



CHEMICAL HYGIENE PLAN

1.0 INTRODUCTION

2.0 THE LABORATORY STANDARD

3.0 SCOPE AND APPLICATION

4.0 ROLES AND RESPONSIBILITIES

- 4.1 PRINCIPAL INVESTIGATOR (PI) / LAB INSTRUCTOR (LI)**
- 4.2 LABORATORY WORKERS / STUDENTS**
- 4.3 DEPARTMENTAL SAFETY COMMITTEE**
- 4.4 OFFICE OF CLINICAL AND RESEARCH SAFETY (OCRS)**

5.0 CHEMICAL HYGIENE MANAGEMENT SYSTEM

- 5.1 LABORATORY-SPECIFIC CHEMICAL HYGIENE PLAN**
- 5.2 CHEMICAL SAFETY PROTOCOLS**
- 5.3 TRAINING**
- 5.4 LABORATORY SAFETY AUDITS**
- 5.5 CHEMICAL HYGIENE PLAN REVIEW**

6.0 CHEMICAL HAZARD INFORMATION

- 6.1 CHEMICAL HAZARD INFORMATION**
- 6.2 PARTICULARLY HAZARDOUS SUBSTANCES**
- 6.3 COMPRESSED GASES**
- 6.4 EXPOSURE MONITORING**
- 6.5 MEDICAL CONSULTATION AND EXAMINATIONS**
- 6.6 EMERGENCY RESPONSE PROCEDURES**
- 6.7 CHEMICAL WASTE DISPOSAL**

7.0 CHEMICAL SAFETY MANAGEMENT AND CONTROL

- 7.1 CHEMICAL STORAGE IN LABORATORIES**
- 7.2 GENERAL LABORATORY VENTILATION**
- 7.3 CHEMICAL FUME HOODS**
- 7.4 GLOVE BOXES AND OTHER LOCAL EXHAUST VENTILATION**
- 7.5 EMERGENCY RESPONSE EQUIPMENT**
- 7.6 LABORATORY ATTIRE**
- 7.7 PERSONAL PROTECTIVE EQUIPMENT**
- 7.8 PERSONAL HYGIENE**
- 7.9 HOUSEKEEPING**
- 7.10 WORKING IN THE LABORATORY**
- 7.11 LABORATORY SECURITY**
- 7.12 LABORATORY RECORDKEEPING**
- 7.13 WORK REQUIRING PRIOR APPROVAL**

8.0 DEFINITIONS

1.0 INTRODUCTION

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

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

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

2.0 THE LABORATORY STANDARD

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

3.0 SCOPE AND APPLICATION

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

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

Where the scope of chemical hazards is not adequately addressed by this document, laboratory specific safe work practices must be developed and implemented to ensure a safe laboratory. A format for development, documentation and implementation of laboratory specific safe work practices is located under Appendix A of the CHP – Chemical Safety Protocols

<https://www.vumc.org/safety/chem/chp>

4.0 ROLES AND RESPONSIBILITIES

4.1 PRINCIPAL INVESTIGATOR (PI) / LAB INSTRUCTOR (LI)

The Principal Investigator (PI) or Lab Instructor (LI) is responsible for complying with the CHP in his or her laboratory. The PI or LI may delegate these responsibilities to a laboratory worker [for example, Chemical Hygiene Officer (CHO)] who is suitably experienced and trained. These responsibilities may not be shifted to inexperienced or untrained personnel.

The PI / LI must assure that:

- A written lab specific CHP is drafted for the laboratory, maintained in the laboratory, reviewed annually, and revised whenever new hazardous chemicals or processes are introduced.
- Research protocols and special projects involving particularly hazardous substances (PHS) are reviewed and that Standard Operating Procedures /Chemical Safety Protocols (CSPs) are established for PHS items
- Laboratory facilities maintain appropriate hazard signage
- Appropriate laboratory attire is worn.
- Visitors and other non-laboratory workers comply with all laboratory safety procedures.
- Appropriate personal protective equipment is provided.
- Appropriate training has been provided per the Laboratory Standard.
- Safety Data Sheets (SDS) are available either in electronic form or hard copy form for hazardous chemicals
- Chemical inventories are established and updated.
- Chemicals are stored and maintained safely.
- Laboratory facilities are secure from unauthorized access.
- Actions are initiated to remediate any problems related to health and safety in the laboratory including non-compliance of state and federal regulations.
- Non-compliance issues, unsafe conditions and inadequate facilities are reported to their Department Chair or to OCSR.
- Appropriate health and safety audits are conducted with follow-up of findings in a timely manner

4.2 LABORATORY WORKERS / STUDENTS

Individual Laboratory Workers are responsible for:

- 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 (CSPs).
- Knowing how to access chemical safety information such as Safety Data Sheets (SDS).
- Reporting accidents, unsafe acts or conditions to their PI / LI.

4.3 DEPARTMENTAL SAFETY COMMITTEE

Each Department determines the need for the establishment of a Departmental Safety Committee to develop the elements of the Chemical Hygiene Plan. Membership in the Departmental Safety Committee may include select faculty and administration, graduate students, and representatives from the Office of Clinical and Research Safety (OCRS).

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

The Departmental Safety Committee (or PI / LI) is responsible for

- Development and approval of departmental specific safety protocols
- Administering laboratory safety training
- Establishing a system for auditing laboratories for safety issues
- Ensuring that all safety deficiencies are corrected in a timely manner
- Developing and maintaining this Chemical Hygiene Plan

4.4 Office of Clinical and Research Safety

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

- Assisting the PI / LI / or Departmental Safety Committee with Environmental, Health and Safety policy development.
- 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 health and safety concerns, and evaluating protective measures.
- Monitoring chemical exposure levels when necessary
- Establishing and updating laboratory signage.
- Assisting with the procurement of Safety Data Sheets (SDS).
- Maintaining a web-based source of information on laboratory safety <https://www.vumc.org/safety/>

- Assisting PI/LI with development of Chemical Safety Protocols (CSP) and Personal Protective Equipment (PPE) recommendations.
- Assisting the PI/LI in maintaining inventories of laboratory chemicals.
- Assisting with chemical storage and compatibility issues in the laboratory.
- Assisting with waste management of laboratory chemicals.
- Producing and posting hazard identification signs.
- Initial laboratory safety training for the PI/LI and all laboratory workers in VUMC laboratories
- Facilitating and participating in Departmental laboratory safety training as needed
- Evaluating chemical fume hood flow and performance.

5.0 CHEMICAL HYGIENE MANAGEMENT SYSTEM

5.1 LABORATORY-SPECIFIC CHEMICAL HYGIENE PLAN

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

- Chemical Safety Protocols (CSP) for all lab-specific processes involving particularly hazardous physical/chemical hazards or hazardous materials. (See Section 5.2)
- Laboratory-specific safety procedures, if applicable.
- Laboratory-specific emergency response procedures, if applicable.

5.2 CHEMICAL SAFETY PROTOCOLS

Chemical safety protocols (CSP) are written procedures used to identify the safety and health concerns and control measures for specific laboratory processes that involve chemical hazards. 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 Departmental Safety Committee or OCRS.

A copy of the CSP form and instructions for completing the form are included in Appendix A of the CHP <https://www.vumc.org/safety/chem/chp>

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.

5.3 TRAINING

All faculty, students, and lab workers that perform research involving chemicals or that supervise others that perform research work in chemical laboratories must undergo general lab safety training that includes the contents of this Chemical Hygiene Plan.

Additionally, faculty members must ensure that all workers performing research work under their supervision have received training on laboratory-specific procedures and safety rules including the Laboratory-Specific Safety Plan. 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 an employee's initial assignment to a work area where hazardous chemicals are present and prior to assignments involving new exposure situations. Training should be documented and maintained by the PI / LI.

On-the-job training should be provided as necessary prior to allowing a student or lab worker to begin a new process or use equipment for the first time. Faculty members and lab managers are encouraged to document this training with at least a sign-off sheet.

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

Also see Appendix B of the CHP for an Outline of Laboratory Safety Training required for laboratories <https://www.vumc.org/safety/chem/chp>

5.4 LABORATORY SAFETY AUDITS

The Departmental Safety Committee or PI / LI is responsible for development of a system for conducting safety inspections / audits of procedures and processes included in the Chemical Hygiene Plan. Inspections will be conducted as follows:

- Inspections will be conducted on a periodic basis (OCRS, departmental, or self-inspection) with annual inspections being the goal
- Results of inspections will be documented and made available to the PI /LI , Department Chair, and OCRS
- Corrective actions for inspection issues will be made in a timely fashion. Serious safety violations will be corrected immediately.
- Safety Hub will be used for inspection checklists, documenting inspection findings, and as a tracking system for corrective actions. For assistance with Safety Hub, contact OCRS <https://vanderbilt.bioraft.com/>

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

The audit checklist includes sections on

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

5.5 CHEMICAL HYGIENE PLAN REVIEW

The PI / LI 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 the Department.

6.0 CHEMICAL HAZARD INFORMATION

6.1 CHEMICAL HAZARD INFORMATION

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

- Safety Data Sheets (SDS) for all hazardous chemicals used or stored in the lab. These must be maintained in the lab either on paper in a binder or in electronic form on a disk or local hard drive.
- Proper labeling. Incoming chemicals must not have their labels removed or defaced. Chemical containers must be labeled with the common name

of the chemical. Abbreviations, formulas, and/or symbols should not be used as the sole means to identify a chemical.

- Inventories of hazardous chemicals used and stored in the lab. Inventories should include the chemical name, physical state, quantity, and general location. Contact OCRS for assistance with chemical inventories.
- Hazard information for chemicals synthesized in the lab. Synthesized chemicals must be addressed in accordance with this Chemical Hygiene Plan including the requirements for preparation of hazard information and labeling. For hazard determination, training requirements, and domestic shipping requirements for chemicals synthesized in the laboratory, see the fact sheet in Appendix F of the CHP - **Newly Synthesized Chemicals** (<https://www.vumc.org/safety/chem/chp>)

6.2 PARTICULARLY HAZARDOUS SUBSTANCES

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

6.3 COMPRESSED GASES

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

6.4 EXPOSURE MONITORING

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

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

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

Exposure monitoring records will be maintained by the PI / LI, Occupational Health, and/or OCRS as appropriate. Employees will be notified of the results of their exposure monitoring within 15 working days after receipt of the sampling results. Employees and their representatives can have access to results from their personal monitoring by contacting the PI / LI. Please contact OCRS (322-2057) to get further information regarding exposure monitoring.

6.5 MEDICAL CONSULTATION AND EXAMINATIONS

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

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

medical consultation. The medical consultation will be used to determine the need for a medical examination.

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

The PI / LI provides to the health care provider:

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

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

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

6.6 EMERGENCY RESPONSE PROCEDURES

Chemical Spills

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

- No faculty, staff, or student should ever attempt to clean up a chemical spill when the nature of the chemical is unknown. Whenever a spill is discovered where the chemical composition and airborne concentrations are unknown, clear the area and contact OCRS.
- Each laboratory using hazardous chemicals must maintain appropriate clean-up materials readily accessible to laboratory personnel. The kits

should be specific for the type of chemicals in use in the laboratory. Kits typically include absorbent pads, socks, and “Safety Sorbent” particulate material. Instructions for using the materials should be reviewed by laboratory staff. Labs should supplement these spill kits with other materials needed for response to specific chemicals that cannot be handled with these basic kits.

- Lab staff should only clean up small chemical spills of known origin that they are comfortable cleaning up and for which they have the proper spill clean-up materials and personal protective equipment. In general, spills of chemicals that are highly volatile, highly corrosive, or highly toxic by inhalation should not be cleaned up by laboratory personnel. Anytime workers experience dizziness or nausea during a chemical clean up, the laboratory should be evacuated and OCRS should be notified.
- Used spill clean-up materials must be disposed of as chemical waste through OCRS.

Chemical Exposures and Medical Emergencies

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

- For non-chemical medical emergencies or illnesses, seek prompt medical attention. Minor injuries requiring first aid treatment may be treated by in house personnel trained in first aid procedures. Bandage small cuts, burns, or abrasions with first aid kits.
- All chemical exposures (even minor ones) should be reported to the PI / LI and Chemical Hygiene Officer.

Fire and Fire Alarms

- Fires contained in small vessels can usually be suffocated by covering the vessel. Do not pick up the vessel. Remove nearby flammable materials to avoid spread of the fire.
- If the fire is burning over an area too large to suffocate the fire, all persons should evacuate except for those trained and qualified to fight the fire.
- Persons trained on using a fire extinguisher may attempt to fight small fires that they are confident they can extinguish.
- Fight fires from a position from which you can escape.
- To use a fire extinguisher, **P**ull the pin, **A**im at the base of the fire, **S**queeze the handle, and **S**weep back and forth. The acronym **PASS** can be used to help remember these actions.
- Always start from 8 to 10 feet away and move in closer to avoid spreading the fire from the force of the extinguisher spray.
- If a fire is not out by the time one extinguisher has been discharged, then evacuate.
- The fire extinguishers provided in the labs are appropriate for all fires except those involving metals such as sodium or magnesium. Class D fire extinguishers should be used for metal fires.
- In the event a fire cannot be extinguished, evacuate the building in accordance with the 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 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 Plant Operations (Vanderbilt University buildings) at 343-9675 or Facilities (VUMC buildings) at 343-4443.

Other Emergencies Requiring Building Evacuation

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

6.7 CHEMICAL WASTE DISPOSAL

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

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

General Waste Requirements

Training

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

Storage

- Every laboratory that generates chemical waste must have at least one area designated for chemical waste storage that is known by lab staff handling chemical waste.
- Store chemical waste in containers that are compatible with the chemicals and that are in good condition and free of leaks or chemical residue.
- Store all chemical waste containers that hold liquid chemical wastes in secondary containment so that spills cannot reach sink or floor drains or containers of incompatible chemicals. The secondary containment should be adequate to hold the entire contents of the largest container stored. Contact OCRS (322-2057) to obtain secondary containment equipment.
- Segregate chemical wastes by compatibility, and never store incompatible wastes in the same secondary containment.
- Store halogenated solvents in separate containers from non-halogenated solvents.

- Store chemical wastes in the same laboratory where they are generated such that the wastes do not have to be transported through offices, hallways, corridors or other public areas for storage.
- Never store more than 55 gallons of waste in one storage location.

Labeling

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

Closed Containers

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

Spills

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

Disposal

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

7.0 CHEMICAL SAFETY MANAGEMENT AND CONTROL

7.1 CHEMICAL STORAGE IN LABORATORIES

The quantities of hazardous chemicals stored in the laboratory should be kept to a minimum. Hazardous chemicals must be stored properly in the laboratories. Chemicals in storage areas should be segregated by hazard class to reduce the

potential for incompatible mixing as specified in Appendix E of the CHP – **Managing Retention and Storage of Chemicals in Your Laboratory.** <https://www.vumc.org/safety/chem/chp>

If special storage is required, contact OCRS for assistance.

7.2 GENERAL LABORATORY VENTILATION

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

Ventilation systems for laboratories are maintained by the Plant Operations HAR shop for campus laboratories and by Facilities HAR for VUMC laboratories. Report any ventilation problems to the Plant Operations HAR Shop at 343-9675 for campus buildings or to Facilities HAR at 343-4443 for VUMC buildings.

7.3 CHEMICAL FUME HOODS

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

All laboratory hoods are equipped with air flow indicators -- either a digital flow monitor that displays the face velocity in feet per minute (fpm) or an analog flow monitor that uses colored lights to indicate flow status -- and a low flow alarm. The hoods are designed to operate with a face velocity in the range of 80 fpm to 120 fpm, with 100 fpm being the average velocity. OCRS performs routine inspections of the fume hoods to ensure adequate face velocity and proper air flow patterns. OCRS will also inspect fume hoods upon request if it is suspected that a hood is not operating properly. Fume hoods for campus laboratories are maintained by Plant Operations HAR Shop (343-9675) and by Facilities HAR shop (343-4443) for VUMC laboratories.

7.4 GLOVE BOXES AND OTHER LOCAL EXHAUST VENTILATION

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

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

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

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

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

7.5 EMERGENCY RESPONSE EQUIPMENT

Emergency Showers and Eyewash Stations

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

Emergency showers are maintained by the Plant Operations Plumbing Shop or Plant Services in accordance with applicable standards. For maintenance issues, contact the Plumbing Shop (322-2622) for campus laboratories or Plant Services for VUMC laboratories (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 the Plant Operations Plumbing Shop (322-2622) or VUMC Facilities (343-4443) depending on the building owner.

Chemical Spill Response Kits

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

First Aid Kits

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

7.6 LABORATORY ATTIRE

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

Clothing and Hair

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

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

Footwear

High-heeled, open-heeled, and/or open-toed shoes, sandals, and shoes made of woven or porous material are not recommended while working in the laboratory,

particularly if working with hazardous material that may cause skin irritation, burns, allergic reactions, or has the ability to penetrate the skin.

7.7 PERSONAL PROTECTIVE EQUIPMENT

Eye and Face Protection

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

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

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

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

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

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

Laboratory Coats

Laboratory coats are recommended while working in the laboratory. Lab coats should be buttoned at all times. Lab coats should be removed immediately if they become contaminated and washed before reusing. Periodically launder 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 C of the CHP**). Never wear lab coats into areas where food is consumed, stored, or prepared.

Laboratory Aprons

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

Gloves

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

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

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

All safety gloves should be inspected prior to each use. Lab workers should look for holes, excessive wear, and tears prior to donning gloves. After each use of non-disposable gloves, the exterior of the gloves should be rinsed thoroughly before removing the gloves. If gloves are observed to be compromised or

damaged, they should be discarded. Non-disposable gloves should be discarded periodically. How often the gloves should be discarded will depend on the glove type, use in the laboratory, construction material, permeation times for chemicals handled, and inspection of the gloves.

Respirators

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

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

7.8 PERSONAL HYGIENE

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

- Do not prepare, store, or consume food or beverages in the laboratory.
- Do not smoke, consume or store tobacco products in the laboratory.
- Do not store or use food preparation and storage equipment (such as microwaves, refrigerators, and coffee makers) in the laboratory.
- Refrigerators used for chemical storage should be conspicuously labeled on the outside with the words, "Chemical Storage Only."
- Glassware or utensils used for laboratory operations should never be used to contain or prepare food or beverages.
- Wash hands and arms thoroughly before leaving the laboratory, even if gloves and a lab coat have been worn.
- Never wear or bring lab coats or aprons into areas where food is consumed, prepared, or stored.
- Never pipette by mouth. Always use a pipette aid or suction bulb.
- Confine long hair and loose clothing while working in the laboratory.
- Never wear gloves into non-laboratory areas including elevators.

7.9 HOUSEKEEPING

Good housekeeping is extremely important for laboratory safety:

- Keep aisle ways, exits, halls, stairways, and access to emergency equipment or controls free from clutter or obstructions. Lack of storage space is not an excuse for blocking aisle ways.
- 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.
- Clean up spills immediately in accordance with the chemical response procedures for the laboratory.
- Keep floors and walkways dry and free from slip/trip/fall hazards at all times.
- Place electric cords, tubing, cables, etc. above walk spaces and thresholds.
- Work areas should be inspected at the beginning and end of each day to ensure proper housekeeping.

7.10 WORKING IN THE LABORATORY

General recommendations for laboratory workers:

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

the door, and provide adequate containment for any potential spillage in the event of failure of the system.

- Any apparatus that may discharge or release hazardous vapors, gases, or dust (vacuum pumps, distillation columns, etc.) must be vented into an appropriate local exhaust device.

7.11 LABORATORY SECURITY

The following are recommendations for maintaining laboratory security:

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

7.12 LABORATORY RECORDKEEPING

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

- Copy of the Chemical Hygiene Plan.
- Laboratory-Specific Chemical Safety Protocols and other Standard Operating Procedures
- Training documentation for annual lab-specific safety training.
- Safety data sheets (SDSs) for all chemicals used or stored in the lab. These must be maintained in the lab or near where the chemicals are used either in paper form in a binder or in electronic form on a disk or local hard drive.
- A 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.

7.13 WORK REQUIRING PRIOR APPROVAL

Certain laboratory activities should be reviewed by PI / LI and/or OCRS prior to implementation in the lab. The PI/LI and/or OCRS will ensure that all appropriate safety measures have been taken and that the work is being conducted in

accordance with applicable regulations and policies. Work requiring prior approval by the PI /LI and/or OCRS includes the following:

- Work with Particularly Hazardous Substances (See Appendix C of the CHP)
- Work with hazardous biological materials, recombinant DNA, or human or primate biological materials (body fluids, tissues, cells, etc.). See the following link for more information: <https://www.vumc.org/safety/bio>
- Work with radioactive materials. See the following link for more information: <https://www.vumc.org/safety/rad>
- Work with lasers. See the following link for more information: <https://www.vumc.org/safety/rad>

8.0 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 70°F, or
- A liquid having a vapor pressure exceeding 40 psi at 100°F (37.8°C) determined by ASTM method D-323-72.

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

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

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

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

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

Gas Flammable means:

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

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

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

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

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

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

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

Laboratory means a facility where the “laboratory use” of hazardous chemicals occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis.

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

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

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

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

Organic peroxide means an organic compound which contains the bivalent -O-O- structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms have been replaced by an organic radical.

Oxidizer means a chemical other than a blasting agent or explosive that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

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

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

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

<https://www.vumc.org/safety/chem/chp>

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

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

- [GHS](#) Category 1A or 1B for reproductive toxicity.

Select carcinogen means any substance that are listed by OSHA ([GHS](#)), the International Agency for Research on Cancer (IARC), and the National Toxicology Program (NTP) as known or suspected human carcinogens: See

Appendix C of the CHP- **Particularly Hazardous Substances (PHS)**
<https://www.vumc.org/safety/chem/chp>

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

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

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