/facilities/ehs/
- Assisting PI/LI/Director/Supervisor with development of Chemical Safety Protocols (CSP) and Personal Protective Equipment (PPE) recommendations.
- Assisting the PI/LI/Director/Supervisor in maintaining inventories of laboratory chemicals.
- Assisting with chemical storage and compatibility issues in the laboratory.
- Providing waste management and disposal service of laboratory chemicals and maintaining all required records.
- Providing general laboratory safety training for lab occupants using hazardous chemicals VU laboratories.
- Facilitating and participating in departmental or school laboratory safety training as needed.
- Evaluating chemical fume hood flow and performance.
- Sharing best practices related to safety, compliance and sustainability in laboratories (energy conservation, water conservation, waste and recycling, etc.)

5.0 CHEMICAL HYGIENE MANAGEMENT SYSTEM

5.1 LABORATORY-SPECIFIC CHEMICAL HYGIENE PLAN

While this university 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, protocol or chemical-specific safety procedures, as applicable.
- Laboratory-specific emergency response procedures, as 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 (EHSS 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.

EHSS maintains a library of Chemical Safety Protocol templates on the EHS website here: www.vanderbilt.edu/facilities/ehs/chemical-safety/. New CSP's are added as necessary. PIs/LIs/Directors/Supervisors 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.

5.3 TRAINING

All lab occupants using chemicals or that supervise other lab members who use chemicals must undergo general lab safety training that includes the contents of this Chemical Hygiene Plan before performing this work. EHSS provides this general training and maintains training records through the Oracle Learn System. This training is available for visiting researchers, interns, and others who are non-VU persons on the EHS website through RedCap but should only be used by those that do not have access to VU's Oracle Learn system. Training information including direct links to online modules is available on the EHS website here: www.vanderbilt.edu/facilities/ehs/safety-training/. The PI / LI/Director/Supervisor is responsible for determining the appropriate general refresher training frequency to ensure all lab occupants are knowledgeable in the content of this training and CHP.

Additionally, PIs/LIs/Directors/Supervisors must ensure that all lab occupants using 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 lab occupant's initial assignment to a work area where hazardous chemicals are present and prior to assignments involving new exposure situations or new chemicals. Refresher training for this lab-specific information and CHP should be provided at least annually. Training should be documented and maintained by the PI / LI/Director/Supervisor by including the date, time, who attended and what information was covered.

On-the-job training should be provided as necessary to allow a lab occupant to begin a new process or use equipment for the first time. PIs/LIs/Directors/Supervisors 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, certain physical hazards, or lasers. Check the following link for information on training requirements for working with these materials - http://www.vanderbilt.edu/facilities/ehs/safety-training/.

See Appendix A of the CHP for an outline of Laboratory-Specific Safety Training suggested for laboratories.

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 (EHSS, departmental, peer and/or self-inspection).
- Results of inspections will be documented and made available to the PI / LI/Director/Supervisor, Department Chair, Chemical Safety Committee, and EHSS.
- The Chemical Safety Committee, in consultation with EHSS 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.
- VU's EHS Assist software will be used for inspection checklists, documenting inspection findings, and as a tracking system for corrective actions. For assistance with VU EHS Assist, contact ehsa@vanderbilt.edu or visit www.vanderbilt.edu/facilities/ehs/ehsa/ .

The Laboratory Inspection procedure and checklist are available by using EHS Assist and a printable version is available in Appendix B of the CHP – **Laboratory Safety Audit Checklist.**

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/Director/Supervisor must ensure that lab occupants 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 online, on paper or on a disk or local hard drive. The EHS Assist program provides a comprehensive inventory of SDSs available here: https:// www.vanderbilt.edu/facilities/ehs/ehsa/
- 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. Assistance with chemical inventories is available here: www.vanderbilt.edu/facilities/ehs/ehsa/
- 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 D of the CHP - **Newly Synthesized Chemicals.**

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 occupants 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**).

6.3 COMPRESSED GASES

Compressed gases pose both chemical and physical hazards for lab occupants. 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.**

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/Director/Supervisor in consultation with EHSS will determine the requirements for exposure monitoring. A combination of factors is used to determine the need for exposure assessment including the chemicals involved, protective measures in place, and lab occupant 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/Director/Supervisor, Occupational Health, and/or EHSS as appropriate. Lab occupants will be notified of the results of their exposure monitoring after receipt of the sampling results. Lab occupants and their representatives can have access to results from their personal monitoring by contacting the PI/LI/Director/Supervisor. Please contact EHSS for further information regarding exposure monitoring.

6.5 MEDICAL CONSULTATION AND EXAMINATIONS

VU individuals 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 a lab occupant develops signs or symptoms potentially associated with a hazardous chemical to which the person has been exposed in the laboratory, the individual should receive an appropriate medical examination. For non-life threatening exposures, VU individuals should go to the Occupational Health Clinic. VU undergraduate students should go to Student Health Services during normal working hours. For serious emergencies or after hours incidents, all individuals should go to the VUMC Emergency Department. Non-VU persons should visit the nearest medical facility.
- 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 individual as

prescribed by the regulation. Contact EHSS or Occupational Health regarding TOSHA regulated substances.
- When an event takes place in lab such as a spill, leak, explosion, or other occurrence resulting in the likelihood of exposure to a hazardous substance, the affected individual 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 medical professionals and will be provided without cost to the employee, without loss of pay, and at a reasonable time and place.

The PI/LI/Director/Supervisor provides to the health care provider:

- The identity of the hazardous chemical(s) to which the lab occupant 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 individual is experiencing, if any.

The health care provider provides a written opinion to the PI/LI/Director/Supervisor 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 during the examination which may place the individual at increased risk because of exposure to the hazardous chemical in the laboratory.
- A statement that the individual has been informed by the healthcare provider 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, contamination of experiments, and property damage. This is especially true of chemicals with high vapor pressures. Safe work procedures should always be followed after a chemical spill has been identified:

- No lab occupant 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 Vanderbilt University Public Safety (VUPS at 911 on-campus or 615-421-1911 when off-campus). VUPS will then alert EHSS and/or Nashville Fire Department's hazardous materials response team, as deemed appropriate.
- Each laboratory using hazardous chemicals must maintain appropriate clean-up materials readily accessible to lab occupants. 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 occupants. Labs should supplement these spill kits with other materials needed for response to specific chemicals that cannot be handled with these basic kits.
- Lab occupants should only clean up small chemical spills of known origin that they are comfortable cleaning up and for which they have the proper training, 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 lab occupants. Any time individuals experience dizziness or nausea during a chemical clean up, the laboratory should be evacuated and VUPS and EHSS should be notified.
- Used spill clean-up materials must be disposed of as chemical waste through EHSS.

Chemical Exposures and Medical Emergencies

- VU faculty, staff, postdocs, and graduate students should visit the Occupational Health Clinic for medical attention. Undergraduate students should visit Student Health Services during open hours. Please visit the Vanderbilt University Medical Center's Emergency Department after-hours or for serious emergencies. Non-VU persons should visit the nearest medical facility.
- 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 occupants 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 lab occupants 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/Director/Supervisor for appropriate follow-up and then to the university's occurrence reporting system available at https://www.vanderbilt.edu/generalcounsel/riskmanagement/.

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, Pull the pin, Aim at the base of the fire, Squeeze the handle, and Sweep 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 through the Ready system at https://ready.app.vanderbilt.edu. VU researchers in VUMC Facilities (VUMC buildings) should report fume hood failures to 615-322-2041 (VUMC Facilities Management).

Other Emergencies Requiring Building Evacuation

For other emergencies requiring building evacuation (bomb threats, explosions, campus threat, 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 "Guide to managing laboratory chemical waste" provided by EHSS and available at www.vanderbilt.edu/facilities/ehs/chemical-safety/ .

Waste collection requests can be submitted through the EHS Assist tool:www.vanderbilt.edu/facilities/ehs/ehsa/ .

Questions regarding chemical waste handling and disposal should be directed to EHSS at chemicalsafety@vanderbilt.edu.

General Waste Requirements Training

- Every laboratory that generates chemical waste must have a copy of the "**Guide for managing laboratory chemical waste**" available. This can be found at: www.vanderbilt.edu/facilities/ehs/chemical-safety/
- Every laboratory that generates chemical waste must have a "**Hazardous Chemical Waste Accumulation Area" sign** posted near their chemical waste storage location. This sign is provided by EHSS or can be printed from www.vanderbilt.edu/facilities/ehs/chemical-safety/
- Laboratory occupants that handle chemical waste must be trained in proper chemical waste management procedures. General lab safety training provided by EHSS includes basic procedures for handling chemical waste for VU labs and is part of EHSS's initial and refresher chemical and physical safety in research labs training modules available in Oracle Learn and on the EHS website.

Storage

- Every laboratory that generates chemical waste must have at least one area designated for chemical waste storage that is known by lab occupants 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 EHSS at chemicalsafety@vanderbilt.edu to obtain secondary containment equipment or lab occupants can order supplies through the EHS Assist software.
- 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.
- Never store more than 55 gallons of waste in one storage location or more than 1 kg of extremely toxic materials like potassium cyanide.

Labeling

- Label chemical waste containers with waste tags provided by EHSS 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 EHSS waste tag. These tags can be requested through the EHS Assist software.

Closed Containers

- Keep chemical waste containers closed at all times except to temporarily add more waste. No open or unlatched 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 through EHS Assist when your chemical waste is ready for pickup at www.vanderbilt.edu/facilities/ehs/ehsa/ .
- Never pour chemical wastes down the sink or other drains unless it is approved by the "Guide for managing laboratory chemical waste" guidelines or EHSS.
- 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

Hazardous chemicals must be stored properly in the laboratories and quantities kept to a minimum. Chemicals 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**. Additionally, VU's EHS Assist software or EPA's Cameo software or app can be a useful tool for chemical compatibility date and is available at https://www.epa.gov/cameo/cameo-chemicals-software.

If special storage is required, contact EHSS for assistance at chemicalsafety@vanderbilt.edu.

7.2 GENERAL LABORATORY VENTILATION

Vanderbilt laboratories are designed to provide adequate ventilation to prevent the buildup of hazardous vapors and gases. 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 Facilities in VUMC buildings. Report any ventilation problems to VU Facilities for campus buildings at 615-343-9675 or through the Ready app at https://ready.app.vanderbilt.edu/ or to VUMC Facilities for VUMC buildings at 615-322-2041.

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 occupants 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. Older 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. Newer high efficiency low flow (HELF) fume hoods are designed to operate at a lower face velocity of approximately 60 fpm. EHSS performs routine inspections of the fume hoods to ensure adequate face velocity and proper air flow patterns. EHSS 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 lab occupant 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 manufacturers' recommendations and applicable government and industry standards.

EHSS 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).**

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 at least monthly for 15 minutes by the PI/lab occupants as well as after any water outage as the outage can introduce air into the water line. Eyewash stations should also be checked for adequate flow annually (1.5 liters of water/minute). **These inspections should be documented in the laboratory.** A bucket or other container can be placed over the top of the eyewash to catch any splatter after a water outage and can also be used to check the 1.5 liter per minute adequate flow rate.

Emergency showers are maintained by VU Facilities or VUMC Facilities Management in accordance with applicable standards. Report any problems to VU Facilities for campus buildings at 615-343-9675 or through the Ready app at https://ready.app.vanderbilt.edu/ or to VUMC Facilities Management for VUMC buildings at 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 Management 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 EHSS for guidance related to 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 occupants 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 covers the arms, legs and feet 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. Chemically-compatible gloves should be worn to protect the hands. 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 exist. 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 EHSS 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 EHSS 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 or snapped 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 in 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.

Gloves

Chemically protective gloves are designed to protect lab occupants' 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.

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 occupants 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 replaced periodically. How often the gloves should be replaced 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 laboratory ventilation, chemical fume hoods and other local exhaust devices. Laboratory occupants 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. If respirator use is being considered, first consult with EHSS about program requirements as wearing a respirator requires medical clearance from Occupational Health as well as fit-testing.

7.8 PERSONAL HYGIENE

Personal hygiene procedures are designed to protect laboratory occupants 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 or have been designated as acceptable by EHSS inspection and documentation.

- Do not prepare, store, or consume food or beverages in the laboratory.
- Do not smoke, vape, consume or store tobacco or vape 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, hallways, or food areas.

7.9 HOUSEKEEPING

Good housekeeping is extremely important for laboratory safety:

- Keep aisleways, 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, safety showers, or electrical panels.
- Keep lab benches, hoods, tables, etc. clean and uncluttered.
- After an experiment or class is completed, clean workspaces (including bench tops and floors), 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.
- Dispose of sharps in an appropriate sharps 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 those working in labs:

- Never work alone in the laboratory without checking in with someone else 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 others.
- Use laboratory equipment only for its designated purpose.
- Pets and unapproved minors are not allowed in laboratories where hazardous materials, processes, or instrumentation are 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 VUPS.
- Require lab occupants to always have identification or proper credentials with them while in the lab.
- If necessary, lock cabinets, refrigerators, or freezers where hazardous materials or controlled substances are stored for additional security.
- Restrict/control access to the lab by limiting the number of people with keys and codes.

7.12 LABORATORY RECORDKEEPING

The following documents should be maintained in the laboratory and available for review by laboratory occupants or approved visitors such as EHSS staff or regulatory agency staff:

- Copy of the Chemical Hygiene Plan.
- Laboratory-Specific Chemical Safety Protocols and other Standard Operating Procedures
- Training documentation for 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 or be readily available online.
- 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/Director/Supervisor prior to implementation in the lab. The PI/LI/Director/Supervisor will ensure that all appropriate safety measures have been taken and that the work is being conducted in accordance with applicable regulations and policies and may consult with EHSS and/or the VU Chemical Safety Committee, if needed. Work requiring prior approval by the PI /LI/Director/Supervisor 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 or similar lab-specific Standard Operating Procedures (SOPs). Laboratory occupants 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: www.vanderbilt.edu/facilities/ehs/biological-safety/
- Work with radioactive materials. See the following link for more information: www.vanderbilt.edu/facilities/ehs/radiation-laser-safety/
- Work with Class 3b and 4 lasers. See the following link for more information: www.vanderbilt.edu/facilities/ehs/radiation-laser-safety/

8.0 DICHLOROMETHANE EXPOSURE CONTROL PLAN

8.1 REGULATORY BACKGROUND

On May 8, 2024, the Environmental Protection Agency issued a final rule in the Federal Register on the manufacture, distribution, and use of methylene chloride, also known as dichloromethane (DCM) (Methylene Chloride Rule). This regulation was issued under the authority of the Toxic Substances Control Act (TSCA) as amended by the Frank Lautenberg Act of 2016. This regulation requires that laboratories that continue to use DCM/methylene chloride have in place mandated requirements to protect all “potentially exposed persons”.

One of those mandated requirements is an Exposure Control Plan (ECP) that documents actions taken to mitigate DCM exposures and is a component of the Workplace Chemical Protection Plan (WCPP). The Rule allows for the incorporation of the ECP into an already existing Chemical Hygiene Plan and can be found in Appendix H.

8.2 ECP ELEMENTS

The ECP must describe efforts that will be taken to protect potentially exposed persons through the use of the hierarchy of controls. The hierarchy of controls specifies that “owners and operators” should first attempt elimination, substitution, then engineering controls, administrative controls, and work practices to manage DCM exposure to the extent feasible prior to requiring the use of PPE as a means of controlling exposure. The following elements are required in the ECP:

- Identification of “potentially exposed persons”
- Identification of possible exposure control measures and rationale for those implemented
- Documentation for reasons that certain controls were not selected
- A description of steps taken to implement controls selected such as proper installation and inspections
- Description of DCM-designated regulated areas
- Description of activities conducted to review and update ECP
- An explanation of procedures in place to respond to changes that may introduce new exposures

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 in writing, electronically or in Oracle Learn for all lab occupants. 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, storing, or waste
    d. Designated work areas for using
    e. Specific emergency response procedures
3. Special hazards in the laboratory
    a. Procedures for working with or around special hazards
    b. Specific emergency response procedures
4. Personal protective equipment (PPE)
    a. Types available (Eye/Face Protection, Lab Coats, Gloves, etc.)
    b. Proper use of PPE
    c. Storing, caring, and disposing of PPE
5. Laboratory and building alarms
    a. Identification of various alarms
    b. Response to various alarms
6. Emergency contact information
    a. Lab contacts
    b. Occupational Health or Student Health
    c. Vanderbilt University Public Safety
    d. EHSS
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
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: _____ Time: _____

Rooms included: _____

Name (please print)	Signature

APPENDIX B

Laboratory Safety Audit Checklist

Vanderbilt University
Chemical and Physical Safety
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:** _____

	Chemical Safety	YES NO N/A
1	Is the chemical fume hood certification current?	
2	Is the chemical fume hood functioning and used properly?	
3	Is the chemical hygiene plan present and current?	
4	Is the chemical inventory accurate and current?	
5	Are the chemicals adequately labeled?	
6	Is chemical safety training current?	
7	Is the chemical spill kit available and stocked?	
8	Is the flammable storage adequate for present quantities?	
9	Are incompatible chemicals physically separated in storage areas?	
10	Are all stored compressed gas cylinders capped properly?	
11	Are all compressed gas cylinders secured properly?	
12	Is contaminated waste in proper receptacles?	
13	Are all peroxide forming chemicals disposed of within the appropriate time frame?	
14	Are the gas alarms functioning?	
15	Are corrosive chemicals stored properly (corrosive cabinet or secondary containment)?	
16	Are laboratory refrigerators utilized properly for storage of materials in the laboratory? (i.e. rated for storage of flammable materials, no food or drink, etc.)	
17	Is mercury use minimized in the lab to the extent possible?	
18	Does the lab have procedures for working with Particularly Hazardous Substance (carcinogens, mutagens, highly acute toxins, peroxide forming chemicals)?	
19	Are SDSs for the lab's hazardous substances accessible?	
	General	**YES NO N/A**
20	Are the aisle, egress, fire alarm pull stations, fire extinguishers, and sprinklers unobstructed?	
21	Is the lab free of electrical hazards?	
22	Is all equipment plugged in safely and are wires/plugs in good condition?	
23	Is the emergency evacuation plan available and current?	
24	Is the lab free of obvious ergonomic issues?	
25	Is the lab free of evidence of food consumption, tobacco use, or the application of cosmetics?	
26	Are the eye wash and safety shower in compliance?	

27	Is the laboratory facility in good working order?	
28	Are fire extinguishers unobstructed, tagged with a current inspection tag, properly pinned, and fully charged?	
29	Is the First Aid kit available and stocked appropriately?	
30	Is the laboratory housekeeping satisfactory?	
31	Is initial hazardous material shipping training current?	
32	Are all items stored at least 18 inches from the ceiling or sprinkler head?	
33	Are lab hazard door placards/signs posted and do they contain accurate information?	
34	Are No Food/Drink signs conspicuously posted?	
35	Are sound laboratory oversight and management practices implemented?	
36	Are appropriate gloves available and worn?	
37	Is proper PPE (safety glasses/googles, gloves, lab coats, etc.) used with chemicals?	
38	Are safety guards in place on machinery?	
39	Is the lab free of trip hazards?	
40	Are proper safety controls in place while using cryogens?	
	Hazardous Waste	**YES NO N/A**
41	Are all chemical waste satellite locations under lab control?	
42	Are all waste streams known and being collected properly?	
43	Are all waste containers properly sealed?	
44	Are all waste containers in good condition and free of leaks or residue?	
45	Are all waste containers properly labeled with chemical waste tags?	
46	Are all chemical waste containers labeled with hazard characteristics such as flammable, corrosive, etc.?	
47	Is hazardous waste training current?	
48	Are all liquid wastes stored in adequate secondary containment?	
49	Is there a designated area to store chemical waste?	
50	Are all waste containers properly segregated by compatibility?	
51	Is the waste storage area at or near the point of generation?	

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

Item #	Picture	Comments

APPENDIX C

Newly Synthesized Chemicals Guide

Newly Synthesized Chemical Hazard Information for Your Laboratory

HAZARD COMMUNICATION FOR NEWLY SYNTHESIZED CHEMICALS

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

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

PIs/LIs/Directors/Supervisors are also responsible for ensuring that newly synthesized chemicals used within their laboratories are properly labeled with the name and hazard characteristic 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)].

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 it with each shipment's documentation. The Domestic Shipment Form for VU can be found here.

Procedures:

1. For all domestic shipments of chemicals or samples within the US Customs Territory, complete TSCA Domestic Shipment Form 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 Guide

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

INTRODUCTION

Before using 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. PHSs should be identified, evaluated, and managed in accordance with this guidance document to ensure that adequate protection from hazards for laboratory occupants 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)as part of the VU EHS Assist software 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 lab occupants are 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.
- Provide documented training covering Chemical Safety Protocols for appropriate lab occupants.

APPENDIX E

Compressed Gases Guide

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. Place a work order through VU READY portal at https://ready.app.vanderbilt.edu/ 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 PI/LI/Director/Supervisor 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.
- Lab occupants 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.

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), submit a waste collection request through the VU EHS Assist software at www.vanderbilt.edu/facilities/ehs/ehsa/.

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 Safety team in EHSS at chemicalsafety@vanderbilt.edu to review plans for using highly toxic gases to ensure adequate safety measures are in place.

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 Guide

Managing Chemical Retention and Storage in your Laboratory

INTRODUCTION

Prudent chemical retention and storage practices are vital to maintain a safe lab 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 powerful explosives and are sensitive to heat, friction, impact, and light, as well as to strong oxidizing and reducing agents. Please refer to the EHS website for more information on peroxide forming chemicals.
- Properly dispose of any unlabeled chemicals or gas cylinders or those 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 EHSS through the EHS Assist software at www.vanderbilt.edu/facilities/ehs/ehsa/ .
- Keep a current inventory of all chemical compounds and compressed gas cylinders in the laboratory. Vanderbilt University uses EHS Assist for assistance with maintaining chemical inventories which can be found at www.vanderbilt.edu/facilities/ehs/ehsa/ . Contact ehsa@vanderbilt.edu for more information.

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 which would result from dropping from heights but within secondary containment to prevent contact with water in the event of a flood in the lab.

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 EHS website at www.vanderbilt.edu/facilities/ehs/chemical-safety/

STORAGE OF HAZARDOUS CHEMICAL WASTE

- Storage of hazardous waste in the laboratory: Each lab should have a designated location in which to store hazardous chemicals 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 EHSS staff.
- Refer to the Guide for Managing Laboratory Chemical Waste available on the EHS website at www.vanderbilt.edu/facilities/ehs/chemical-safety/ .

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. EHS Assist and EPA's CAMEO app 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 any of these 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/table salt, 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 VU EHS.**

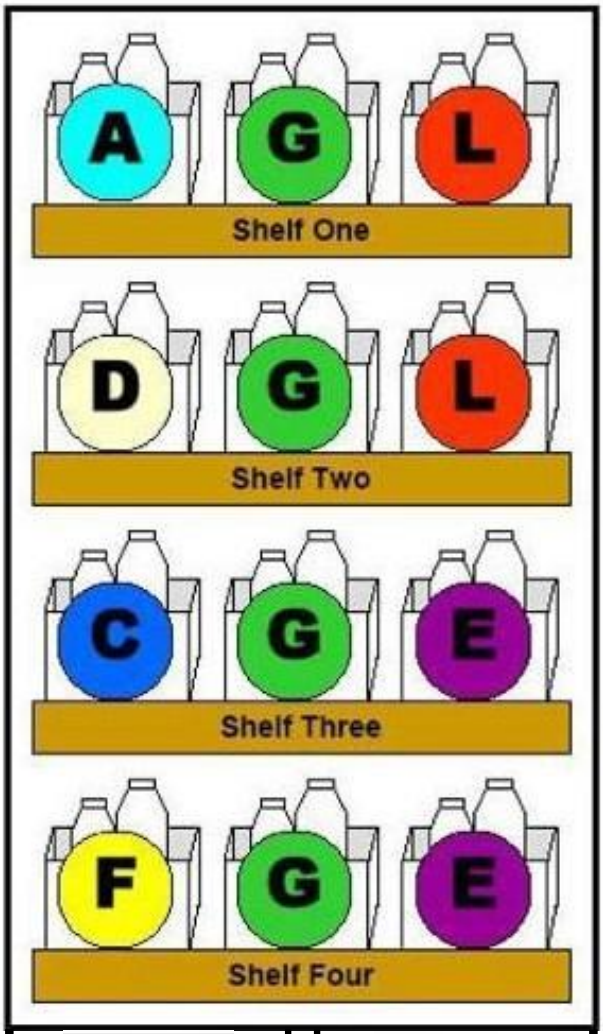
STORAGE GROUPS

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

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 VU EHSS



Incompatible with other chemicals

Separate from other chemicals.

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 their assignments. 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 individuals. 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 D of the CHP- **Particularly Hazardous Substances (PHS)**

- 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 space where relatively small quantities of hazardous chemicals are used on a non-production basis.

Laboratory Fume 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 individuals do not work inside the enclosure during the release of airborne hazardous chemicals.

Laboratory occupant, or lab occupant, means any Vanderbilt faculty, staff, postdoc, or student or a non-VU person such as a visiting researcher, intern, or visitor using hazardous chemicals in the lab.

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 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 D** 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 a 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 D of the CHP- **Particularly Hazardous Substances (PHS)**

- 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 D of the CHP- **Particularly Hazardous Substances (PHS)**

- 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 D of the CHP- **Particularly Hazardous Substances (PHS)**

- 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.

APPENDIX H

Dichloromethane Exposure Control Plan

INTRODUCTION

Dichloromethane (DCM), also known as methylene chloride, is a volatile organic compound commonly used as a solvent in various laboratory and industrial applications. Due to its potential health hazards, including respiratory irritations and carcinogenic properties, the Environmental Protection Agency (EPA) issued a new regulation on May 8, 2024 focused on DCM with the goal to minimize exposure and ensure the safety of those individuals using DCM.

Vanderbilt University is committed to providing a safe and healthy work environment for the Vanderbilt research community. Thus, the following exposure control plan (ECP) is designed to eliminate or minimize exposure to dichloromethane This ECP includes:

- Exposure assessment method used to identify "potentially exposed persons" (PEPs) and assess their exposure
- Implementation of exposure control methods including:
    - Elimination of DCM use
    - Substitution with less hazardous alternatives
    - Engineering controls
    - Administrative controls
    - Personal protective equipment (PPE)
- Communication of hazards and training for PEPs
- Recordkeeping

PURPOSE, SCOPE AND APPLICABILITY

The purpose of this ECP is to document the actions taken to mitigate exposure to DCM. This includes controlling DCM exposure to a concentration that is below the levels defined in the Federal Register rule including the EPA Existing Chemical Exposure Limit (ECEL) of 2 parts per million (ppm) as an eight-hour time-weighted average (8-hr TWA) and below the EPA Short Term Exposure Limit (EPA STEL) of 16 ppm averaged over 15 minutes.

This ECP covers all areas where DCM is handled and is applicable to all PEPs which could include faculty, students, staff, and visitors. This ECP was approved by Vanderbilt's Chemical Safety Committee on January 28, 2025.

PROGRAM ADMINISTRATION AND RESPONSIBLE PARTIES

- The Chemical Hygiene Officer (CHO) will author, maintain, review, and update the ECP at least annually and whenever necessary to address changes such as new or modified tasks and procedures. Additionally, the CHO or their designee will be responsible for making the written ECP available to PEPs and inspecting regulatory agencies.

- The Chemical Safety Committee (CSC) will be responsible for reviewing and approving the initial ECP and any subsequent updates.

- The Principal Investigator (PI) for research labs, Lab Instructor (LI) for teaching labs, or Director and/or Lab Supervisor for Cores and other areas is responsible for the health and safety of lab occupants and complying with the CHP in their area. The PI/LI/Director/Supervisor must ensure that all necessary personal protective equipment (PPE), engineering controls such as chemical fume hoods, and chemical waste labels are provided and maintained. Additionally, the PI/LI/Director/Supervisor will ensure that all PEPs under their supervision are properly trained on the ECP and how to safely use DCM.

- Individuals who are determined to have potential exposure to DCM (i.e., potentially exposed persons or PEPs) must comply with the procedures and work practices outlined in this ECP.

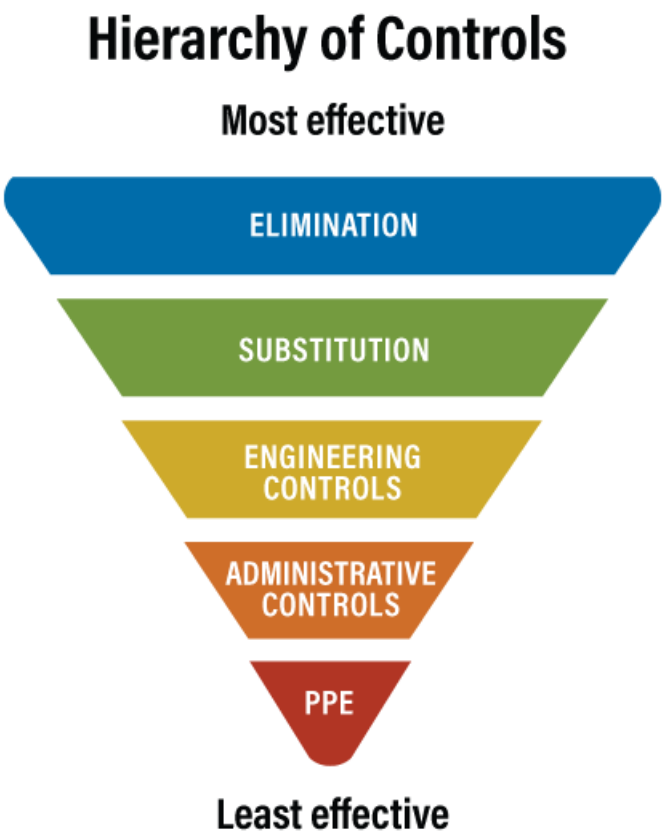
EXPOSURE ASSESSMENT METHOD TO IDENTIFY "POTENTIALLY EXPOSED PERSONS" (PEPs)

Areas using DCM were initially identified through their chemical inventories and chemical waste collections. Surveys were then distributed to the PI/LI/Director/Supervisors of those areas to determine if they could dispose of their DCM and if not, to further quantify DCM usage and frequency by the individuals in their areas.

Through a thorough review of the survey information and targeted consultations, an exposure assessment was developed for all PEPs. This exposure assessment method identified PEPs and associated reasonable exposure control methods. The exposure assessment was used to establish similar exposure groups (SEGs) which included PEPs being exposed to DCM by similar methods, volumes, and frequencies. The established SEGs were fume hood use only, bench top use, transfer of DCM, consolidation (waste bulking operations), and spill response. Based on these SEGS, representative personal air sampling was conducted throughout April 2025.

EXPOSURE CONTROL METHODS

The hierarchy of controls has been utilized to identify possible control methods to reduce DCM exposure to any PEP to less than the EPA ECEL and STEL. The hierarchy of controls is outlined below:



Elimination: PI/LI/Directors/Supervisors and PEPs will eliminate DCM use whenever and wherever it is feasible to do so.

Substitution: PI/LI/Directors/Supervisors and PEPs will substitute the use of less hazardous alternatives to DCM whenever feasible to do so. PI/LI/Directors/Supervisors and PEPs will periodically (e.g., annually) evaluate opportunities to substitute less hazardous alternatives.

Engineering Controls: Identified DCM work areas (e.g., laboratory waste handling locations) should be equipped with properly functioning engineering controls such as local exhaust ventilation or chemical fume hoods to control exposures to DCM.

As all personal air samples were below the regulatory exposure limit of 2 ppm the primary exposure control method is to use DCM in chemical fume hoods. Where bench top work takes place, adequate ventilation should

be provided to effectively exhaust the DCM vapors away from the user. DCM handling activities performed in other locations such as hazardous waste accumulation areas where bulking operations are performed will utilize local exhaust ventilation (e.g., slotted fume hood). Dilution ventilation and laboratory snorkels do not adequately control DCM exposures below the ECEL and EPA STEL so should not be used.

To ensure that engineering controls adequately control DCM exposures, the following will occur:

- Upon installation or following significant repair or renovation, laboratory fume hoods will be commissioned in accordance with the test methods prescribed by ANSI/ASHRAE Standard 110: Methods of Testing Performance of Laboratory Fume Hoods.
- Test records will be maintained by Vanderbilt's Planning, Design and Construction department that manages new installations and significant renovations.
- Other local exhaust ventilation (e.g., slotted hoods) will be commissioned in a manner that confirms performance with manufacturer specifications.

Laboratory chemical fume hood performance will be evaluated during routine lab inspections performed by VU Environmental Health, Safety, and Sustainability (EHSS) in accordance with the guidelines outlined in the Chemical Hygiene Plan. Other local exhaust ventilation will be routinely evaluated as well. PEPs should be trained how to properly use chemical fume hoods and local exhaust ventilation to minimize DCM exposures. Proper use of laboratory chemical fume hoods includes:

- Maintaining the fume hood sash below the indicated height of operation and as low as practical.
- Working at least 6 inches from the front of the hood.
- Positioning equipment within the hood in a manner that will not prevent the ventilation in the hood from adequately capturing contaminants.
- Understanding how to respond during a fume hood alarm by immediately securing materials and stopping work within the hood until the issue has been corrected.
- Understanding how to notify the appropriate Facilities department (VUMO or VUMC Facilities Management) for fume hood repairs or to address issues with proper functioning and to then contact VU EHSS to verify proper operation of the fume hood once repaired.

Administrative Controls: PEPs are required to be trained in appropriate work practices and use of equipment, including PPE and respiratory protection if needed, to ensure the safe handling of DCM.
PEP rotation is not allowed to be used to maintain exposures below the ECEL and STEL.

Personal Protective Equipment (PPE)
PEPs are required to use PPE such as safety glasses and/or eye goggles, protective gloves and lab coats to provide protection from dermal contact. Polyvinyl alcohol, laminate, or Viton gloves are the only gloves that should be worn when handling DCM. Lab coats should always be worn when handling DCM in a laboratory setting.
PPE must be provided to all PEPs at no cost to them and stored in a prominent location in the lab. Training should be provided by the PI/LI/Director/Supervisor, or designee, in the use of the appropriate PPE for the tasks or procedures the PEPs will perform.
All PEPs using PPE must observe the following precautions:

- Wash hands immediately or as soon as feasible after removal of gloves or other PPE.
- Remove PPE after it becomes contaminated, and before leaving the work area.
- Used PPE should be disposed of in a lab waste container dedicated to contaminated PPE.
- Wear appropriate gloves when handling or touching contaminated items or surfaces; replace gloves if torn, punctured, contaminated, or if their ability to function as a barrier is compromised. Reusable chemical protective gloves may be decontaminated for reuse if their integrity is not compromised; discard reusable chemical protective gloves if they show signs of cracking, peeling, tearing, puncturing, or deterioration.
- Never wash or decontaminate disposable gloves for reuse.
- Wear appropriate face and eye protection when splashes, sprays, spatters, or droplets of hazardous chemicals pose a hazard to the eye, nose, or mouth.
- Remove immediately or as soon as feasible any garment contaminated by hazardous chemicals in

such a way as to avoid contact with the outer surface.

Respiratory Protection

Respiratory protection will be used in designated areas. Supplied air respiratory protection should be used in designated areas where PEPs may be exposed to DCM concentrations that exceed the ECEL or EPA STEL. Respiratory protection must be used in accordance with the university's Respiratory Protection Plan. Note: air purifying respirators are prohibited by the EPA rule.

Designated DCM Areas

Designated areas for DCM use will be demarcated with signs that state, "Notice: Designated Use Area for Dichloromethane/Methylene Chloride. Authorized personnel only. Respiratory protection and protective clothing required when dichloromethane is in use."
Access to designated DCM areas should be restricted only to PEPs who have been properly trained.
NOTE: Personal air sampling conducted by Vanderbilt identified no lab areas with exposures above the regulatory limit meaning there are no Designated DCM Areas on campus.

Training

PEPs covered by the DCM rule will receive initial training on the requirements of the DCM rule, elements of this ECP, and the control methods applicable to their specific situation such as glove and lab coat selection, use, maintenance, and replacement if dermal exposures are expected to occur. The initial training can be found here or can be found on Oracle by searching for the course Working with Dichloromethane (DMC)/Methylene Chloride (MC).
Should respiratory protection be necessary, training will also be provided in accordance with the OSHA Respiratory Protection standard (OSHA 1910.134).

The training will be a combination of general information provided by EHSS and process and lab-specific training provided by the PI/LI/director/supervisor. Training completion records should be kept for at least **three years.** Lab and procedure-specific training records must be maintained by the PI/LI/director/supervisor. Training records should include:

- the dates of the training sessions
- the contents or a summary of the training sessions
- the names and qualifications of persons conducting the training
- the names and VUNetID if available of all persons attending the training sessions

General DCM training records are available for each PEP within their online Oracle and EHSA training record. Lab and procedure-specific training records should be requested by the PEP of the PI/LI/director/supervisor and should be provided within 15 days of the request.

Housekeeping

Accumulated DCM waste should be placed in containers which are closable, compatible with its contents, constructed to contain all contents and prevent leakage, appropriately labeled (see Labels), and closed prior to removal to prevent spillage or protrusion of contents during handling. Bins and pails should be cleaned and decontaminated as soon as feasible after visible contamination.

Contaminated broken glassware should be picked up using mechanical means, such as a brush and dustpan, and placed in a contaminated broken glassware box which all labs should keep on hand. Sharps contaminated with DCM should be disposed of in a chemical sharps container which is typically black and available through the VU chemical storeroom.
Articles of clothing contaminated with DCM such as lab coats should not be laundered and should instead be disposed of in the lab's chemical waste container.

NON-APPLICABLE EXPOSURE CONTROLS

The only exposure control method not implemented is respiratory protection as it was not required based on the results of the personal air monitoring. All results were below the regulatory exposure limit of 2 ppm.

ECP UPDATES

Vanderbilt has a robust laboratory chemical safety inspection program to monitor the effectiveness of DCM exposure controls. Additionally, EHSS staff interact frequently with PEPs and other lab occupants to gauge the use and effectiveness of DCM control methods.

PI/LI/Directors/Supervisors should notify EHSS of any new sources of exposure so exposures can be assessed and control methods implemented. The ECP will be continuously improved over time through information obtained through the university's laboratory chemical safety inspection program. Updates to the ECP will be reviewed and approved by the Chemical Safety Committee (CSC) as needed but no less than the 5-year requirement outlined in the EPA rule. This ECP will always be publicly available on the VU EHS website at www.vanderbilt.edu/facilities/ehs/ as part of the University's Chemical Hygiene Plan.