

Overview

The Occupational Safety and Health Administration's (OSHA) "Occupational Exposures to Hazardous Chemicals in Laboratories" standard requires that laboratories that store or use **High Hazard Substances (HHSs)** develop and implement a High Hazard Operating Procedure (HHOP) for each substance. All users must understand the hazards of and safe handling procedure for HHSs.

The [HHOP Form](#) developed by WCM Environmental Health and Safety serves as a tool to coordinate information into a succinct procedure, and facilitates review with and by laboratory staff. This Update provides general guidelines on developing HHOPs. The lab can also develop alternative procedures to the HHOP form, as long as this document includes the elements listed below.

Applicability

High Hazard Substances include the following types of materials:

- Explosives
- Water Reactive (flammable)
- Flammable Gases
- Pyrophoric Liquids and Solids
- Self-Reactive
- Acutely Toxic

Note: The EHS Update: [Working with Carcinogens and Reproductive Toxins](#) provides more information and the SOP requirements for these particularly hazardous substances.

Responsibilities

Principal Investigators (PIs) are responsible for:

- Identifying all High Hazard Substances present in their laboratories, ensuring that a High Hazard Operating Procedure is established for each, and providing the HHOP and relevant training to each user.
- Ensuring that laboratory personnel handling HHSs read and understand the HHOP prior to use; receive hands-on training, and handle materials only under the supervision of a competent person until they are judged competent.

Laboratory Personnel who work with High Hazard Substances must:

- Be familiar with the types of hazards associated with these substances.
- Be competent in the safe handling and use procedures identified in the HHOP and/or supporting documentation.
- Receive specific hands-on training from the Principal Investigator or other experienced senior laboratory staff.
- Understand the engineering controls and personal protective equipment requirements, their capabilities, and limitations.
- Conduct all activities with HHSs under the supervision of a competent person until they have satisfactorily demonstrated competency in the safe handling and use of these materials.

Environmental Health and Safety (EHS) provides assistance with the development and implementation of High-Hazard Operating Procedures (HHOPs) and associated exposure control strategies for highly hazardous substances.

HHOP Chemical Determination

The United Nations Globally Harmonized System (GHS) for Classification and Labeling of Chemicals is a system for standardizing the classification and labeling of chemicals based on physical, health, or environmental hazards. All chemicals are assigned hazard or GHS-H codes based on the nature and severity of the hazards. GHS-H codes are useful in determining which materials require an HHOP as the definitions are standardized worldwide.

[H codes](#) are available on the manufacturer's container label or the Safety Data Sheet (SDS). Copies of SDSs are available in the lab's SDS binder, on the [ChemWatch](#) SDS online database, or on the manufacturer's website. If needed, EHS can assist in obtaining SDSs from manufacturers or adding additional SDSs to ChemWatch.





GHS CLASSIFICATIONS AND SUB-CLASSIFICATIONS REQUIRING HHOP PRIOR TO USE

Explosives (GHS codes H200, H201, H202, H203, H204, H205)

An explosive substance (or a mixture) is a solid or liquid, capable by chemical reaction of producing gas at a temperature, pressure and speed that may cause damage to the surroundings.

Flammable Gases (GHS codes H220, H221)

Gases with a flammable range in the air at 20°C and a standard pressure of 101.3 kPa.

Self-Reactive Substances (GHS code H240)

Thermally unstable liquids or solids liable to undergo a strongly exothermic thermal decomposition, even without the participation of oxygen (air). Heating may cause an explosion.

Pyrophoric Liquids and Solids (GHS code H250)

Materials which, even in small quantities, could ignite within five minutes after coming into contact with air.

Self-heating substances and mixtures (GHS code H251)

A solid or liquid substance or mixture (other than a pyrophoric) that could heat itself by reaction with air and without energy supply.

Water-Reactive Chemicals (GHS code H260)

Solids or liquids which, by contact with water, may become spontaneously flammable or release flammable gases in dangerous quantities.

Acute Toxicity (GHS codes H300, H310, H330)

Substances with *Acute toxicity* may have adverse effects following oral or dermal administration of a single dose of a substance, or multiple doses given within 24 hours, or an inhalation exposure of 4 hours.

Substances assigned to Categories 1 and 2 on the basis of published lethal dose 50 (LD50) for oral and dermal exposures or lethal dose 50 (LC50) for inhalation exposure are considered High Hazard Substances.

Toxicity	LD/50 Oral (mg/kg)	LD/50 Dermal (mg/kg)	LC/50 Gases (ppm)	LC/50 Vapors (mg/l)	LC/50 Dusts & Mists (mg/l)
Category 1	≤ 5	≤ 50	≤ 100	≤ 0.5	≤ 0.05
Category 2	> 5 - ≤ 50	> 50 - ≤ 200	> 100 - ≤ 500	> 0.5 - ≤ 2.0	> 0.05 - ≤ 0.5

Note: Complete the HHOP for the high hazard substance only, typically the stock material. Keep in mind that many substances do not meet the HHOP criteria once they are diluted or mixed. For example, sodium borohydride in solid powder form requires an HHOP, due to its high water reactivity (GHS code H260). The solution form, however, although still hazardous (H261 in contact with water releases flammable gases, H314 causes severe skin burns and eye damage, H360 may damage fertility or the unborn child), does not require an HHOP.

Elements of the HHOP

High Hazard Operating Procedures for a substance or mixture must contain the following information:

- Name of Principal Investigator and location of laboratory.**
- High Hazard Substance Information:** Include the name, CAS number, primary high hazard classification(s), physical state, concentration, the amount on hand, the estimated rate of use, and reactivity/incompatibility for the substance.
Review the SDS, container label or other technical documents for this information. Recommended optional information include the manufacturer name and product number.
- Significant Route(s) of Exposure:** Anticipate and check all potential route(s) of exposure based on the work that will be done with the substance.
- Additional Materials to Be Reviewed Before Using this HHS:** List the documents that a user must review prior to using this substance to ensure safe handling. Include the name of the documents and their location.
- Exposure Controls:** Identify engineering controls and personal protective equipment; giving priority first to engineering controls to mitigate or eliminate exposures.



- Chemical Hood: Should be used for chemicals that generate gases or vapors and for processes that can produce mists, fumes, or aerosols.
- Glove Box/Atoms Bag: Should be used if protection from atmospheric moisture or oxygen is needed, or when a chemical hood does not provide adequate protection from exposure to the substance.
- Personal Protective Equipment (PPE): identify PPE that must be worn in addition to standard laboratory PPE.
 - Disposable Lab coats: select a disposable lab coat if there is potential for contamination with a substance that should not go to laundry, or that could readily penetrate the lab coat.
 - Face shield: Worn over chemical splash goggles, a face shield provides full face protection when working with large volumes or severely corrosive chemicals.
 - Chemical splash goggles: Should be worn when there is a possibility of a significant chemical splash. Many chemical manipulations, particularly where pressure is involved, warrant chemical splash goggles.
 - Safety glasses: Protect from flying particles and minor chemical splash (e.g., opening a centrifuge tube or a cryogenic vial).
 - Gloves: Since no single glove material offers complete protection from all chemicals, it is important to select the glove that offers the best resistance for each application. Refer to the SDS or glove manufacturer compatibility charts for more information.
 - Respirators: Offer protection from inhalation of substances when engineering controls are not sufficient. The use of respirators must be approved by EHS as training and fit testing are required prior to use. Contact EHS at 646-962-7233 if a respirator is needed.

6. Use and Storage:


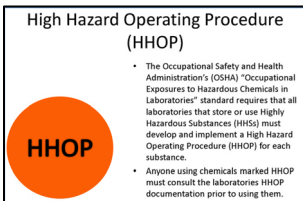
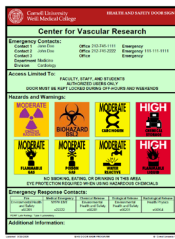
Review the manufacturer's Safety Data Sheet to determine if specific handling or storage conditions exist for the product.

- Authorized personnel: select the type of employees authorized to work with the HHS. Only personnel who are fully trained on the handling procedures and are aware of the hazard(s) associated with the HHS are allowed to handle it.
- Persons handling or conducting procedures with HHSs should never work alone: check this box if the HHS presents an **immediate** danger that would incapacitate the user (for example, explosive, pyrophoric, extremely toxic via inhalation, flammable gas).
- Laboratory Protocol / Procedure: Provide a brief description of the part of the experiment that requires handling the substance, including the various concentrations used.
- If a vacuum system is used, describe what will be done to ensure that the substance is not accidentally drawn into the vacuum system (e.g., cold traps, filters).
- If High Hazardous Substances are administered to animals, a RARC Protection and Control form must be completed. For additional information, please refer to the [RARC User Guide](#).
- Use Location: Designate and post the location(s) where the substance will be used. The clear posting of designated use areas will increase control, minimize the spread of contamination, and facilitate decontamination.

Note that many substances do not meet the HHOP criteria once they are diluted or mixed. For example, sodium azide powder is an HHS, but sodium azide in less than 5% solution, is not an HHS and does not require an HHOP. A designated area may be the entire laboratory, a smaller section of a laboratory, or a piece of equipment such as a fume hood.

- Storage Location: identify the storage location of HHS. Refer to the table below for labeling requirements.
- Hazard Communication and Signage: should be communicated to lab personnel as shown in the following table.



Containers	Storage area	Designated area	Lab (if HHS used throughout the lab)
An HHOP sticker must be applied to each HHS container.	Post the HHOP EHS sign to each storage area; e.g., cabinet, shelf, fridge, fume hood.	Post a sign in each designated area where the HHS is used.	EHS posts lab door sign based on hazards present in the lab.
		This sign is generated by each lab for its own needs. The sign must include a hazard warning (e.g., acutely toxic, water reactive). Each employee must understand and be trained on the meaning of the designated area sign.	
Ensure that the chemical name and hazard warning are also on the container label.	The storage area sign and HHOP stickers are available from EHS.		If the door sign needs to be updated, contact EHS at 646-962-7233.

7. Medical Attention and First-Aid: Some HHSs may require specific first-aid or emergency procedures in the event of an exposure, such as the administration of an antitoxin. The HHOP must include information on first-aid procedures, supplies and emergency contacts beyond basic first aid, as well as any requirements for follow-up medical consultations or examinations. If you are unsure what emergency/first-aid procedures are required for the material used, contact EHS for assistance.

8. Decontamination:

- Include special decontamination procedures beyond basic laboratory housekeeping and cleaning. Good housekeeping is essential to the health and well-being of laboratory personnel. All equipment and work surfaces used for handling HHSs should be decontaminated after use. The decontamination method used must effectively remove/deactivate any residue of the substance.
- When leaving a designated area, remove any PPE to avoid cross-contamination.
- Ensure a hand wash facility is available when working with HHSs.

9. Emergency Procedures and Spill Response:

- Include specialized spill clean-up or neutralization procedures needed for the HHS in case of a spill or emergency. Verify that the laboratory is equipped with the proper emergency supplies for the particular HHS.
- Basic emergency equipment such as eyewash station, safety shower and fire extinguisher must be present in the work area. If any equipment is not immediately available, contact EHS at 646-962-7233.

In the event of a chemicals spill, call EHS at 646-962-7233 immediately for assistance. Do not attempt to clean a spill of high hazard chemicals. Turn off all ignition sources and evacuate the laboratory immediately.

10. Waste Management and Disposal: Select which waste disposal procedure(s) apply to the HHS and list the location where the waste will be stored:

- Hazardous waste collected by EHS,
- Neutralization or deactivation prior to disposal which requires EHS pre-approval,
- [EPA acutely toxic chemical](#) which requires that all waste, sharps and other used containers be disposed of as hazardous waste, or
- Other disposal method(s) which requires EHS pre-approval.

11. Training: Select all applicable training in addition to the annual EHS Laboratory Safety training, reading the SDS and the HHOP. Training options include (1) hands-on with the Principal Investigator or other experienced senior staff familiar with the safe handling of the HHS; and (2) working under the close supervision of an experienced senior staff until deemed competent to work unsupervised. List other training requirements specific to working with each HHS.



Additional information covering these elements and the HHOP form are available in the WCM [Laboratory Chemical Hygiene Plan](#).