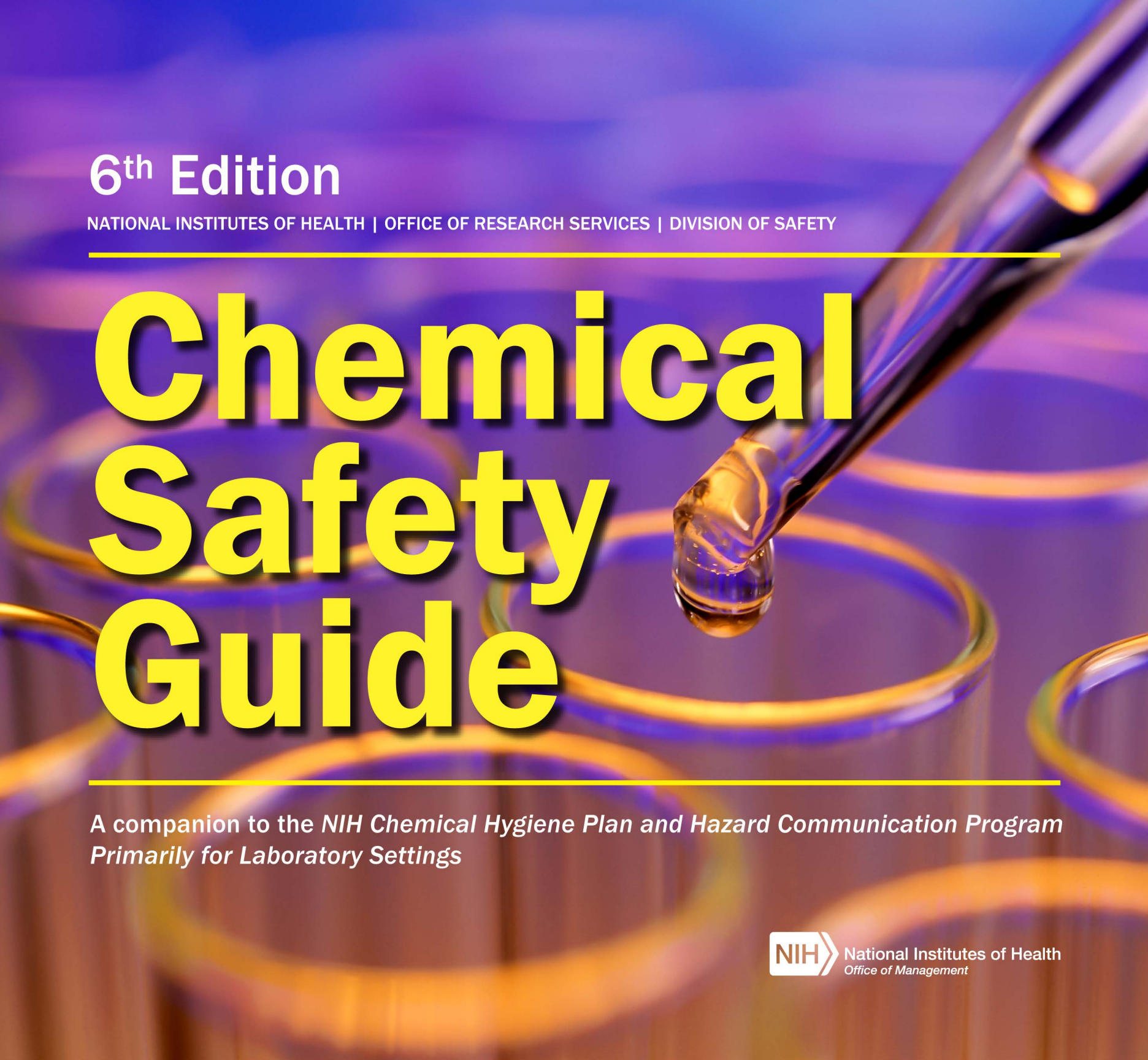




6th Edition

NATIONAL INSTITUTES OF HEALTH | OFFICE OF RESEARCH SERVICES | DIVISION OF SAFETY

Chemical Safety Guide

*A companion to the NIH Chemical Hygiene Plan and Hazard Communication Program
Primarily for Laboratory Settings*

Globally Harmonized System

The Globally Harmonized System of Classification and Labeling of Chemicals (GHS) provides an international standardized approach to the classification and labeling of chemicals. The Occupational Safety and Health Administration (OSHA) Hazard Communication Standard (HCS) aligns with the GHS to ensure consistency of information. The HCS requirements include:

Hazard Classification: Provides specific criteria for classification of health, physical and environmental hazards, as well as classification of mixtures.

Labels: Chemical manufacturers and importers are required to provide a label that includes a harmonized signal word, pictogram and hazard statement for each hazard class and category, along with precautionary statements.

Safety Data Sheets (SDS): Previously called, Material Safety Data Sheets (MSDS), have a specified 16-section format.

Signal Word: There are two signal words in the GHS system - Danger and Warning. These signal words are used to communicate the relative level of hazard on both the label and the SDS, with "Danger" indicating the more severe hazard. The appropriate signal word is determined by the hazard classification.

Information and Training: While the GHS does not address training, the HCS requires that all personnel working with chemicals be properly trained to recognize and understand chemical labels and safety data sheets. If you see old pictograms on chemicals, please relabel if they are within the expiration date or contact DEP for disposal at (301) 496-4710.

GHS Pictograms:

HEALTH HAZARD	FLAME	EXCLAMATION MARK
 • Carcinogen • Mutagenicity • Reproductive Toxicity • Respiratory Sensitizer • Target Organ Toxicity • Aspiration Toxicity	 • Flammables • Pyrophoric • Self-Heating • Emits Flammable Gas • Self-Reactive • Organic Peroxides	 • Irritant (skin and eye) • Skin Sensitizer • Acute Toxicity (harmful) • Narcotic Effects • Respiratory Tract Irritant • Hazardous to Ozone Layer (Non-Mandatory)
GAS CYLINDER	CORROSION	EXPLODING BOMB
 • Gas Under Pressure	 • Skin Corrosive/Burns • Eye Damage • Corrosive to Metals	 • Explosives • Self-Reactives • Organic Peroxides
FLAME OVER CIRCLE	ENVIRONMENTAL (NON-MANDATORY)	SKULL AND CROSSBONES
 • Oxidizers	 • Aquatic Toxicity	 • Acute Toxicity (fatal or toxic)



Labeling

In compliance with GHS, chemical manufacturers and importers are required to provide a label that includes six elements:

1. Product identifier
2. Signal word
3. Pictogram
4. Hazard statement
5. Precautionary statement
6. Product supplier

EPICHLOROHYDRIN ①
UN No. 2023
CAS No. 106-89-8

② **DANGER**

③

④
Flammable liquid and vapor. Toxic if swallowed. Toxic in contact with skin. Causes severe skin burns and eye damage. May cause an allergic skin reaction. May cause cancer.

⑤
Do not breathe dust/fume/gas/mist/vapor/spray. Wear protective gloves/protective clothing/eye protection

Fill Weight: 18.52 lbs. Lot number: A0323111323
Gross weight: 20 lbs. Fill Date: 1/15/2021

⑥
Jackson Chemical Company - City of Industry, Los Angeles, California, USA (323) 268-1815



Once in the lab, the user may not obscure or remove any of the label elements from the container. If the chemical is transferred into a different container, the name of the chemical and any associated hazards must also be placed on that container; The label must be legible, in English, and prominently displayed on the container.

This includes:

- All chemicals transferred from original container
- Any prepared solution

- Secondary containers within which a chemical is stored.
- Chemical waste (the word “waste” must also appear on the label)

NOTE Containers of newly synthesized chemicals have unknown hazards. Label these containers with hazard information as best determined. It is important to include the location (lab notebook, computer file) for finding specific information, such as:

- Chemical name, exactly as it appears on the outside of the container
- Molecular formula

Peroxide Formers

- Must be triple dated with a received date, opened date and expiration date, then tested as recommended for peroxides.

Secondary Container/ Solution Labeling

Secondary container labeling is required in the following instances:

- When the secondary/transfer container will be used for longer than one work shift
- When the person who transferred the chemical leaves the work area
- When the person who transferred the chemical takes it to an alternate location where they are no longer in direct possession of the chemical

This labeling requirement includes flasks, beakers, spray bottles and test tubes containing chemicals. If the chemical will not leave the supervision of the person who transferred it during one workday, full secondary container labeling is not required.

Full secondary container labeling includes the following requirements:

- Name of the chemical (legible in English)
- Hazard warning(s)
- Date of transfer to secondary container
- Preparer's name
- Expiration date (if applicable)

Recommend using labels available at NIH store. Please see [NIH Chemical Hygiene Plan \(CHP\)](#) for more information (Section V, page 10).

Safety Data Sheets

Safety Data Sheets (SDS) have replaced Material Safety Data Sheets (MSDS) under the Globally Harmonized System. They present details of the chemical hazards in a standardized format to improve clarity and comprehension.

The SDS is to include the following sixteen sections in this order:

1. Identification
2. Hazard identification
3. Composition/information on ingredients
4. First aid measures
5. Firefighting measures
6. Accidental release measures
7. Handling and storage
8. Exposure controls/personal protection
9. Physical and chemical properties
10. Stability and reactivity
11. Toxicological information
12. Ecological information
13. Disposal considerations
14. Transport information
15. Regulatory information
16. Other information



Hazard Assessment

Hazard assessment identifies the hazards of the chemicals and processes used in the laboratory. The assessment evaluates the potential for risk and the severity of the risk associated with the hazards. The assessment determines measures to eliminate, minimize, or control the hazards and potential risks.

What needs to be done?

To perform a chemical hazard assessment, laboratory workers should examine their plan for an experiment and identify all the chemicals that they are planning to use. The SDS for each chemical should be reviewed. SDS should be maintained by the laboratory in a central location, accessible either as a hard copy or electronically.

What does this entail?

A chemical hazard assessment entails gathering information about the health and physical hazards of the chemical and the proposed use of the chemical or reagent. This information should include:

1. SDS for the chemical or reagent
2. Description of work/activities/use
3. Storage requirements
4. Disposal and environmental requirements
5. Health surveillance
6. Emergency procedure
7. Proposed controls, to include:
 - Elimination
 - Substitution
 - Engineering controls
 - Administrative controls
 - Personal protective equipment (PPE)
8. A specific written chemical standard operating procedure (SOP) is required for Particularly Hazardous Substances (PHS). Reference PHS fact sheet ([DS Fact Sheet on Particularly Hazardous Substances \(PHS\)](#)).

Reference appendix B of the [Chemical Hygiene Plan](#) and the [DS SOP Control band template](#).

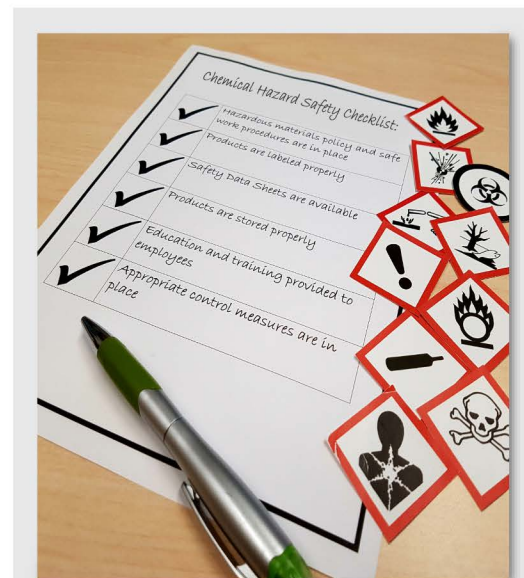
Who does the Assessment?

The principal investigator or supervisor with primary responsibility for the laboratory performs the chemical hazard assessment. He or she may consult with your [IC Safety and Health specialist](#).

NOTE The Chemical Hygiene Plan contains templates for performing chemical hazard assessments and generating Control band SOP. Refer to the [NIH Chemical Hygiene Plan \(CHP\)](#) for more information.

NIH National Institutes of Health • Office of Research Services • Division of Safety			
Control Banded Standard Operating Procedure (SOP) Templates for Particularly Hazardous Substances (PHS)			
Division of Safety (DS) has developed SOP templates for PHS using the concept of control banding. "Control Banding" assigns general protection strategies to chemicals with similar hazards that are grouped into "bands". Chemicals that cannot be grouped with other chemicals based on the hazardous characteristics will have chemical specific SOP's. Contact: DS (IC Safety Specialist) for assistance in identifying the right SOP template for your chemical.			
SOP templates for Particularly Hazardous Substances (PHS)			
Control bands/Pictograms	Hazards	Example	SOP#
	Carcinogen/ reproductive toxin	Boric acid, Cadmium, beryllium and its compounds, estrogen, nickel compounds, silica, tamoxifen, formamide, dexamethasone etc.	SOP-1
	Acutely toxic	Acetaldehyde, copper cyanide, epinephrine, phenyl thiourea, sodium fluoride	SOP-2
	Acutely toxic and carcinogen/reproductive toxin	Carbon tetrachloride, Dichloromethane, Chloroform, 1,1-Dichloroethane, Ethylene dichloride, Vinylidene chloride, cis and trans-1,2-Dichloroethene, 1,2-Dichloropropane, Methyl chloroform, 1,1,2-Trichloroethane, chromium, arsenic, sodium azide, sodium cyanide, diazomethane, nickel carbonyl, chloroaniline, vanadium oxide, thallium salts, ethidium bromide, amino pyridine etc.	SOP-3
	Acutely toxic and carcinogen/reproductive toxin	chromium, arsenic, sodium azide, sodium cyanide, diazomethane, nickel carbonyl, chloroaniline, vanadium oxide, thallium salts, ethidium bromide, amino pyridine etc.	SOP-4
	Acutely toxic and Corrosive	Bromine, ammonia, acrolein etc. HF requires chemical specific SOP	SOP-5
	Carcinogen/reproductive toxin and flammable	Carbon disulfide, dimethylformamide (DMF), Diethylene glycol dimethyl ether (diglyme), heptane, hexane, toluene, xylene etc.	SOP-6
	Acutely toxic and flammable	Allyl alcohol, bromoacetone etc.,	SOP-7
	Acutely toxic and oxidizer	Nitrogen oxides, chlorine trifluoride, chlorine dioxide, sodium nitrite etc.	SOP-8
	Acutely toxic, corrosive and carcinogen/reproductive toxins	chromic acid, phenol, arsenic oxide, cobalt chloride, imidazole etc.	SOP-9
	Acutely toxic, carcinogen/reproductive toxin and flammable	Cyclohexane, benzene, dioxin, thiophenol, benzenethiol, ethoxyethanol (Ethylene glycol ethyl ether) etc.	SOP-10
	Acutely toxic, carcinogen/reproductive toxin and flammable	Cyclohexane, benzene, dioxin, thiophenol, benzenethiol, ethoxyethanol (Ethylene glycol ethyl ether) etc.	SOP-10
	Corrosive and flammable PHS	Hydrazine, cyclohexylamine, formaldehyde, acrolein, sodium borohydride, isopropyl amine etc.	SOP-11

Above: Control Banded SOP Document providing PHS examples and templates

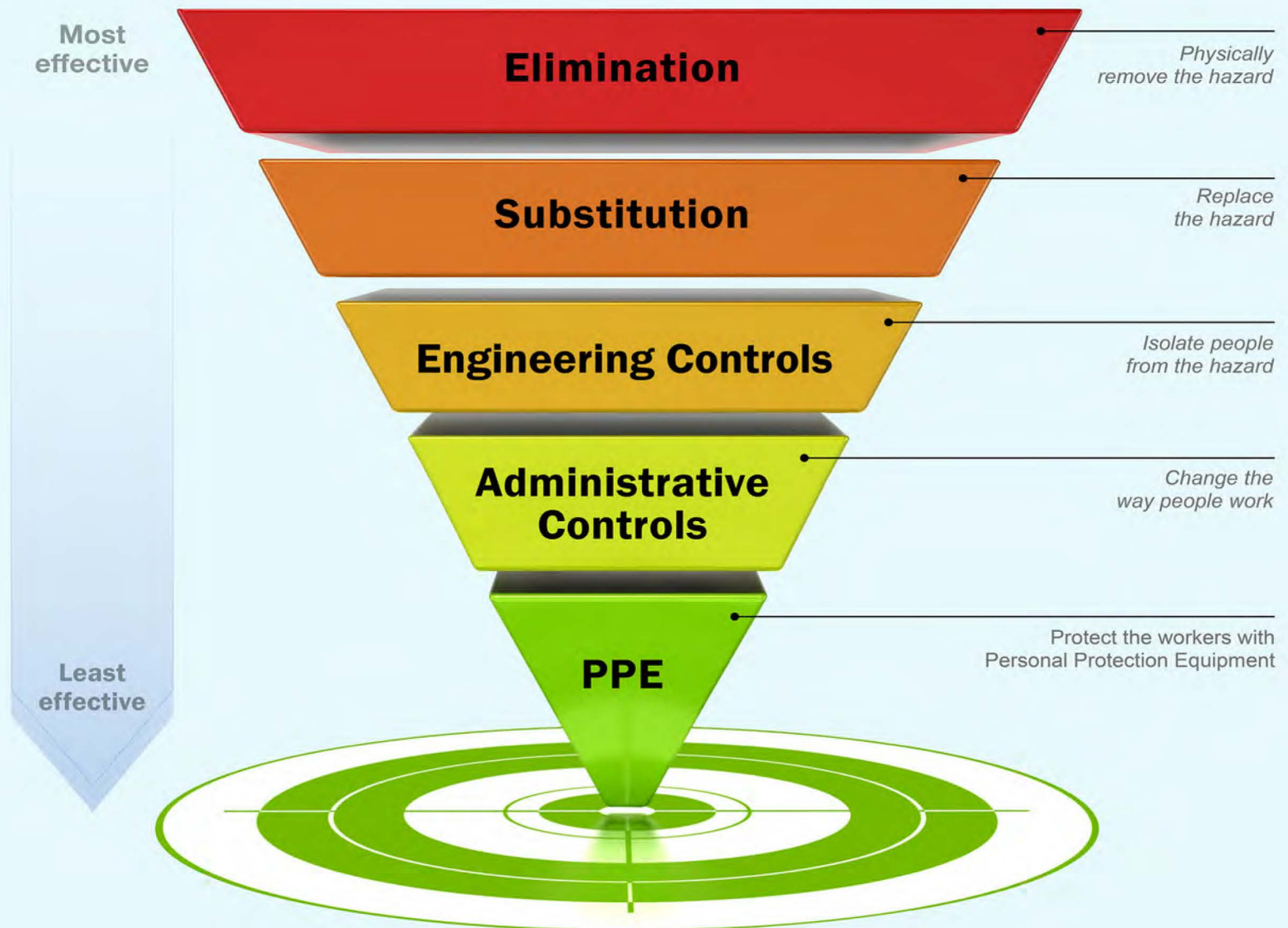


A chemical hazard assessment entails gathering information about the health and physical hazards of the chemical and proposed use of a chemical or reagent

Control banded Standard Operating Procedure (SOP) Templates for Particularly Hazardous Substances (PHS)

DS has developed SOP templates for PHS using the concept of [control banding](#). "Control Banding" assigns generic protection strategies to chemicals with similar hazards that are grouped into "bands". Chemicals that cannot be grouped with other chemicals based on the hazardous characteristics will have chemical specific SOP. Control banded SOP templates can be used for PHS in your lab and additional Lab-Specific SOP templates (Appendix I of the Chemical Hygiene Plan (CHP)) can be used for non-PHS. Contact your Safety Specialists for assistance in identifying the right SOP template for your chemical.

Hierarchy of Safety Controls



Control of Exposure

The best way to control or minimize exposures is to eliminate the hazard.

If a hazard cannot be eliminated, other hazard control methods must be used. Personal protective equipment (PPE) is the least effective method and should never be the only method used. PPE must be used in conjunction with more effective controls.



Engineering Control: Chemical Fume Hood



Administrative Control: Standard Operating Procedures, policies and guidance



Personal Protective Equipment: Gloves and goggles

For information about engineering controls refer to Section 5 – Ventilation

For information about Personal Protective Equipment (PPE) refer to Section 6 – Personal Protective Equipment (PPE)

NOTE Prevention is the most effective means of hazard control. Prepare your work area before beginning any work!

Administrative controls:

- Ensure personnel are adequately trained on the hazards and associated processes.
- Never pipette by mouth.
- Transport laboratory chemicals using bottle carriers, secondary containment, and/or suitable carts.
- Follow the established procedures for the decontamination and movement of scientific and medical equipment found in the NIH Personal Property Management Guide.
- In the event of a hazardous chemical spill, immediately follow the hazardous material spill procedure (see next page).
- Store all food, beverages, cosmetics, and medications outside the lab.
- Keep all doors to the laboratory closed to ensure proper fume hood performance and directional airflow into the lab.
- Ensure unimpeded access to safety showers, eyewash stations and exit pathways.
- Test and flush eyewash stations weekly and document using the [Weekly Eyewash Equipment Inspection Sheet](#). Call ORF at (301) 435-8000 to have failed equipment

fixed promptly. Make sure all personnel know where the eye wash and safety shower are located and how to use them properly.

- Call Office of Research Facilities (ORF) (301) 435-8000 to have the safety showers tested annually. Submit a ticket at <https://58000.nih.gov/>.
- Enter an online clearance request through [myCority](#) for the lab with the Division of Safety (DS) when non-laboratory personnel must enter the laboratory to perform services such as renovations or equipment repair. Routine services such as floor trash collection and floor cleaning do not require clearance. Refer to [Laboratory Clearance](#) for guidance.
- Keep emergency phone numbers and emergency response plans readily available.

Personal Protective Equipment:

PPE is the least effective control method because it relies on users identifying the right PPE and using it correctly and should never be used without other controls.

- Protect your clothes and exposed skin by wearing appropriate personal protective equipment. Consult the PPE section for detailed information.
- Do not wear PPE outside the laboratory.
- Upon completion of work remove PPE carefully and thoroughly wash hands and forearms before leaving the laboratory. Dispose of all disposable PPE properly.
- Wear appropriate eye protection while working in the lab.

NOTE Contact lenses may be worn, with some exceptions, but these do not function as protective devices. The NIOSH Current Intelligence Bulletin prohibits wearing of contact lenses when working with certain chemicals.

Spill Prevention:

Most spills are preventable. The following are some tips that could help to prevent or minimize the magnitude of a spill:

- Substitute with a less hazardous chemical whenever possible.
- Think through each step of your experiment carefully.
- Order/use the smallest quantity of chemicals possible.
- Use bottle carriers to transport chemicals.
- Order chemicals in poly-coated glass safety bottles. The protective coating on these bottles can provide containment if the bottle breaks.
- Use secondary containment for all hazardous chemicals.
- Do not store bottles near the edges of shelves and bench tops.

Each department must have appropriate spill control and response items available. Refer to Appendix H of the [NIH Chemical Hygiene Plan \(CHP\)](#) for more details.

High-Level Hazard Spill:

High-level hazard spill is defined as one that is requiring outside assistance like a Fire Department. If ANY of the following criteria are met, an emergency response must be initiated:

- Spill of any PHS, pyrophoric or water reactive material.
- Any spill requiring outside assistance based on the risk assessment (generally spills >500ml outside containment or >1L inside containment).

[Risk assessment matrix image](#). Refer requiring outside assistance like Fire Department to [spill in the lab](#) for more details.

If you witness or are involved in a high-level hazard spill situation:

1. Leave the area, closing doors behind you.
2. Prevent others from entering the area.
3. If anybody is exposed initiate first aid at the work site:
 - Eyes: Flush with eyewash for 15 minutes
 - Skin: Use closest emergency shower for 15 minutes. Remove contaminated clothing while under the shower.

4. Contact the Fire Department:

Bethesda main campus: Dial 911 from an office phone or (301) 496-9911 from a cell phone; Off-campus: Dial 9-911 from an office phone or 911 from a cell phone. For satellite locations, follow satellite-specific guidance which supersedes the main campus guidance at these [locations](#).

RML: Contact the Security Control Center (SCC). Dial 0 from an office phone or (406) 363-9400 from a cell phone.

IRF-Frederick: Call on-site OMS Clinic or follow emergency response plan.

Baltimore: Refer to the Baltimore chemical spill SOP for guidance.

5. Notify your supervisor as soon as possible.

6. Report to OMS

Bethesda main campus: Report (Monday-Friday, 7:30 AM to 5:00 PM) to the Occupational Medical Service (OMS), Building 10, Room 6C306 or call (301) 496-4411 as soon as possible. If life threatening, call the Fire Department of your local NIH campus immediately.

RML: Report (Monday-Friday, 8:00 AM to 4:30 PM) to RML OMS, Building 5, Room 204 or call (406) 375-9600 as soon as possible. If life threatening, call 0 from an office phone or 911.

IRF-Frederick: Report (Monday-Friday, 7:30 AM to 5:00 PM) to IRF OMS, Room 1B116 or call (301) 631-7233 as soon as possible. If life-threatening, call 911.

Baltimore: Report (Monday-Thursday, 8:30 AM to 4:30 PM; Friday, 7:30 AM to 3:30 PM) to Baltimore OMS: BRC, Room 18210 or call (443) 740-2309 as soon as possible. If Baltimore OMS is unavailable during normal working hours, contact Bethesda OMS at (301) 496-4411.

For all campuses, if OMS is closed, call the Clinical Center Operator at (301) 496-1211 and ask them to page an OMS physician immediately. For alternative satellite locations report to your onsite OMS Clinic (if applicable) or follow your satellite emergency response plan.

7. Do not re-enter the room until the Fire Department or appropriate authorities determine that the area is safe.

NOTE Breakthrough time for nitrile gloves may be quite short for some chemicals; use thick nitrile gloves or multi-hazard gloves such as Silver Shield® when working with those chemicals. Always check the manufacturer's guide for compatibility.

NOTE ALWAYS report to OMS in the event of chemical exposure, no matter how minor.



Low-Level Hazard Spills:

Low-level hazard spill -

- Spill that can be cleaned up by the lab based on the risk assessment (Generally spills <500ml outside containment or <1L inside containment of a known non PHS or water reactive/pyrophoric material).

DO NOT attempt to clean up a spill unless you have the training and resources to clean the spill with no risk to yourself or others. Attempt ONLY if it is a low-level hazard spill after the risk assessment and you are comfortable addressing and you have appropriate supplies on hand, including:

- Personal protective equipment: safety goggles, chemical resistant gloves, lab coats, face shields.
- Spill kit with absorbent material compatible with the chemical spilled to contain the spill.
- Disposal container (or bag) to collect the absorbent material and any item contaminated with the chemical including the disposable PPE used for cleanup. Dispose as chemical waste.

RML: Contact the Security Control Center (SCC). Dial 0 from an office phone or (406) 363-9400 from a cell phone.

Baltimore: Refer to the Baltimore Chemical Spill SOP.

Other satellite locations: Follow satellite-specific guidance, if applicable.

For more information consult the [Spill in Laboratory](#) and the [NIH Chemical Hygiene Plan \(CHP\)](#).



Chemical Storage

Proper chemical storage can be a challenge in the limited space of laboratories. The hazards associated with chemical storage can be reduced through prudent purchasing, handling and disposal practices.

Consideration for proper storage:

Ensure all hazardous chemicals are properly labeled. GHS compliant secondary containment labels are available through the NIH Supply Center that can be filled out with all necessary information.

Record the date of receipt on each bottle to assist with inventory management.

Record the date of receipt, opening and expiration on each peroxide former and dispose prior to the expiration date or test if applicable. Refer to Appendix D, table 2 in the [Chemical Hygiene Plan \(CHP\)](#), and Fact Sheet on [Managing Peroxide Formers in the Lab](#) for more information.

Upon preparation, label and date solutions with the chemical or mixture name, as well as any applicable hazard warnings. See additional information in Hazard Identification/Labeling section.

Store incompatible chemicals separately by hazard class. Within a hazard class, chemicals may be stored alphabetically. Refer to [Chemical Segregation and Storage Table](#) and [chemical segregation and storage fact sheet](#).

Storage limit outside the flammable cabinet-

Limit flammables and combustibles outside of flammable cabinets to what is actively in use (maximum 10 gallons any given time). Anything that is not in active use must be stored in an approved flammable cabinet. The total amount described above should include flammable waste stored in that area. Refer to [chemical storage and segregation fact sheet](#) and [NIH CHP Appendix D](#) for additional information.

Always store hazardous chemicals at or below eye level and never on top of storage units. Do not overcrowd shelves.

Do not store chemicals on the floor.

Liquids should be stored on shelves with a lipped edge and in spill trays to hold the contents if the container breaks or leaks.

Store acids in a dedicated corrosive storage cabinet. [Separate inorganic and organic acids using secondary containment](#).

Store bases in a corrosives cabinet.

Store highly toxic materials in a closed, dedicated poison cabinet.

Do not use chemical fume hoods to store containers, chemicals, and equipment, as this prevents proper air flow, reduces available work space, and may increase hazards in case of fire or spill.

✓TIP Elevate the equipment and supplies using a small shelf while working inside a fume hood to avoid blocking the rear baffle and disrupting the proper air flow.

Freezers and refrigerators used for flammable chemical storage must be rated appropriately for hazardous material storage (explosion proof, flame resistant).

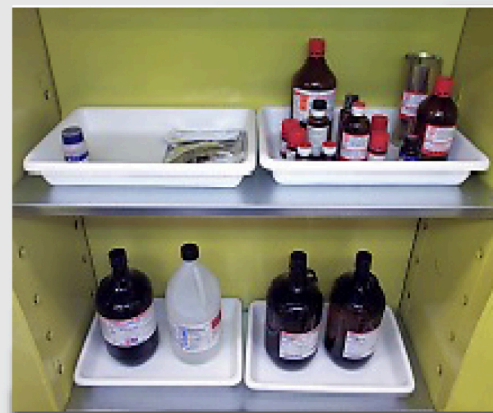
NEVER store hazardous chemicals in a cold room or other storage area with recirculating ventilation.



Store acid in a ventilated corrosive cabinet



Store bases in a corrosive cabinet



Store chemicals on spill trays to contain leaks or drips

Please consult Appendix D in the [NIH Chemical Hygiene Plan \(CHP\)](#).

Chemical Storage (continued)

- Do not store hazardous chemicals under a sink.
- Store chemicals away from heat and direct sunlight.
- Rotate chemical inventory. Dispose of chemicals by their expiration date.
- Inspect chemical containers regularly for deterioration and integrity.
- Store chemicals under appropriate conditions. Refer to the SDS for guidance.

Consideration For Ordering:

- Purchase less hazardous alternatives whenever possible.
- Keep a chemical inventory to avoid duplicate purchases. Maintain a chemical inventory in the lab. DS recommends using LabArchives for chemical inventory. Refer to [How to use Lab Archives for Chemical Inventory](#) for details.
- Purchase chemicals in reasonable quantities that will be used within six months of purchase.



NOTE If an old or expired container of a peroxide-forming or chemical reactive is found, do not move it. On **Bethesda main campus** contact the Division of Environmental Protection (DEP) at (301) 496-4710 for assistance in disposing of the container.

RML: Contact the Industrial Hygienist (IH) at (406) 802-6398.

IRF-Frederick: Contact DEP at (240) 236-9575.

Baltimore: Contact DEP at (301) 346-6287 or pittj@mail.nih.gov.

Chemical Transport

Moving chemicals within your laboratory:

- Assess chemicals prior to moving to ensure that they are in good condition, properly sealed and labels are well attached. Refer to [Section VI of Chemical Hygiene Plan \(CHP\)](#).

- Inspect each container's cap or closure seals for the formation of crystals.
- Hazardous chemicals being transported outside the laboratory or between stockrooms and laboratories must be in break-resistant secondary containers, placed in a suitable outside container or bucket, or in carts specifically designed for safe transportation.
- Personal protective equipment (PPE) should not be worn when transporting chemicals between floors, or outside a building.
- Use freight elevators for the transport of hazardous materials. If you must use a passenger elevator, never ride with passengers.
- Place chemicals in sturdy secondary containers



Do not tighten, open or move containers that have crystals forming on the caps and seals or inside the bottle in case they are shock sensitive; on Bethesda main campus notify your IC safety specialist and supervisor immediately. Contact chemical waste services immediately for removal at (301) 496-4710. If believed to be an emergent situation (picric acid, diethyl ether, organic peroxides), express this when placing the call.

RML: Contact the IH at (406) 802-6398.

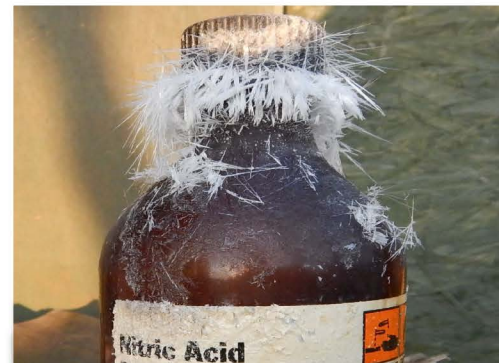
IRF-Frederick: Call DEP at (240) 236-9575.

Baltimore: Call DEP at (301) 346-6287.

For more detailed information consult the [Chemical Hygiene Plan \(CHP\)](#), Appendix D.



Proper use of chemical bottle carrier



Inspect bottle caps for crystals.

Moving chemicals outside of your lab:

Assess chemicals prior to moving to ensure they are in good condition. Chemical transportation services are available through the DEP. Please contact DEP (301) 496-7990 and your DS Safety Specialist for guidance when you are planning a laboratory move or before you move any chemicals.

RML: Chemical transportation services are available through the RML HAZMAT Team. If you are planning a laboratory move or before moving chemical stocks, please contact the HAZMAT Team Lead at (406) 363-9219 and the RML Industrial Hygienist (IH) at (406) 375-7467.

Baltimore: Contact DEP at (301) 346-6287 or pittj@mail.nih.gov and chemical technicians for your IC.

- **NIDA:** NIDASafety@mail.nih.gov.
- **NIA:** NIAIRPBaltimoreSafetyOffice@mail.nih.gov



Sturdy secondary containers on carts are used to transport chemicals safely



Chemical Waste Disposal

Waste disposal procedures are described in detail in the [NIH Waste Disposal Guide](#) and [Chemical waste disposal guidance tool](#). Below are general guidelines:

DON'T:

- Don't mix incompatible chemicals.
- Don't discard chemicals in sinks, medical pathological waste (MPW) boxes, or general trash.
- Don't treat chemical waste in any manner, including use of ethidium bromide filters.
- Don't dispose of volatile chemicals by evaporation.
- Don't put waste containers in hallways or other public locations.
- Don't move chemicals with precipitation on or in the bottle.

NOTE Picric acid is a commonly used reagent in biological laboratories which becomes a dangerous explosive if allowed to crystallize. If dry picric acid (or with crystals on the neck or solution) is discovered, DO NOT MOVE THE BOTTLE. Call DEP for removal. Picric Acid is a Particularly Hazardous Substance (PHS). Consult the CHP, Appendix B, for more detailed information.

***Certain items may require special handling based on the stability of the material.**
These items may include peroxide formers, explosives, water reactive chemicals, as well as shock, air and temperature sensitive items. CALL DEP FOR REMOVAL OF THESE ITEMS.

DO:

- Keep waste containers closed at all times.
- Store waste in the laboratory while awaiting pick up.
- Place liquid waste containers in secondary containers (pans).
- Have chemical waste picked up within 60 days of accumulation start date.
- Dispose of empty chemical bottles as chemical waste or recycling.
- Use only the safety cans provided by the chemical disposal service for disposing of flammables.
- Attach and complete a chemical waste tag to ALL chemical waste not in its original container.
- Contact DEP or your [IC Safety Specialist](#) if you are unsure how to dispose of a chemical.

Consider an annual chemical clean-up day to redistribute useful chemicals and dispose of old or unwanted chemicals. Redistribution is an idea to reduce waste and cut cost.

- Redistribute your excess useful chemicals by using the DEP program. Visit the [Surplus Chemical Redistribution Program](#).
- Segregate acids and bases, whether dry or liquid, when collecting chemicals for pickup or when cleaning up the laboratory.
- Flammables should be stored in their own box for chemical waste pick up (separate from acids and bases). Exceptions exist for methanol/acetic acid/water solution and triethylamine (please call DEP for guidance).
- Leave original labels on bottles whenever possible.
- If the researcher cannot identify a chemical, please keep the unknown chemical(s) separated from other chemicals.

- Affix a Chemical Waste tag to each box, identifying contents.
- Call DEP for pick-up:

Bethesda main campus: (301) 496-4710

RML (HAZMAT team): (406) 363 -9219

IRF-Frederick: (240) 236-9575

Baltimore: (301) 346-6287

Please refer to the [NIH Waste Disposal Guide](#) for details as shock, air and temperature-sensitive items. Call DEP for removal of these specific items or visit <https://orf.od.nih.gov/EnvironmentalProtection/WasteDisposal/Documents/NIH-Waste-Disposal-Guide-2022-508Ready.pdf>.



Chemical Waste Tag and examples of correct disposal techniques

Highly Reactive Chemicals

Highly reactive chemicals include those which are inherently unstable and susceptible to rapid decomposition. Also included in this category are those chemicals which can react alone or with other substances in a violent uncontrolled manner, liberating heat, toxic gases, or leading to an explosion.

Air, light, heat, mechanical shock (when struck, vibrated or otherwise agitated), water and certain catalysts can cause decomposition of some highly reactive chemicals, and initiate an explosive reaction. Hydrogen and many other flammable compressed gases may react explosively in air.

Alkali metals, such as sodium, potassium and lithium react violently with water liberating hydrogen gas. Examples of shock sensitive materials include acetylides, azides, organic nitrates, nitro compounds and peroxides. When working with highly reactive chemicals, employees should conduct a Chemical Hazard Assessment.

Organic Peroxides are extremely sensitive to light, heat, shock, and sparks as well as to strong oxidizing and reducing materials. All organic peroxides are highly flammable. Peroxides may deteriorate quickly. Always dispose of peroxides by following the NIH CHP guidelines.

Peroxide Formers

- Can form peroxides spontaneously during storage and especially after exposure to light and the air. This is particularly dangerous if:
 - > It explodes during a distillation, where applied heat to the concentrated peroxides may trigger a violent explosion.
 - > It can evaporate during storage, leaving the crystals of highly explosive peroxide at the bottom of the container.

Peroxide forming chemicals must be labeled with the date of receipt from the manufacturer and the “opened” date.



Peroxide forming chemicals must be labeled with the date of receipt from the manufacturer, "opened" date, and “expiration” dates. [Peroxide Labels Avery 5196312](#) and [Peroxide Labels Avery Business Card-5132024](#)

NOTE Avoid the distillation, concentration, or evaporation of peroxide formers without first testing to ensure the peroxides are within the acceptable levels. Refer to [CHP Table 2](#) and [Fact Sheet on Managing Peroxide Formers in the Lab](#). Peroxide detection test strips are available from most lab equipment suppliers.

Chemicals that are sensitive to peroxide formation can be broken into three categories shown in the following table

NOTE For more information consult the [NIH Chemical Hygiene Plan \(CHP\)](#) and [Fact Sheet on Managing Peroxide Formers in the Lab](#).

List of Common Peroxide Forming Compounds

Class A: These chemicals can form explosive levels of peroxides during storage without concentration. Test open bottles for peroxide formation before using or discard after 3 months. Dispose of after 12 months even if unopened.				
Isopropyl ether Butadiene	Chlorobutadiene (Chloroprene)	Potassium amide Potassium metal	Sodium amide Tetrafluoroethylene	Divinyl acetylene Vinylidene chloride
Class B: <u>Test every 6 months</u> for peroxide formation following the date of opening. These chemicals are a peroxide hazard during storage and on concentration (distillation/evaporation). Dispose of after 12 months unless testing indicates no peroxides present. Test for peroxides immediately before evaporation or distillation.				
Acetal Acetaldehyde Benzyl alcohol Benzaldehyde 2-butanol	Cumene Cyclohexanol 2-Cyclohexen-1-ol Cyclohexene Cyclopentene Diacetylene	Dicyclopentadiene Diethylene glycol- dimethyl ether Diethyl ether Dioxane	Furan Methyl acetylene Methyl cyclopentane Methyl-isobutyl ketone 2-pentanol 4-pentene-1-c	1-phenyl ethanol 2-propanol *(test prior to concentration or distillation only) Tetrahydrofuran Tetrahydronaphthalene Vinyl ethers
Class C: <u>Test every 6 months</u> following the date of opening. Unsaturated monomers may auto-polymerize because of peroxide accumulation. Open bottles without inhibitors must be discarded within 24 hours. Open bottles with inhibitors must be disposed of after 12 months unless testing indicates no peroxides present.				
Acrylic acid Butadiene	Chlorotrifluoroethylene	Ethyl acrylate	Methyl Methacrylate Styrene	Vinyl acetate Vinyl chloride Vinyl piridine

Safe Management of Particularly Hazardous Substances in NIH Laboratories

What are Particularly Hazardous Substances (PHS)?

PHS are chemicals that may pose extreme hazards to laboratory employees. As defined by the OSHA Laboratory Standard (29 CFR 1910.1450), PHS include substances with a high degree of acute toxicity, reproductive toxins, and select carcinogens (those strongly implicated as a potential cause of cancer in humans and/or those regulated by OSHA). OSHA and NIH require the development of protocols for the identification and management of PHS. Refer to [NIH Chemical Hygiene Plan \(CHP\)](#), [Section X-Appendix B](#) and [Fact Sheet on Particularly Hazardous Substances \(PHS\)](#) for details.



Who is responsible for identifying and mananging PHS in NIH labs?

The Principal Investigator (PI) has primary responsibility for determining which chemicals must be handled as PHS. Each PI is also responsible for ensuring that employees follow



appropriate protective measures and receive training when working with any PHS. The DS Chemical Hygiene Officer (CHO) and safety

specialist for your institute (301-496-2960) are available to assist upon request.

RML: Contact the RML IH (406) 802-6398).

IRF-Frederick: Contact IRF-DS at (301) 631-7244.

My laboratory uses numerous hazardous chemicals. How do I determine which ones must be classified as PHS?

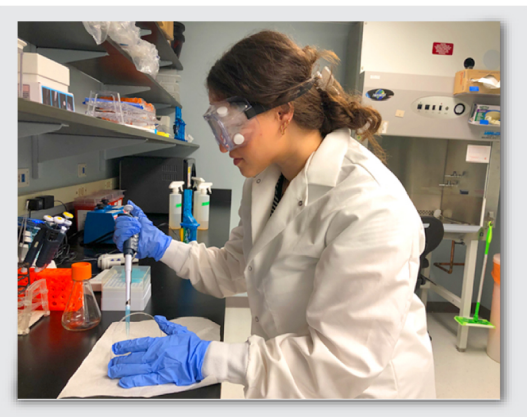
Determine classification by reviewing the SDS. PHS is a select carcinogen, reproductive toxin, and/or a substance that has a high degree of acute toxicity. Chemicals that may be considered PHS if the chemical label has one or both of the health hazard pictogram and skull/crossbones pictogram. If so, there is a possibility that the chemical can be a PHS. Confirmation can be made by reviewing the SDS Section 2 for carcinogens reproductive toxins and Section 11 for acute toxins. The table below has detailed definitions and reference links.

Category	Definition and Resources
Select Carcinogens 	- Any substance that meets one of the following criteria: - Regulated by OSHA as a carcinogen: https://www.cdc.gov/niosh/npg/nengapdx.html - Listed under the category "Known to be carcinogens" in the 15th Report on Carcinogens - Agents Classified by the IARC Monographs, Volumes 1–137 - American Cancer Society (ACS) has compiled the above-mentioned lists into one: Known and Probable Human Carcinogens. - Safety Data Sheet (SDS) Section 2 for specific hazards Reproductive Toxin
Reproductive Toxins 	- Agents that can have adverse effects on various aspects of reproduction: fetal development (teratogens), chromosomal damage (mutagens), fertility, gestation, lactation, and sterility - Reproductive toxins can affect both men and women. - Safety Data Sheet (SDS) Section 2 for specific hazards
Acute Toxin 	- OSHA doesn't provide any clear guidance on this category. Chemicals with high acute toxicity are those having oral, inhalation, or dermal LD50 and LC50 values below the threshold values: - Oral LD50 (rats): < 50 mg/k - Dermal LD50 (rabbits): < 200 mg/kg - Inhalation LC50 (rats): < 200 ppm in air - Safety Data Sheet (SDS) Section 11 for Toxicological Information (LD50 and LC50 values) and Section 2 for specific hazards. - Registry of Toxic Effects of Chemical Substances (RTECS) is also a good source of informatoin on acute toxins.

Then, if a substance meets **any of the above**

criteria, it is considered as PHS and an SOP and hazard analysis are required. Ask the following questions while conducting the hazard analysis:

- Is the chemical handled rarely, occasionally, or repeatedly?
- Is the procedure done on the open bench, in a laboratory hood, or in an enclosed apparatus?
- Is there a potential for the employee to be exposed to the chemical?
- Does the chemical's use pose a significant potential for exposure through any route (inhalation, skin, or ingestion)? For instance, is it highly volatile? Are dusts or aerosols formed? Is it heated or concentrated?
- Is this a reproductive hazard? Reproductive hazards are substances or agents that may affect the reproductive health of women or men or the ability to have healthy children. OMS may be consulted by all staff of reproductive capability (i.e., women, men, those who are pregnant, planning to become pregnant, or breastfeeding) when there is a concern for past exposure or potential future exposure to a reproductive hazard(s).
- Do any employees have known chemical sensitivities?
- Is there a potential for new or unknown substances to be created during the procedure?
- Are the signs and symptoms of exposure readily apparent?



Once I have identified all the PHS in my lab, what do I do next?

1. Determine whether or not the chemical can be replaced with a less hazardous chemical.
2. If it cannot be replaced, follow the steps below to conduct a hazard assessment and create a [PHS specific SOP](#). When PHS are used for the first time, perform a chemical hazard analysis using the [Laboratory Hazard Analysis template in Appendix I](#) of the Chemical Hygiene Plan. Assistance is available from the IC Safety Specialist and the DS Chemical Hygiene Officer (CHO). For detailed information, consult the NIH Chemical Hygiene Plan.
3. The SOP includes:
 - description of the PHS
 - a step-by-step review of the work involving the PHS
 - the engineering controls and PPE for the PHS
 - special handling procedures and storage requirements
 - spill and accident procedures exposure
 - waste collection and disposal
 - designated area and decontamination procedures.
4. Once the hazard analysis, SOP and OMS consultation (if applicable), have been completed, the laboratory can begin to work with the PHS safely.
5. The PI/supervisor can approve the use of the PHS only after employees have been trained according to the safety protocol per the PHS requirement. Document that all employees who work with any PHS have received proper training and a copy of the written safety protocol.



NOTE Commonly used PHS are chloroform, formaldehyde, sodium azide and ethylene oxide. PHS examples that have antidotes or prophylaxis are hydrogen fluoride, MPTP, phenol and hydrogen cyanide. Please refer to the [NIH Chemical Hygiene Plan, Appendix B](#) for further information.

NOTE Medical counseling through the Occupational Medical Service (OMS) is offered for employees working with hazardous chemicals. OMS provides additional services to employees working with potentially hazardous chemicals that monitor individuals for adverse health effects and determines treatment strategies that can help to prevent or significantly reduce adverse health effects if exposed. These include medical surveillance and post-exposure treatment and follow-up programs.

Where can I get more information?

For assistance with PHS or any other lab safety questions, contact the DS at (301) 496-2960.

RML: Contact the RML IH at (406) 802-2960.

IRF-Frederick: Contact IRF-DS at (301) 631-7244.

NIA Labs: Contact NIA Safety at NIAIRP
Baltimore SafetyOffice@mail.nih.gov.

NIDA Labs: Contact NIDA Safety at NIDASafety@mail.nih.gov.

See also:



NIH Chemical Hygiene Plan (CHP), <https://ors.od.nih.gov/sr/dohs/Documents/chemical-hygiene-plan.pdf>

National Research Council, *Prudent Practices in the Laboratory: Handling and management of Chemical Hazards*, National Academy Press <https://nap.nationalacademies.org/catalog/12654/prudent-practices-in-the-laboratory-handling-and-management-of-chemical>.



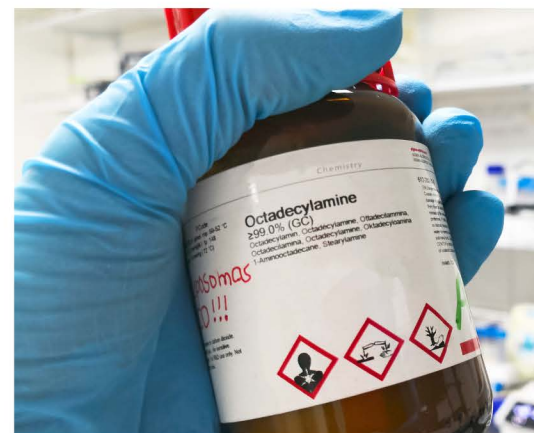
OSHA standard 29 CFR 1910.1450. Occupational exposure to hazardous chemicals in laboratories, <https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.1450>



Appendix B of the OSHA laboratory standard (1910.1450) contains a list of references, at <https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.1450AppB>.



OSHA Laboratory Safety Guidance booklet, OSHA 3404-11R, 2011, available at <https://www.osha.gov/sites/default/files/publications/OSHA3404laboratory-safety-guidance.pdf>



Safe Management of Particularly Hazardous Substances in NIH Laboratories

- For more information on and how to identify and manage PHS see Appendix B of the NIH CHP and Fact Sheet on Particularly Hazardous Substances-(PHS) [DS Fact Sheet on Particularly Hazardous Substances \(PHS\)](#). Once identified, follow the below steps for safe management.
- Identify all potential physical and health effects
- Perform a step-by-step review of the work
- Identify engineering controls, work practices and PPE to be used
- Establish a clearly marked, designated [area for the PHS](#).
- Identify decontamination procedures (see “Hazard Control” section for more detail)
- Write a PHS-specific SOP
- Ensure primary barriers (e.g., chemical fume hoods, downdraft tables, etc.) are functioning properly
- Ensure availability and use of appropriate PPE
- Train employees according to the safety protocol
- Document training

Pyrophoric and water reactive material

Pyrophoric and water reactive materials can ignite instantaneously/catch fire without an external ignition source when in contact with air/moisture. Extreme care must be taken while handling these chemicals to avoid fire/explosion and serious injuries. Refer to [Managing Pyrophoric and Water Reactive Chemicals in the Laboratory](#).



Toxic Chemical Reduction Initiative

NIH developed the Toxic Chemical Reduction Initiative in conjunction with the requirement for strict control of Particularly Hazardous Substances in response to the mandate of Executive Order 13514 and NIH's environmental goal to reduce toxic and hazardous chemical use. This initiative identified alternatives that are less toxic and more environmentally friendly than their more

hazardous counterpart. This venture was spearheaded by the Division of Environmental Protection through the NIH Environmental Management System (NEMS). About 200 toxic chemicals were scored numerically and ranked based on the following four criteria for reduction:

- Health and safety risk
- Quantity generated

- Mandated regulatory reduction
- Alternative availability and feasibility

(For more information about this initiative, visit the NIH Environmental Management System (NEMS) website at <https://nems.nih.gov/Pagesdefault.aspx>). For information regarding the NIH DEP chemical redistribution program visit [Surplus Chemical Redistribution](#).

Compressed Gas

Hazards associated with compressed gases include:

- Oxygen displacement
- Fires
- Explosions
- Toxic gas exposures
- Physical hazards associated with high pressure systems

Special storage and handling precautions are necessary to control these hazards. Oxygen monitoring may be required for some areas depending on the type and the amount of compressed gases and cryogens stored/used in that area. Refer to [Protocol for use and Maintenance of Oxygen Monitoring Devices](#)

Storage

Oxygen monitoring may be required for some areas depending on the type and the amount of compressed gases and cryogens stored/used in that area. Refer to Protocol for use and Maintenance of Oxygen Monitoring Devices [Oxygen Monitoring Devices](#).

Store cylinders in cool, well-ventilated, fire-resistant areas in compliance with local, state, and federal regulations.

Separate flammable gases from oxygen/oxidizer gases by a minimum distance of 20 feet.

Do not store full and empty cylinders together.

Keep empty compressed gas cylinders closed, capped, secured. Store full and empty separately.

Keep the number of cylinders in the laboratory to a minimum and ensure that the cylinder contents are properly and prominently labeled.

Empty cylinders should be stored so that they may be removed easily.

Handling

Be familiar with the hazards of the compressed gas (consult the SDS).

Transport using a suitable hand truck or cart equipped with a chain or belt for securing the cylinder to the cart, even short distances. Gas cylinders should never be rolled or dragged into place.

Cylinder caps should be secured on each cylinder unless in use and is fitted with a correct regulator. Cylinder caps protect the valve on top of the cylinder from damage. Never tamper with pressure relief devices in valves or cylinders.

Use a crescent wrench, not a pipe wrench (it roughens the edges of the nut), when manipulating the regulator.

Use compressed gases only in a well-ventilated area; never use or store them in a cold room. Cold rooms are built to be closed systems without ventilation and expose the user to risk of asphyxiation if compressed gases are used.

Toxic, flammable, and corrosive gases should be handled in a chemical fume hood. Develop SOPs and label the area with appropriate [signage](#). Monitoring may be required for some gases. Contact DS.

Where more than one type of gas is in use, label gas lines.

Inspect valves and tubing regularly for wear and tear, and for leaks using the soap bubble test.

Don't use oil or grease to seal the O-ring on the regulator. Refer to [Compressed Gas and Cryogen Safety Guideline Document](#) for more information.




National Institutes of Health • Office of Research Services • Division of Safety




Store > Separate > Secure > Inspect > Close


- [Store](#) cylinders in cool, well-ventilated, fire-resistant areas in compliance with local, state and federal regulations.
- [Separate](#) flammable gases from oxidizer gases.
- [Secure](#) cylinders vertically with restraints, maximum two in one strap/chain. Do not roll or drop cylinders.
- [Inspect](#) cylinders for leaks and check support restraints regularly.
- [Close](#) valves and tighten caps when not in use.

Questions/Comments? Contact the Division of Safety's Oxygen Monitoring Program Manager at (301) 3496-3353 or visit <https://go.usa.gov/xEGGg>.


In case of a leak, alert the NIH Fire Department by dialing 911. For all other locations call 911.

For more information, visit us at the DS Oxygen Monitoring Devices website at <https://ors.od.nih.gov/sr/dohs/safety/Pages/oxygen.aspx>. See [Compressed Gas and Cryogen Safety Guideline Document](#).

Cryogenic Liquids and Solids

Nitrogen and helium

Nitrogen and helium are the most commonly used cryogenic liquids. Liquid nitrogen (LN2) is commonly used for storing laboratory samples and/or components; liquid helium may be used for cooling superconducting magnets. Both are extremely cold (-195.8°C/-384.4°F for nitrogen and -268.9°C/-516°F for helium) while in a compressed, liquid state.

Contact with cryogen may cause serious freezing (frostbite) injury. Wear cryo-protective insulated gloves when working with cryogenic liquids. Cryogenic gloves used in research are not designed/rated to protect against immersion into cryogenic liquids or prolonged handling of cryogenically chilled materials. Seek training to safely work with cryogens and liquid nitrogen. Consult manufacturer's instructions before using. For more information about cryogen safety, including how to respond to a cryogen-related injury, please see the [DS Cryogen Fact Sheet](#).

When liquid nitrogen or helium are dispensed they release gases, which can displace oxygen in the air and create potentially hazardous environment. OSHA specifies that a hazardous atmosphere may include one where the oxygen concentration is below 19.5% or above 23.5%. Cryogenic liquids should never be used in spaces with poor or recirculating ventilation, such as cold rooms.

The following are some of the most common locations where cryogenic liquids are found, potentially creating an oxygen deficient atmosphere:

- Magnetic Resonance Imaging (MRI) rooms (or magnet rooms)
- Nuclear Magnetic Resonance (NMR) Spectroscopy rooms
- Liquid Nitrogen Tanks (freezer farms)
- Transmission Electron Microscope (TEM) rooms

Oxygen monitoring devices may be needed in these areas to continuously monitor oxygen levels where cryogenic liquids are stored. To

determine if an oxygen monitoring device is needed in your location refer to [Oxygen Monitoring Devices](#) or call the DS Oxygen Monitoring Program Manager for an assessment on the **Bethesda main campus** at (301) 496-2960. **RML:** Call the IH at (406) 363-9429. **IRF-Frederick:** Call the IH at IRF-DS staff for assistance.

These devices require preventive maintenance and calibration on an annual basis, or as specified by the manufacturer. There is also a DS protocol for using these devices.

For more information, visit [Oxygen Monitoring Devices](#).

Oxygen monitoring devices:

- are typically installed in locations where compressed gases or cryogenic liquids are stored and/or dispensed in a manner that would create the potential for displacement of oxygen
- may be required by the NIH Design Requirements Manual for Biomedical Laboratories and Animal Research Facilities
- alarm occupants of dangerously low oxygen levels
- must be serviced and maintained by the NIH Institute or Center, including calibration recommended by the manufacturer.

If the device alarms, evacuate the space and call 911 (off campus call 9-911) to have the Fire Department verify oxygen levels.

RML: Call the SEC at (406) 363-9400.

IRF-Frederick: Call any IRF-DS staff for assistance.

Baltimore: Call Facilities

- GSH (BRC): (443) 740-2766
- Camelot (Triad): (410) 558-9797.

Cryogenic solids

Dry ice is a cryogenic solid and should be treated in a manner different than regular ice. Dry ice is extremely cold, solid CO₂ and is a

simple asphyxiant. Safety measures for handling and transporting the material include:

- Wear protective clothing. Use appropriate insulated gloves (ex. Cryogloves) and proper clothing (long-sleeves, pants, closed-toe shoes, etc.) to ensure no skin is exposed.
- If possible, use tongs while wearing gloves instead of your properly gloved hands to pick up dry ice.
- Handle the dry ice in a well-ventilated room and NEVER use dry ice in a cold room.
- Do not place dry ice in an airtight container; the pressure caused by the dry ice sublimating may cause the container to explode or rupture.
- Do not dump dry ice down the drain as it may damage the sink or plumbing; allow it to sublimate at room temperature, ideally in a chemical fume hood (CFH) or local exhaust device or if unavailable, in a large well-ventilated space.



Nuclear Magnetic Resonance Spectrometer (NMR)



Chemical Fume Hoods and Other Local Exhaust Ventilation

The best way to prevent or reduce exposure to hazardous airborne chemicals is through the use of ventilation systems. Local exhaust airborne hazards at the source and directs contaminated air away from the work area.

All LEV must be certified by DS when installed and on an annual basis.

A chemical fume hood (CFH) is a ventilated enclosure in which gases, vapors and fumes are exhausted. A fan on the roof of the building pulls air and airborne contaminants through the hood and ductwork and exhausts them to the atmosphere.

✓ TIP Elevate equipment and supplies a few inches by using a stand to ensure baffles are not blocked and have proper airflow.

Routine cleaning/maintenance and annual inspection of your fume hood is very important to ensure performance. The green sticker on the CFH has information on certification status of your CFH. Schedule annual fume hood certifications using the following [Service Request](#) link.

The CFH sash provides protective shielding and maximizes hood performance by optimizing the velocity of the air through the front. Keep the sash at or below the appropriate level when working (as indicated by the green sticker) to ensure optimal face velocity. Improper positioning of the sash can result in loss of containment (i.e. if the sash is too high, air velocity will be insufficient, if the sash is too low, air velocity will be too high, resulting in turbulence which can force contaminants out of the hood). All work in a CFH should be conducted at least 6" inside (past) the sash. Close the sash when the CFH is not in use.

The baffles direct the air being exhausted, and it is important that the baffles are not closed or blocked since this block the exhaust air flow.

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

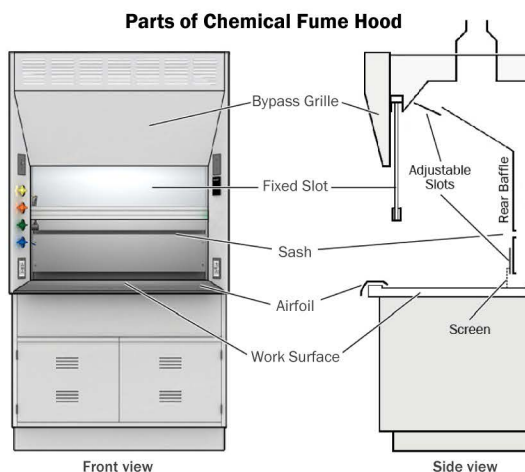
Class II Type B biosafety cabinets provide protection from biohazardous materials as well as small quantities of potentially hazardous vapor-producing chemicals. Air is pulled through the cabinet and a HEPA filter. If considering a Type B biosafety cabinet for your work, contact DS (301-496-2960) to discuss suitability. Do not use a ductless BSC for chemical work.

✓ TIP Use Biological Safety Cabinet (BSC) Surface Decontamination Guidance for proper procedures.

Downdraft Tables. Like chemical fume hoods, downdraft tables exhaust air to the outside atmosphere. Unlike chemical fume hoods, the blower is usually mounted below the work area so that air is pulled down through a perforated surface and then exhausted to the outside. Downdraft tables are used for applications involving heavier-than-air gases and materials such as anesthetic gases and histological chemicals.

Other Local Exhaust Ventilation, (e.g., slot hoods, snorkels and cage changing tables) must be certified when installed and on an annual basis.

NOTE Ductless CFHs are not permitted to be used in NIH laboratories. Captured organic vapors may desorb from the charcoal filters, resulting in capture failure.



Use a tissue to check for proper airflow.



Downdraft table



Class II Type B biosafety cabinet

Negative Airflow

In any laboratory where hazardous materials are handled, the air must flow from outside of the laboratory into the laboratory. It is critical to keep doors closed to maximize ventilation efficiency. The laboratory's negative airflow serves as a secondary barrier to chemical hazards by keeping hazardous airborne particles and noxious odors inside the laboratory.

Cold Rooms

Overview

Cold rooms have closed air-circulation systems and re-circulate any vapors from spills and leaks within the chamber.

The refrigeration coils in cold rooms are aluminum and are subject to damage from corrosive atmospheres.

Electrical equipment used in cold rooms:

- Should have Ground Fault Circuit Interrupter (GFCI) protection, as cold rooms are often damp.
- Should be plugged directly into an outlet. Do not use extension cords.
- Should be allowed to equilibrate prior to use after removal from a cold room, as condensation can occur.

Cold room chemical hazards

Compressed gas, dry ice, liquid nitrogen and liquid helium can pose an asphyxiation hazard by displacing oxygen and should never be used or stored in a cold room.

Flammable chemicals can release sufficient vapors to form explosive atmospheres. Cold rooms have fans and electrical equipment that are potential ignition sources. Flammable chemicals should be stored in flammable cabinets in laboratories, not in cold rooms.

Noxious fumes may be released by materials that have been heated on a hot plate. Only use stir plates (not hot plates) in the cold room

Recommendations for cold room work

- Ensure door release mechanisms are working and doors are free of obstructions.
- Avoid working alone. If you must work alone, let others know you are working inside and have someone check on you periodically.
- Take a 10-minute break every 50 minutes while working inside the cold room.
- Ensure that shoes have no-slip soles; water and ice are common in cold storage and pose slip and trip hazards.
- Dress appropriately: layer clothing for warmth and wear insulated gloves to protect your hands.
- NEVER store chemicals, dry ice/cryogenics, or compressed gases in the cold room.
- It is critical to keep doors closed to maximize ventilation efficiency.
- Avoid mold contamination by keeping cardboard or other paper products out of the cold room.
- Include emergency contact information posted outside of the cold room.



Prevent Asphyxiation

No fresh air circulates in a cold room!

NO hazardous chemicals, pressurized gases or dry ice

Avoid Mold Contamination

Preserve your health and scientific data!

NO food, drink, cardboard or other paper products

Maintain Equipment Integrity

Prevent rust and corrosion!

AVOID moisture build-up; keep the door closed

AVOID cluttering and trash accumulation

CLEAN UP all spilled materials immediately



NO Hazardous Chemicals



NO Pressurized Gases



NO Dry Ice



NO Food or Drink



NO Cardboard or Other Paper Goods



DO Clean up spills & dispose of trash

PPE General Guidelines

Using personal protective equipment is essential and is the last line of defense and must be used in conjunction with engineering controls, work practices, and administrative controls. For information on choosing appropriate PPE please review the [NIH CHP Appendix F](#).

Minimum protection

All persons working in the lab should have clothes that cover their legs and arms, and closed-toe shoes. **When handling hazardous chemicals, appropriate eye protection, appropriate gloves and laboratory coats must be worn.** This is the minimum protection required and must be upgraded as appropriate for the risk.

Additional PPE

Additional PPE must be worn if indicated by the potential exposure, such as:

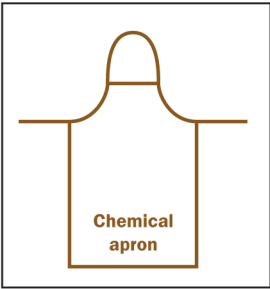
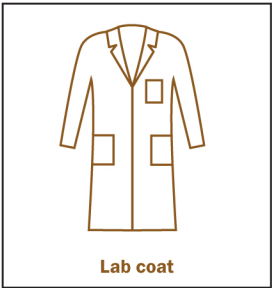
- splash goggles
- face shields
- chemical aprons
- disposable coveralls
- chemical resistant gloves
- respiratory protection
- chemical resistant footwear

Factors to consider are the hazards/quantity of the chemical, length and route of exposure, and type of contact (splash, mist, vapor, occasional or continuous immersion). Contact your [DS safety specialist](#) for assistance in selecting appropriate gloves and respiratory protection. The use of respiratory protection requires an industrial hygiene hazard assessment and a medical clearance by OMS, followed by a fit test and training by the DS TAB.

Chemical resistant gloves

Gloves must be selected on the basis of their chemical resistance to the material(s) being handled, their suitability for the procedures being conducted, their resistance to wear as well as temperature extremes. Consult the Glove Selection section and the [NIH CHP appendix F](#) for detailed guidance for selecting chemical resistant gloves, or contact your [DS safety specialist](#).

⚠️ ALERT Improper selection may result in glove degradation, penetration of the chemical through the glove, and ultimately exposure to the chemical.



Lab coats, gloves and eye protection provide minimum safeguarding.



Wear additional PPE as needed.



Wear respiratory protection as needed.

Contact DS for enrollment in the [Respiratory Protection program](#) and fit-testing. Refer to [Respiratory Protection Program](#) for details.

Lab Coat Selection

Lab coat selection and use:

- Fabric weight and weave affect how easily material ignites and burns; select tight weave, heavy weight, and tightly fitted sleeves/cuffs for work with flammables and pyrophorics.
- Cuffed sleeves prevent exposure to wrists and arms.
- Closeable lapel is preferred for maximum coverage from hazards.
- Consider sturdy chemical-resistant aprons for high-hazard work such corrosives, etc.
- Most synthetic material resist ignition but once ignited will melt and can cause severe localized burns.
- Blended fabrics often have a high rate of burning combined with fabric melting.
- Reusable lab coats should be laundered weekly or when contaminated, whichever is earlier, and replaced when damaged. Follow lab coat supplier’s instructions for laundering and replacement. Only use an approved commercial laundry services. Do not take lab coats home to launder.
- Use only fire-retardant lab coats with pyrophoric or highly flammable chemicals.
- Consider heavy-duty materials such as Tychem® for chemical contact. Tychem® is a Tyvek® fabric coated with polyethylene and provides protection against minor chemical spills and splashes.

- Lab coats should extend to the knees and be fully buttoned down with sleeves rolled down.
- Don’t wear lab coats in public places, such as offices, lunchrooms or lounge areas as they can transfer hazardous materials and contaminate these areas.
- Tyvek® coveralls can be used over street clothes for protection against particles. However, they do not provide sufficient protection against liquids.
- Cotton lab coats are preferred over polyester as they are more breathable and flame resistant.

Lab Coat Type	Fabric Type	Protective Use	Improper Use
Standard	100% cotton (preferred for maximum protection) or cotton/polyester blend fabric (burns more readily than 100% cotton)	Minimal risk chemicals with low risk of exposure to fire. Radioactive materials, cryogenics, and lasers (general benchwork)	“Moderate to high volume use of chemicals, flammables, pyrophorics when the risk of exposure to fire is high
Fluid/Splash and Tear Resistant	Polyethylene-coated polypropylene (disposable)	Human and animal blood and body fluids, BSL2/3 and BSL3 and bloodborne pathogens	Use with flammables and pyrophorics
Chemical resistant apron and sleeves	Polyethylene-coated high-density polyethylene, neoprene, vinyl, pvc, polyester or polyethylene-coated polypropylene	Select chemical exposure	Use with flammables and pyrophorics
Nomex (Flame Resistant)	Flame resistant fabric	Flame or pyrophoric liquids and solids. Wear with a chemical apron when working with non-polar organic solvents such as acetone, dichloromethane, diethylamine, ethyl acetate, n-hexane, tetrahydrofuran, toluene	Non-flammable or pyrophoric liquids and solids
Spunbonded olefin such as Tyvek®	Tear resistant fabric/high-density polyethylene fibers	Biological material or particulate and clean rooms	Best at protecting against dry substances but minimal protection against liquids/splashes



Glove Selection

Glove selection and use:

- All gloves are permeable and the changes are not always apparent.
- Visible degradation of gloves can include swelling, softening, hardening and discoloration. [Refer to Chemical Resistance Guidance for information.](#)
- Different gloves are resistant to different chemicals.
- Multiple gloves can be worn together for greater protection (use smallest size that will provide adequate dexterity and comfort).
- Reusable gloves can be used for intermittent chemical work. They must be properly rinsed and air dried. Always inspect reusable gloves for integrity before use.
- Disposable gloves provide barrier protection for small amounts of chemicals. They should be replaced immediately when contaminated, and never reused.
- Glove liners may be reused, but must be replaced when contaminated.
- Never use latex gloves for chemical work.

Factors to consider when choosing a chemical resistant glove:

- frequency and duration of chemical contact
- nature of contact (immersion and/or splash)
- concentration of chemical
- chemical compatibility
- temperature of chemical
- abrasion-resistance requirements
- puncture, snag, tear, and cut-resistance
- length of hand and arm to be protected
- dexterity requirements
- grip requirements and conditions (e.g., wet or oily)
- thermal protection - to protect against heat and cold
- size
- comfort

Always consult the manufacturer’s glove selection guidelines, and [your DS safety specialist](#) for help in selecting the appropriate glove. [Appendix F of the NIH CHP](#) can be consulted for determining the correct glove for a task.

Consider using:

- **Extended cuffs** to protect wrists and forearms.
- **Ultra-thin gloves** to provide greater tactile sensitivity.
- **Textured finishes** to provide better grip.



Example of cryogen protective gloves



Example of chemical resistance gloves

Always consult the manufacturer's glove selection guidelines, and your DS safety specialist for help in selecting the appropriate glove. Consult the following resource for glove permeability information: https://www.aaes.com/ansell_8th-edition-chemical-resistance-guide/

Glove Type	Uses	Caution
Disposable: vinyl, latex, nitrile	Dry powders, aqueous solutions. Nitrile gloves are resistant for short duration to a wide range of chemicals	Disposable gloves must be replaced immediately upon chemical contamination. Not suitable for long time use of halogenated solvents.
Reusable: Neoprene (Black)	Corrosives, solvents and alcohols; Resists oils and offers less fatigue	Must be properly rinsed and dried after each use.
Reusable: Nitrile (Blue or Green)	Organic solvents (non-halogenated); Puncture and abrasion resistant	Must be properly rinsed and dried after each use.
Reusable: Nomex® or Zetex®	Temperature extremes	Must be properly rinsed and dried after each use.
Reusable: Butyl	Aldehydes, ketones and esters	Must be properly rinsed and dried after each use.
Reusable: Viton®	Chlorinated and aromatic solvents	Must be properly rinsed and dried after each use.

Eye and Face Protection Selection

Eye and face protection selection and use:

- Eye protection is mandatory where there is potential for injury.
- Eye protection must be appropriate for the type of hazard (e.g. chemical splash and vapors, impact hazards, lasers, ultra violet light).

Safety Glasses/Spectacles: Designed to protect against impact hazards. Additional PPE, such as face shields, are to be used simultaneously when working with chemicals.

Safety Goggles: Protect the eyes, eye sockets, and facial area surrounding the eyes from chemical hazards. They provide a seal around the eyes preventing entry under or around goggles. Safety goggles must be fitted to worker's face, poorly fitted goggles will not offer necessary protection.

Safety goggles must be used when working with chemical substances which may result in eye contact in the form of splash, mists, vapors or fumes one of the following should be used:

- **Non-vented goggles** protect eyes from vapors, mists, fumes or other hazards. Eyes must be completely covered, but the material hazard does not require covering all exposed skin.
- **Vented goggles** protect from moderated quantities of liquids with no vapor or mist danger. Several types exist. For example, the common, hardware-store goggle has holes drilled into the plastic. This is unsuitable for laboratory work because liquids can get through the holes. Vented laboratory goggles have a series of buttons embedded into the plastic. These buttons house a baffle plate that allows air to pass but present a physical barrier to liquids.

Face Shields: Shield entire face from a range of hazards. Face shields are secondary protectors to be used in addition to primary protection such as safety glasses or goggles. For additional OSHA resources refer to <https://www.osha.gov/eye-face-protection> or use the QR code below.



Chemical Segregation and Storage Table

Chemical Segregation

Class of Chemicals	Common Chemical Examples	Additional Concerns and Storage Recommendations	Common Incompatible Chemical Types	Possible Reaction if Mixed/Health Concerns
Corrosive Acids-Organic 	- Acetic acid - Butyric acid - Trifluoroacetic acid - Propionic acid - Formic acid - Carbonic acid - Benzoic acid	- Store in ventilated corrosives cabinet on protected shelving using secondary containment, keep away from incompatible chemicals - Do not store under the sink - Do not store acids on metal shelving - See compatibility chart for storage	- Flammable liquids - Flammable solids - Bases - Oxidizers - Inorganic acids - Cyanides - Sulfides - Poisons/toxins	- Heat - Gas generation - Violent reaction - DO NOT POUR WATER INTO ACID - Causes skin burns - Respiratory distress - Use NIOSH approved gloves, eye protection, face shield and apron
Corrosive Acids-Inorganic 	- Nitric acid - Sulfuric acid - Phosphoric acid - Hydrochloric acid - Hydrofluoric acid	- Store concentrated acids in secondary containers. Store in a corrosive cabinet labeled "Acid" or on shelving using a secondary containment - Do not store under the sink - Do not store acids on metal shelving <u>Hydrofluoric acid</u> (HF) should only be handled by trained personnel. as it is a PHS and requires extra handling precautions and a chemical specific SOP. Store in a secondary container. HF is a bone decalcifier.	- Flammable liquids - Flammable solids - Bases - Oxidizers - Organic acids - Cyanides - Sulfides - Poisons/toxins	- Heat - Gas generation - Violent reaction - DO NOT POUR WATER INTO ACID - Hydrofluoric acid can result in skin irritation/burns and requires a chemical specific SOP - Respiratory distress - Use NIOSH approved gloves, eye protection, face shield and apron
Corrosive Bases-Organic/Caustic 	- Hydroxylamine - Tetramethylethylamine - Diamine - Triethylamine - Propylenediamine - Cuprietylenediamine solution - Dicyclohexylamine	Store in separate cabinet preferably with ventilation, corrosive cabinet or storage area with a spill tray. (DO NOT store under sink)	- Acids - Oxidizers - Flammable liquids/solids - Inorganic bases - Poisons/toxins - Amines are generally incompatible with isocyanates, halogenated organics, peroxides, acidic phenols, epoxides, anhydrides, and halides	- Heat - Gas generation - Violent reaction - Skin irritation and burn - Respiratory distress - Foul odor - Use NIOSH approved gloves, eye protection, face shield & apron
Corrosive Bases-Inorganic/Caustics 	- Ammonium hydroxide - Potassium hydroxide - Sodium hydroxide - Calcium hydroxide - Sodium hydroxide - Sodium hypochlorite solution (bleach) - Magnesium hydroxide	- Store in separate cabinet preferably with ventilation, corrosive cabinet or storage area with a spill tray, away from potential water sources (DO NOT store under the sink) - Store solutions of inorganic hydroxides in labeled polyethylene containers	- Acids - Oxidizers - Flammable liquids - Flammable solids - Organic bases - Poisons/Toxins	- Heat - Gas generation - Violent reaction - Skin burn and irritation - Respiratory distress - Use NIOSH approved gloves, eye protection, face shield and apron

Chemical Segregation

Class of Chemicals	Common Chemical Examples	Additional Concerns and Storage Recommendations	Common Incompatible Chemicals Types	Possible Reaction if Mixed/Health Concerns
Flammable Solids 	- Paraformaldehyde - Phosphorus - Magnesium - Sulfur - Potassium sulphide - Naphthalene - Camphor	- Keep in a dry, cool area away from oxidizers and corrosives - Follow specific safety procedures - Conduct work on small scale if possible - Keep amounts on-hand to a minimum - Keep away from other flammables	- Acids - Bases - Oxidizers - Poisons/toxins	- Fire Hazard - Violent Reaction - Generates toxic fumes - Respiratory distress - Keep away from ignition & sparks - Ignites readily, burn fiercely - Use NIOSH approved gloves, eye protection, face shield and apron
Flammable Liquids 	- Ethanol - Ethyl Acetate - Methanol - Acetone - Benzene - Xylene - Toluene - Diethyl Ether - Tetrahydrofuran - Acetonitrile - Propanol - Gasoline	- Flammable storage cabinet or refrigerator rated for flammable/hazardous storage/explosion proof - Peroxide-forming chemicals must be dated upon delivery and opening (two dates) ie: Di-ethyl Ether, Tetrahydrofuran, Furan, Methyl Butanol, Methyl Acetylene, Heptanol, Dioxanes, Diglyme - Please consult NIH CHP Peroxide Formers and Fact Sheet on Peroxide Formers	- Oxidizers - Acids - Bases - Reactives - Poisons/toxins	- Fire Hazard - Heat - Violet Reaction - Watch for vapor mist - Causes eye and skin irritation - Keep away from ignition or sparks - Use NIOSH approved gloves, eye protection, face shield and apron
Toxic 	- Halogenated solvents like Chloroform, dichloromethane etc. - Cyanides - Heavy metal compounds (e.g. Cadmium, Mercury, Osmium, Arsenic, Barium) - Formamide - Phenol - Carbon Tetrachloride 2-Mercaptoethanol - Acrylamide - Ethidium Bromide - Sodium Azide Solution	- Store in a dark, dry, ventilated, cool area in an unbreakable chemically resistant secondary container (polyethylene) - Store volatile toxic materials with evaporation rate above 1.0 - (ether =1.0) in flammable cabinet - Store non-volatile liquid poisons in a refrigerator or cabinet; amounts less than 1 liter can be stored in a cabinet above bench level, ONLY if the cabinet has sliding doors (not swinging) - Sodium Azide, must be kept refrigerated	- Flammable liquids - Acids - Bases - Reactives - Oxidizers - Corrosives - Please consult Division of Environmental Protection (DEP) for assistance	- Generation of Toxic and Flammable Gas - Combustible - Heat - Fire Hazard - Explosion Hazard - Violent Reaction - Chloroform explosively reacts with chemically-reactive metals (e.g., Aluminum or Magnesium powder, Sodium, and Lithium), Strong Oxidizers, Strong Caustics (e.g., Alkalis), and decomposes in sunlight - Some toxins are mutagenic and carcinogenic - Review your SDS before working with toxic material - Use NIOSH approved gloves, eye protection, face shield and apron
Explosives 	- Picric Acid Dry) - Ammonium Nitrate - Nitro Urea - Trinitroaniline - Benzoyl Peroxide (Dry) - Trinitrobenzene - Trinitrobenzoic Acid - Trinitrotoluene - Urea Nitrate - Trinitrophenol - Diazoisbutylnitrile - Sodium Azide (Solid)	- Store in a secure location away from other chemicals; store in an area away from friction or shock - Store Picric acid in cool location away from heat and light and keep wet with at least 10% moisture content to prevent it from drying out and becoming potentially explosive. Inspect the container regularly to ensure the content is wet. - Storage regulations DO NOT apply to binary explosives until mixed. Consult Explosive Expert of DEP	- Please consult the SDS and the DEP - Explosives must be stored as "STAND ALONE". It must never be stored with any chemicals of any kind - Peroxide formers should be tested as detailed in the NIH CHP	- Explosion hazard - Violent reaction - Heat - Shock sensitive - Regular inspection maybe required, to check for deposits or crystallization - Use spark proof tools - Use NIOSH approved gloves, eye protection, face shield and apron

Chemical Segregation

Class of Chemicals	Common Chemical Examples	Additional Concerns and Storage Recommendations	Common Incompatible Chemicals Types	Possible Reaction if Mixed/Health Concerns
Oxidizers 	- Peroxides - Nitrates - Perchlorates - Permanganates - Sodium Hypochlorite (Solid) - Potassium Dichromate - Chlorates - Chlorites - Chromates - Bromates - Superoxides	- Store in secondary containment separately from combustibles and flammable materials - May explosively decompose on shock, friction, or concussion. - May EXPLODE ON HEATING, to form irritating toxic fumes and gases of Benzoic Acid and Carbon Monoxide. Its a strong oxidant and reacts violently with combustible, organic and inorganic acids, and reducing materials, causing fire and explosion hazard. Attacks some forms of plastics, rubber or coatings	- Combustibles - Flammables - Organic materials - Reducing agents	- Fire Hazard - Gas Generation - Toxic Gas - Explosion Hazard - Forms irritating toxic fumes - Use NIOSH approved gloves, eye protection, face shield & apron
Peroxide Formers 	- Acrylonitrile - Isopropyl Alcohol - Ethers (e.g. Diethyl Ether, Isopropyl Ether) - Acetals and Ketals, especially Cyclic Ethers and those with primary and/or secondary Alkyl groups or Aldehydes (e.g. Acetaldehyde, Benzaldehyde) - Vinyl and Vinylidene compounds - Dienes - Tetrahydrofuran - Dioxane - Butylated Hydroxytoluene (BHT)	- Store in airtight bottles, away from light and heat in a dark, cool dry area; avoid using containers with loose-fitting lids and ground glass stoppers; crystallization, discoloration, and formation or deposition of layers are signs a peroxide former may have become shock sensitive; do not use or move such containers: contact DEP - All bottles of peroxide-forming chemicals must have the received date marked on the container; when the bottle is first opened, the container must be marked with the date opened - Testing should be conducted following the NIH CHP guidelines and the Peroxide Former Fact sheet.	Always consult the Safety Data Sheet (SDS), NIH CHP and the Division of Environmental Protection (DEP) guidelines for safe management	- Explosion hazard - Violent reaction - Shock sensitive - Combustion (Exothermic Reaction) - If an old or expired container of a peroxide-forming chemical or reactive is found, do not move it. Contact the DEP at 301-496-4710 for assistance in disposing of the container. - Use proper PPE - Use NIOSH approved gloves, eye protection, face shield & apron
Water Reactive 	- Sodium Metals - Lithium Metals - Potassium Metals - Sodium Borohydride - Alkali Metal Hydrides - Cesium Metal	- Store in a dry, cool area away from potential spray from fire sprinklers and other water sources (DO NOT store under the sink) - Label this area for water-reactive storage - Do not store with any other chemicals	- Aqueous solutions - Oxidizers - Please consult the Safety Data Sheet (SDS) and the Division of Environmental Protection (DEP)	- Heat evolution - Violent reaction when mix with water - Liberates hydrogen gas with water - Reacts violently with water - Use NIOSH approved gloves, eye protection, face shield and apron

Chemical Segregation

Class of Chemicals	Common Chemical Examples	Additional Concerns and Storage Recommendations	Common Incompatible Chemicals Types	Possible Reaction if Mixed/Health Concerns
Toxic Compressed Gases 	- Carbon Monoxide - Hydrogen Sulfide - Nitrogen Dioxide - Arsenic - Pentafluoride - Boron Tribromide - Bromine - Chlorine - Fluorine - Chloropicrin - Cyanogen	- Handle toxic compressed gases in a chemical fume hood - Must be secured in upright position, bonded or chained against the wall - Indoor storage or use of toxic compressed gases shall be provided with a gas cabinet, exhausted enclosure, or gas room - Label the storage area with appropriate signage - Require SOP and emergency response plan - Refer to the SDS information for additional guidance on the storage and compatibility requirements - Contact DS to determine if a fail-safe valve and/or continuous monitoring for toxic gas may be required during use	- Flammable Compressed Gases - Oxidizing Compressed Gases - Please consult the specific SDS and DEP	- Release of Toxic Gas - Hydrogen Sulfide is a colorless, flammable, extremely hazardous gas with a "rotten egg" smell; - Prolonged exposure may cause nausea, tearing of the eyes, headaches or loss of sleep, airway problems (bronchial constriction) in some asthma patients; - Possible fatigue, loss of appetite, headache, irritability, poor memory, dizziness and slight conjunctivitis to name a few symptoms and effects - Use NIOSH approved gloves, eye protection, face shield, & apron - Wear safety shoes
Carcinogens 	- Benzene - Benzadine - Methylene Chloride - Carbon Tetrachloride - Cadmium & Compounds - Arsenic & Compounds - Asbestos - Alfatoxins - Beryllium & Compounds	Label all containers as "PHS signage" or the equivalent - Store according to the hazardous nature of the chemical, using appropriate security when necessary - Comply with NIH CHP and all PHS requirements	Please consult the specific SDS and DEP	- Please consult the specific SDS and DEP - Use NIOSH approved gloves, eye protection, face shield, and apron
Teratogens 	- Tegretol - Aminopterin - Chlorobiphenyls - Coumarins - Tetracycline - Tapazole - Propylthioracil (PTU)	Label all containers as "PHS signage" - Store according to the hazardous nature of the chemical, using appropriate security when necessary - Comply with NIH CHP and all PHS requirements	- Aniline incompatible with Nitric Acid and Hydrogen Peroxide - Please consult the specific SDS and DEP	- Please consult the specific SDS and DEP - Use NIOSH approved gloves, eye protection, face shield, and apron

Chemical Segregation

Class of Chemicals	Common Chemical Examples	Additional Concerns and Storage Recommendations	Common Incompatible Chemicals Types	Possible Reaction if Mixed/Health Concerns
Flammable Compressed Gases  	- Methane - Acetylene - Butane - Propane - Hydrogen - Silane - Ethane - Arsine - Germane	- Handle flammable compressed gases in a chemical fume hood - Store in well-ventilated areas; mechanically ventilated cabinets, store away from oxidizers, open flames sparks, and other sources of heat ignition; post NO SMOKING signs around storage area(s) or entrance(s) to storage room(s); flammable gases stored outdoors where ambient temperatures exceed 125 degrees F (51.7 degrees C) shall be protected from direct sunlight - Must be secured in upright position, bonded or chained against the wall - Require SOPs are emergency response plan - Some gases may require continuous monitoring for leaks and accidental releases. Check with DS. - Use a spark proof wrench to attach regulators and make other connections; install a flame/flash arrestor at the regulator outlet flow valve. Refer to Compressed gas guidelines for more information.	- Oxidizers - Toxic Compressed Gases	- Fire Hazard - Explosion Hazard - Use NIOSH approved gloves, eye protection, face shield & apron - Wear safety shoes
Oxidizing Compressed Gases  	- Oxygen - Chlorine - Fluorine - Nitrogen oxides - Gas mixtures containing oxygen higher than atmospheric concentrations (above 23%)	- Store oxidizers separately from flammable gas containers or combustible materials; minimum separation requirement from these materials is 20 ft. or a 5 ft. noncombustible barrier with a fire resistance rating of at least 30 minutes - Must be secured in upright position, bonded or chained against the wall - Clean equipment used for Oxygen and Nitrous Oxide with Oxygen compatible materials free from oils, greases, and other contaminants - Fluorine shall be handled in specially passivated containers and associated equipment - Require SOPs and emergency response plans - Fluorine, chlorine etc. require continuous monitoring for leaks and releases. Check with DS	- Flammable Compressed Gases - Toxic Compressed Gases	- Fire Hazard - Explosion Hazard - Use NIOSH approved gloves, eye protection, face shield & apron - Wear safety shoes

Chemical Segregation

Class of Chemicals	Common Chemical Examples	Additional Concerns and Storage Recommendations	Common Incompatible Chemicals Types	Possible Reaction if Mixed/Health Concerns
Flammable Aerosol Cans 	Pressurized Aerosol cans containing flammable liquid not limited to: • Acetone • Thinner • Toluene • Petroleum Distillates • Butyl Cellusolve • Xylenes • Methanol	Content under pressure: • Store at room temperatur; or store above 120°F • Do not use near heat, sparks and open flames • Always use secondary containers when storing with other chemicals	• See incompatibles for flammable liquids • Do not store with acids, oxidizers, toxic and reactive chemicals • Use secondary container with flat surfaces for stability	• Read instructions and usage as directed • Review SDS prior to use • Use NIOSH approve gloves or PPE. Rinse skin thoroughly with soap and water • Contact emergency services for severe skin impact or eye exposure • Use fire extinguisher in case of fire or dial 911
Non-Flammable-Corrosive-Toxic Aerosol Cans  	Pressurized Aerosol cans NOT containing flammable liquid but not limited to Corrosive or Toxic carrier: • Ammonia • Sodium Hydroxide • Sodium Hypochlorite • Amines	Content under pressure: • Store at room temperature • Do not use near heat, sparks and open flames • Always use secondary containers when storing with other chemicals • Use in a chemical fume hood	• See incompatibles for corrosive acid, base and toxic items above; Use secondary container with flat surface for stability	• Read instructions and use as directed • Review SDS prior to use • Use NIOSH approve gloves or PPE. Rinse skin thoroughly with soap and water • Contact emergency services for severe skin impact or eye exposure • Use fire extinguisher in case of fire or dial 911

1. Adapted from Prudent Practices in the Laboratory: Handling and Disposal of Chemicals, National Research Council, 2011.

2. Boston University Environmental Health and Safety. (2011) Chemical Segregation and Storage.

3. The University of Texas Health Science Center at Texas. (2022). Chemical Segregation & Incompatibilities Guidelines. Chemical Hygiene Plan.

Contact

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National Institutes of Health Resources



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[Radioactive Waste](#)
Pick-up: 301-496-4551
Assistance: 301-496-5774



[Division of Fire Rescue Services \(DFRS\)](#)
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Email: NIHFiredep-l@ors.od.nih.gov



Useful Websites



[National Library of Medicine Gateway](#)



[Agency for Toxic Substances and Disease Registry](#)



[PUB CHEM](#)



[NIOSH Pocket Guide to Chemical Hazards](#)



[OSHA Laboratory Standard – Safety & Health Topics](#)



[OSHA Hazardous & Toxic Substances](#)



[Chemical Safety Board – Video on Lab Accidents](#)
“Experimenting with Danger”



[Argonne National Labs](#)



[DrugBank](#)



[Sigma-Aldrich](#)



[Physicians' Desk Reference \(PDR\) Health](#)



[Chemical Compatibility Chart](#)



[NIH personal Property Management Guide](#)

Chemical Safety Guide, 6th Ed.



<https://ors.od.nih.gov/sr/dohs/Documents/chemical-safety-guide.pdf>