New Paltz
STATE UNIVERSITY OF NEW YORK

POLICIES AND PROCEDURES

DEPARTMENT: Environmental Health and Safety

SUBJECT: Lab Hygiene/Chemical Hygiene Plan

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Purpose and Authority

The purpose of the **Chemical Hygiene Plan (CHP; the Plan)** is to protect employees from physical and health hazards associated with occupational exposure to chemicals in the laboratory, and to maintain occupational exposures below recommended levels. The components of the Plan include:

- establishing laboratory safety rules and standard operating procedures;
- defining criteria for exposure control measures, including personal protective equipment, engineering controls, and safe work practices;
- conducting an ongoing ventilation inspection and maintenance program;
- providing information and training to employees regarding the provisions of the Plan, and the identified hazards of chemicals in their work area;
- defining criteria for laboratory activities that would require prior approval;
- conducting environmental and personnel monitoring to continually re-evaluate hazards, and making provisions for medical consultations and examinations to assess potential exposures;
- designating responsibilities for implementation of the Plan, including the Chemical Hygiene Officer and Committee members; and
- making provisions for additional exposure protection for extremely hazardous substances.
- Meeting the requirements of the OSHA LAB Standard 1910.1450 and Personal Protective Equipment standard 1910.132 for labs.
- Procedures for training and information dissemination.

The CHP has been developed in compliance with OSHA 29 CFR 1910.1450, “Occupational Exposures to Hazardous Chemicals in the Laboratory”, better known as the “Laboratory Standard” (LS), effective January 31

This Chemical Hygiene Plan (CHP) has been developed at SUNY New Paltz, from various sources, in order to comply with the Occupational Safety and Health Administration (OSHA) Laboratory Standard Rules and regulations. This laboratory standard is published as an amendment to 29CFR 1910, Subpart Z, and identified as Section 1910.1450. The title of that amendment is "Occupational Exposure to Hazardous Chemicals in Laboratories." The laboratory standard applies only to certain laboratories. OSHA defines a hazardous chemical as a substance for which there is statistically significant evidence, based on at least one scientific study, showing that acute or chronic harm may result from exposure to that chemical.

This document is intended only to highlight those safety measures necessary for achieving a safe and healthy work environment. Where the scope of hazards is not adequately addressed by this general document, specific Standard Operating Procedures must be developed by the laboratory director.

This CHP does not, however, apply to:
Work involving chemicals that do not meet the conditions of the definition of laboratory use of hazardous chemicals. In such cases, the University shall comply with all relevant specific substance standards even if such use occurs in a laboratory type setting.

General Principles

SUNY New Paltz is dedicated to the safe operation of their laboratories, and adopts the following guiding principles in the implementation of the CHP:

- Minimization of chemical exposures to the extent possible;
- Avoidance of the underestimation of risks associated with chemical exposure;
- Providing adequate ventilation and other operational controls;
- Developing and continuously re-evaluating its Chemical Hygiene program; and
- Complying with the PELs and threshold limits values (TLVs) associated with the hazardous chemicals used in the workplace.

Responsibilities

The *Department Chair* is responsible for chemical hygiene within that department. The chair or someone designated by the chair within each department must ensure that appropriate audits of the Plan are being conducted. Lab self audits are conducted at annually and originals are to be filed in department records and copies forwarded to the Chemical Hygiene Officer in the EH&S department.

- **The *Laboratory Supervisor*** (faculty, research associate, or laboratory instructor) has overall responsibility for chemical hygiene in each laboratory, and must: (1) ensure that workers and students know and follow the chemical hygiene rules, and that appropriate training has been provided (each employee must read and sign the Document of understanding found in the appendix of this document ; (2) ensure protective equipment is available and in working order, and be consulted as to the required level of protective apparel and equipment for a particular activity; (3) perform regular inspections of the laboratory for hygiene, housekeeping, and safety compliance (4) Laboratory Supervisors assess safety precautions and maintain adequate facilities.(5) and arranges for inspection of safety equipment including maintenance of fire extinguishers, eye washes, and fume hoods. (6). Ensure employees and research students who use the labs understand Why, when, and what Personal Protective Equipment (PPE) is necessary ,Selection criteria and limitations of the PPE, How to properly don, doff, adjust, and wear PPE, The proper care, inspection, maintenance useful life and disposal of the PPE

- The ***Laboratory Manager*** coordinates the procurement, storage, distribution, and disposal of chemicals; and the purchasing and distribution of PPE and laboratory supplies and apparatus, for each department and ensures the availability of MSDS's for all chemicals used in the lab. Lab Manager ensures the Emergency Posting Contact Information is current (see Lab Posting requirements in section L and Appendix). Lab Managers must ensure chemical inventories are kept and accurate See chemical inventory requirements in section M .

- Each ***Employee*** working with or around chemicals, having been informed and trained, is responsible for remaining aware of and handling those chemicals safely, according to the associated hazards and in observance of hygienic work practices. If uncertainty arises as to the hazards of a substance or the safety of a procedure, it is the responsibility of the employee(s) involved to ask for guidance. Each employee must understand why, when, and what Personal Protective Equipment (PPE) is necessary, the selection criteria and limitations of the PPE, how to properly don, doff, adjust, and wear PPE, and the proper care, inspection, maintenance useful life and disposal of the PPE.

Chemical Hygiene Officer

The Chemical Hygiene Officer (CHO) at SUNY New Paltz is the Environmental Health and Safety (EH&S) Manager. The CHO: (1) coordinates with the Chemical Hygiene Committee to develop and implement appropriate chemical hygiene policies and practices; (2) works with the Laboratory Supervisors to assess safety precautions and maintain adequate facilities; (3) advises the Laboratory Manager on the use and disposal of chemicals; (4) knows the current legal requirements regarding regulated chemicals; (5) seeks ways to improve the Chemical Hygiene Plan with annual reviews/updates.

1. STANDARD LAB OPERATING PROCEDURES

A. General Rules

1. Safety Self Audits will be conducted annually by each lab, original retained in department records and copies forwarded to the Environmental Health and Safety (EH&S) Dept.(see Self Audit section of this program).
2.. Avoid working alone in a laboratory or chemical storage facility whenever possible. If you must work alone in one of these areas, notify someone else in the building of your intentions and location.
3. Contact lenses are permitted to be worn when working in a laboratory or chemical storage area but splash proof goggles shall also be worn.
4. Wear appropriate eye and skin protection while working with chemicals (See PPE section of this policy).
5. When working with flammable chemicals, be certain that there are no sources of ignition near enough to cause a fire or explosion in the event of a vapor release or liquid spill.
6. Use fume hood when handling toxic or flammable chemicals.
7. Use a tip-resistant shield for protection whenever an explosion or implosion might occur.

B. General Rules for Chemical Use in labs

For the chemicals being worked with, all individuals should know and constantly be aware of:

1. The chemical's hazards, as determined from the NFPA label, the MSDS or SDS and other appropriate references.
2. Appropriate safeguards for using that chemical, including personal protection equipment (Gloves and Goggles See PPE section for more detailed PPE Hazard Assessment).
3. The location and proper use of emergency equipment (Fire Extinguishers, Spill Control, Eyewash/Showers etc).
4. How and where to properly label and store chemicals.

> **IMPORTANT: Labeling**. If you transfer a quantity of a chemical from one container to another for storage, use, or disposal, the new container must also have a label indicating the name of that chemical as it appears on the MSDS / SDS (no abbreviations , nomenclature, etc) and the PRIMARY chemical or physical hazards associated with it (see the Information and Training section for more information on labels and MSDS's or SDS's) for example , a container of Ethanol, shall be labeled "Ethanol" and a hazard of "Flammable" on each container, flask, beaker etc.
>
> **There is an exception under OSHA 1200 which reads as follows**: The employer is not required to label portable containers into which hazardous chemicals are transferred from labeled containers, and which are intended only for the **immediate** use of the employee who performs the transfer. The employee who performed the transfer **must be present at all times while the unlabeled container is being used**, if the employee leaves the lab or the container is put in storage, the container must be labeled with name of chemical and primary hazard prior to that employee leaving lab (even for a short period such as a break).

5. Proper personal hygiene practices.
6. The proper methods of transporting chemicals.
7. Appropriate procedures for emergencies including evacuation routes, spill cleanup procedures and proper waste disposal.
8. Store only chemicals that are compatible with each other. Never store bases with Acid (such as ammonium hydroxide with HCL acid, never store flammables/combustibles with oxidizers (such as acetic acid with nitric acid or acetone with hydrogen peroxide) see MSDS for chemicals storage compatibilities. A guideline chemical compatibility table has been included in appendix of this program

C. Personal Hygiene Rules in Labs

1. Flush promptly with water whenever a chemical has contacted the skin.
2. Avoid inhalation of chemicals; do not "sniff" to test chemicals.
3. Do not use mouth suction to pipette anything; use suction bulbs or other pipette filling devices.
4. Wash hands well with soap and water before leaving the laboratory; never wash with solvents.
5. Do not bring food, drinks, or smokes to a laboratory, or apply cosmetics in the laboratory or chemical storage area.
6. Confine long hair and loose clothing. Wear shoes at all times in the laboratory. Do not wear sandals or perforated shoes.

E. Personal Protective Equipment (PPE) Use in Labs

Personal Protective Equipment (PPE) includes all clothing and work accessories designed to protect employees from workplace hazards. Protective equipment should not replace engineering, administrative, or procedural controls for safety. It should be used in conjunction with these controls. Employees must wear protective equipment as required and when instructed by a supervisor.

For each hazard identified, select personal protective equipment that will protect the employee by creating a barrier against workplace hazards. Consider the likelihood of an accident and the seriousness of a potential accident. Personal protective equipment must be selected to protect against any hazard that is likely to occur or has a serious injury impact if it does occur. It is important that employees become familiar with the potential hazards, the type of protective equipment that is available, and the level of protection that is provided by that equipment, i.e., splash protection, impact protection, etc.

The personal protective equipment selected must fit the employee it is intended to protect. Make certain that employees have the correct size of protective equipment. Whenever possible, select adjustable personal protective equipment. Employee input in the selection process is critical. Employees will more likely wear personal protective equipment that fits properly and is comfortable. Damaged or defective protective equipment shall be immediately taken out of service to be repaired or replaced.

1. Eye protection worn when working with chemicals shall meet the requirements of the American National Standards Institute (ANSI) Z87.1. The Standard eyewear is goggles for corrosive liquids .When working with corrosives in an operation with a potential for splashing, a face shield, type N, large enough to protect the chin, neck and ears, as well as the face, must be worn with goggles.
2. When working with corrosive liquids, wear impermeable gloves made of materials known to be resistant to permeation by the corrosive chemical and tested by air inflation prior to use (do not inflate by mouth) for the absence of pinhole leaks.
3. When working with hazardous chemicals, wear chemical and fire resistant laboratory coat. It is preferable to wear long-sleeved/long legged clothing than to wear short-sleeved shirts, short pants, or short skirts.
4. When working with allergenic, sensitizing or toxic chemicals, wear gloves made of materials known to be or tested and found to be resistant to permeation by the chemical and tested for the absence of pinhole leaks.
5. Wear low-heeled shoes with fully covering "uppers"; do not wear shoes with open toes or with uppers constructed of woven material.
6. Whenever exposure by inhalation is likely to exceed the threshold limits described in the MSDS or other reference, use a fume hood. If this is not possible, use a proper respirator.
7. Carefully inspect all protective equipment before using. Never use defective protective equipment.
8. Know the location of safety equipment: emergency shower, eye wash station, fire extinguisher, fire blanket, fire alarm pull station.
9. Electrically ground containers using approved methods before transferring or dispensing a flammable liquid from a large metal container.

PPE Hazard Assessment for Lab Employees and Research Students completed by Michael Malloy in conjunction with Chairpersons of Biology and Chemistry Depts (Dan Jelski, Dan Freedman, and Tom Nolen) on 08/18/2008

PPE Hazard Assessment **Hazards in the Lab**	**PPE Required**
HAZARDOUS LIQUID CHEMICALS	
Corrosive Liquids (Acids/Caustics): Small containers < 1 liter	Safety goggles is the standard eyewear , safety glasses with side shields is accepted for low splash potential operations of containers of 5 mls or less or where used in closed equipment or chemical fume hood with sash down (not for dispensing to closed equipment) , gloves, closed toe shoes.
Large containers > 1 liter	Safety goggles, gloves, rubber apron, closed toe shoes. If there is a potential for splashing, it is required to use both face shield and goggles such as dispensing /transferring corrosive liquids or open bench top experiments.
Flammable Liquids	Safety goggles preferred, safety glasses accepted where low splash potential, gloves (see appendix C), closed toe shoes.
Dispensing from 5 gal drums	Safety goggles, gloves, closed toe shoes. If potential for a splash is high it is required to use a face shield in addition to goggles.
Highly reactive liquid chemicals and high energy oxidizers	Safety goggles preferred, safety glasses accepted where low splash potential operations, rubber apron for greater than 1 liter , gloves (see appendix C), closed toe shoes. Face shield or body shield must be used in addition to protective eyewear during the reaction based on the scale of the reaction.
Liquids with high acute toxicity (poisons)	Safety goggles, gloves (see appendix C), impermeable apron, closed toe shoes. If potential for a splash high use impermeable coveralls and a face shield in addition to goggles.
Liquids with high chronic toxicity (known and suspected carcinogens, reproductive toxins)	Safety goggles preferred, safety glasses accepted for low splash potential operations, gloves (see appendix C), rubber apron for greater than 1 liter, closed toe shoes.
Other hazardous liquid chemicals (not included in the above categories)	Safety goggles/glasses based on a splash potential, gloves (see appendix C), closed toe shoes.
SOLID CHEMICALS	
Caustic solids (lime, etc)	Safety glasses, gloves (see appendix C), closed toe shoes. If potential for getting a chemical into the face is high use face shield in addition to glasses.
Flammable solids (alkali metals, red phosphorous, etc)	Safety glasses, gloves (see appendix C), closed toe shoes.
Highly reactive solids & high energy oxidizers	Safety glasses, gloves (see appendix C), closed toe shoes. Face shield or body shield during reaction based on the scale of the reaction in addition to protective eyewear.
Solids of high acute toxicity (poisons)	Safety glasses, gloves (see appendix C), closed toe shoes. If must weigh, use particulate mask. If potential for disseminating powder high, use protective coveralls and a face shield in addition to glasses and mask.
Solids of high chronic toxicity (carcinogens and reproductive toxins)	Safety glasses, gloves (see appendix C), closed toe shoes. If must weigh, use particulate mask. or vented balance enclosure.

PPE Hazard Assessment **Hazards in the Lab**	**PPE Required**
Other hazardous solid chemicals (not included above)	Safety glasses, gloves (see appendix C), closed toe shoes.
Compressed toxic gases	Safety goggles, gloves, closed toe shoes.
Work with pressurized glass/plastic vessels (potential for creating flying fragments)	Face shield, safety goggles/glasses based on substances in the vessel, gloves, closed toe shoes.
LIGHT RADIATION	
Lasers Class IIIb or IV	Protective eyewear of the appropriate optical density
Sources of UV light (hand hold irradiators, UV screens, germicidal lamps)	Safety glasses, gloves (see appendix). Based on the duration of exposure and the source it may be advisable to use a face shield instead of glasses.
TEMPERATURE EXTREMES:	
Heat (hot surfaces, hot solutions, etc)	Face shield, thermal gloves, closed toe shoes.
Cold Low temperature freezers	Thermal gloves, closed toe shoes.
Cryogenic gases (N_2, He_2, etc)	Face shield, Lab coat and or apron, thermal gloves, closed toe shoes.
Autoclave operation	Face shield, rubber apron, thermal gloves, lab coat, closed toe shoes.

* The personal protective equipment that appears on the survey has been assigned to provide protection for eyes, face, feet, and hands. For additional information on PPE consult Personal Protective Equipment Program in the New Paltz Safety Manual.

Employees are responsible to know how to don and doff each piece of PPE .

Careful consideration must be given to the level of protection, fit, durability, and comfort of the PPE. PPE that fits poorly will not afford the necessary level of protection. Protective devices are generally available in a variety of sizes and care should be taken to ensure that the right size is selected. Some PPE is equipped with adjustable features such as goggles and face shields . Adjustments should be made on an individual basis for a comfortable fit that will maintain the protective device in the proper position. However, PPE should never be modified without written approval from the manufacturer. PPE should be maintained in a clean and reliable condition, and defective equipment must not be used.

Supervisors must ensure their employees receive information and training on how to use the assigned PPE. PPE must always be used in accordance with the manufacturer's specifications. Training and information to be provided to each user of PPE includes:

- Why, when, and what PPE is necessary
- Selection criteria and limitations of the PPE
- How to properly don, doff, adjust, and wear PPE
- The proper care, inspection, maintenance useful life and disposal of the PPE

Each employee must demonstrate an understanding of this training, and ability to wear PPE properly, before being allowed to perform work requiring the use of PPE. Methods of demonstrating understanding include orally questioning the employee, observing the employee using the PPE in a real or artificial setting by the lab manager. Employees must be retrained if employees were found to be improperly wearing or storing PPE.

F. Housekeeping Rules in Labs

1. Access to emergency equipment, showers, eyewash stations, and exits shall never be blocked by anything, not even a temporarily parked cart.
2. All chemical containers must be labeled with at least the identity of the contents and its hazards to users such as the NFPA warning label
.3. Keep all work areas, especially laboratory benches, clear of clutter. Clean up the work area on completion of an operation or at the end of each workday.
4. Keep all aisles, hallways, and stairs clear of all chemicals.
5. All chemicals shall be placed in their assigned storage areas at the end of each workday.
6. At the end of each workday, the contents of all unlabeled containers are to be considered wastes and disposed of accordingly.
7. Wastes shall be properly labeled and kept in their proper containers until collected for disposal.
8. Promptly clean up all spills; properly dispose of the spilled chemical and cleanup materials.
9. All working surfaces and floors shall be cleaned regularly.
10. No chemicals are to be stored in aisles or stairwells, on floors, or in hallways.
11. Apparatus which may discharge toxic chemicals such as vacuum pumps and distillation columns, shall be vented to a fume hood or provided with a suitable trap.
12. Avoid practical jokes or horseplay or other behavior which might confuse, startle or distract another worker.

G. Procedures for Working with Gases and Systems Above/Below Ambient Pressure

1. Detection methods for compressed gas leaks may include:

- Airborne dust, smoke or mist.
- Unusual odor or taste.
- Sound of gas escaping.
- Positive findings from monitoring operations.
- Unexplained decrease in pressure on gas gauges.

Compressed or liquefied gases present hazards if released as they cause high local concentrations, leading to explosive mixtures (if flammable) and displacement of oxygen (asphyxiation hazard). Liquid oxygen is extremely hazardous as it causes a highly explosive atmosphere. Liquid air (and liquid nitrogen exposed to air) contains liquid oxygen. As they boil, the nitrogen boils first, leaving higher and higher concentrations of oxygen in the remaining liquid. Substances that are colder than the boiling point of oxygen (90°K) can cause oxygen to liquefy. The most commonly used such substances would be liquid helium and liquid hydrogen, although liquid fluorine, neon, and argon also have boiling points lower than oxygen. Tanks of these gases must be allowed to vent, as they are not perfectly insulated, thus some liquid evaporates and causes pressure to build up. Hence, tanks of these gases may hiss unless they are empty. Helium, neon, argon and nitrogen, being relatively nontoxic, can be vented into a lab, as the amount of air displaced by normal venting is insignificant. Liquid hydrogen and liquid fluorine are very hazardous and should be stored properly and vented to a reaction chamber that converts them to non-hazardous form.

2. Ensure all pressurized compressed gas cylinders (regardless of size) are secured at all times which included use, storage, and transport. Protective caps must be placed back on cylinder when not in use.

H. Prior approval for Lab experiments

Individuals, other than faculty, must obtain prior approval to proceed with a laboratory task from the laboratory director or his or her designee whenever:
1. A new laboratory procedure or test is to be carried out, or a new instrument is to be used.
2. It is likely that flammable or toxic limit concentrations could be exceeded or that other harm is likely.
3. There is a change in a procedure or test, even if it is very similar to prior practices. "Change in a procedure or test" means:

    a. A significant increase or decrease in the amount of one or more chemicals used.

    b. A substitution or deletion of any of the chemicals in a procedure that could cause a safety risk.

I. Stopping of lab tasks

Any Laboratory task shall be stopped immediately and faculty notified if:
1. There is a failure of any of the equipment used in the process, especially of safeguards such as fume hoods or clamped apparatus.
2. There are unexpected results that caused a near miss or an injury (see reporting of injuries section for more detail)
3. Members of the laboratory staff become ill, suspect that they or others have been exposed, or otherwise suspect a failure of any safeguards.

J. Chemical Spills

Minor spills (less than 1 liter) of hazardous chemicals shall be taken care of immediately by properly trained lab personnel using proper cleanup and disposal methods such as spill cleanup kits located in laboratories and stockrooms.

Major spills of toxic substances or accidents involving any hazardous chemical should be resolved immediately according to SUNY New Paltz’s Emergency Procedure plan by dialing 911 from any campus phone or (845) 257-2222 from cell phone.

K. Chemical Waste Disposal

In order to assure that minimal harm is done to people, other organisms and the environment from the disposal of waste laboratory chemicals, indiscriminate disposal of chemicals by pouring them down the drain or adding them to mixed refuse for landfill burial is unacceptable.
The following procedures shall be followed in disposing of waste chemicals:

1. Aqueous solutions of acids and bases shall be neutralized before flushing down the drain with large volumes of water.
2. Solutions containing toxic heavy metals such as mercury, lead, chromium, silver, etc. shall be placed into "metal waste" disposal containers and placed in designated Satellite Accumulation Areas (SAA) .
3. Fume hoods shall not be used as a means of disposal of volatile chemicals.
4. Liquid organic wastes shall be emptied into labeled compatible containers kept in SAA tubs or bottle jackets in vented metal cabinets in each laboratory. Waste containers shall be labeled according to the existing protocol which includes the Words “Hazardous Waste Handle with Care” the name(s) and percentages of each of the chemicals included in containers, and the hazardous properties (such as flammable, corrosive etc) and the date when container is full . Liquid waste containers shall be removed and replaced when full and safely stored for disposal by a licensed waste hauler.
5. Highly reactive wastes such as acid chlorides shall be converted to a less reactive form before disposing in the waste containers.
6. Always ensure Hazardous Waste containers remain closed and capped (i.e. do not leave funnels in openings between fillings).
7. Dry solid wastes shall be stored in labeled containers until removed by a licensed waste hauler. A running inventory shall be maintained of each waste container's contents. Old or unneeded chemical stocks should be removed from storage and disposed of periodically.

L. Lab Emergency Posting

On the back of the main doors to labs (including labs rooms within labs where experiments are performed) shall be posted the “Emergency Reference Guide” (found in appendix). The information on the posting shall be kept current including the off hours and weekend contact information. This posting is vital for emergency response and serves as a reminder of emergency policies within labs.

M. Lab Chemical Inventories-

To assist compliance to this OSHA lab standard, HAZCOM standard and emergency response, an accurate chemical inventory must be kept of all hazardous chemicals stored/used in labs. This inventory must include the names, quantities and locations of storage within the labs. The inventory sheet included in the appendices can be used or any equivalent method as long as EH&S have access to the information and the inventory included exact locations, names and quantities.

II. PROCEDURE-SPECIFIC SAFETY PROCEDURES

All laboratory procedures must contain a written description of specific safety practices (such as PPE) and incorporating the applicable precautions described in this section. All individuals shall understand these practices before commencing a procedure.

A. PROCEDURES FOR TOXIC CHEMICALS

The Material Safety Data Sheets (MSDS) or Safety Date Sheet (SDS) for most of the chemicals used in the laboratory will state recommended limits or OSHA-mandated limits, or both, as guidelines for exposure. Typical limits are threshold limit values (TLV), permissible exposure limits (PEL), and action levels. When such limits are stated, they should be used to assist the laboratory director in determining the safety precautions, control, measures, and safety apparel that apply when working with toxic chemicals.
1. When a TLV or PEL value is less than 50 ppm or 100 mg/m3, the user of the chemical must use it in an operating fume hood or else in a glove box, vacuum line, or similar device which is equipped with appropriate traps and/or scrubbers. If none are available, no work shall be performed using that chemical.
2. If a TLV, PEL or comparable value is not available for that substance, the animal or human median inhalation lethal concentration information, LC50, will be assessed. If that value is less than 200 ppm or 2000 mg/m3 (when administered continuously for one hour or less), then the chemical must be used in an operating fume hood or else in a glove box, vacuum line, or similar device which is equipped with appropriate traps and/or scrubbers. If none are available, no work shall be performed using that chemical.
3. Whenever laboratory handling of toxic substances with moderate or greater vapor pressures will likely exceed air concentration limits, laboratory work with such liquids and solids will be conducted in a working fume hood or in a glove box, vacuum line, or similar device which is equipped with appropriate traps and/or scrubbers. If none are available, no work shall be performed using that chemical.

A reactive chemical is one that:
a. Is described as such the MSDS /SDS
b. Is ranked by the NFPA as 3 or 4 for reactivity
c. Is identified by the DOT as:

- an oxidizer
- an organic peroxide, or
- an explosive, Class A, B, or C

d. Fits the EPA definition of reactive in 40 CFR 261.23
e. Fits the OSHA definition of unstable in 29 CFR 1910.1450, or
f. Is known or found to be reactive with other substances.
g. See Section on Global Harmonization for further details on new categorizations of hazards

Handle reactive chemicals with all proper safety precautions, including segregation in storage and prohibition on mixing even small quantities with other chemicals without prior approval of the laboratory director and use of appropriate personal protection and precautions.

B. PROCEDURES FOR CARCINOGENS REPRODUCTIVE TOXINS, SUBSTANCES THAT HAVE A HIGH DEGREE OF ACUTE TOXICITY, AND CHEMICALS OF UNKNOWN TOXICITY

Follow the procedures described in this section when performing laboratory work with greater than 10 mg of any carcinogen, reproductive toxin, substance that has a high degree of acute toxicity, or a chemical whose toxic properties are unknown.
1. The following definitions will apply:

> a. **Select carcinogen:** Any substance defined as such in 29 CFR 1910.1450 and any other substance described as such in the applicable MSDS.
> b. **Reproductive toxin:** Any substance described as such in the applicable MSDS, or any substance identified as a reproductive toxin by the Oak Ridge Toxicology Information Resource Center (TIRC), (615) 576-1746, or, for teratogens only, any substance identified as such in Thomas H. Shepard, "Catalog of Teratogenic Agents", 6th Ed., Johns Hopkins Press, 1989.
> c. **Substances with a high degree of acute toxicity:**
> Any substance for which the LD50 data described in the applicable MSDS causes the substance to be classified as a "highly toxic chemical" as defined in ANSI Z129.1.
> d. **Chemical whose toxic properties are unknown**: A chemical for which there is no known statistically significant study conducted in accordance with established scientific principles that establishes its toxicity. For the purpose of this CHP, chemicals in these four categories will be called "inimical".
> f. **Designated area:** A hood, glove box, portion of a laboratory, or an entire laboratory room designated as the only area where work with quantities of the inimical chemical in excess of the specific limit shall be conducted.

2. Designated areas shall be posted and their boundaries clearly marked. Only those persons trained to work with inimical chemicals will work with those chemicals in a designated area. All such persons will:

> a. Use the smallest amount of chemical that is consistent with the requirements of the work to be done.
> b. Use high efficiency particular air (HEPA) filters or high efficiency scrubber systems to protect vacuum lines and pumps.
> c. Store inimical chemicals or remove them from storage.
> d. Decontaminate a designated area when work is completed.
> e. Prepare wastes from work with inimical chemicals for waste disposal in accordance with specific disposal procedures consistent with the Resource Conservation and Recovery Act (RCRA) and as designated by SUNY NEW PALTZ Hazardous Waste Disposal Policy.

3. Store all inimical chemicals in locked and enclosed spaces with a slight negative pressure compared to the rest of the building.
4. Do not wear jewelry when working in designated areas.5. Wear long-sleeved disposable clothing and gloves known to resist permeation by the chemicals to be used when working in designated areas.

C. PROCEDURES FOR FLAMMABLE CHEMICALS

In general, the flammability of a chemical is determined by its flash point, the lowest temperature at which an ignition source can cause the chemical to ignite momentarily under certain controlled conditions (see MSDS for more information).
1. Chemicals with a flash point below 200°F (93.3°C) will be considered "fire hazard chemicals."

2. OSHA standards and the National Fire Protection Association (NFPA) guidelines on when a chemical is considered flammable apply to the use of flammable chemicals in the laboratory. In all work with fire-hazard chemicals, follow the requirements of 29 CFR, subparts H and L; NFPA Manual 30, "Flammable and Combustible Liquids Code;" and NFPA Manual 45, "Fire Protection for Laboratories Using Chemicals."

3. Fire-hazard chemicals shall be stored in a flammable-solvent storage area or in storage cabinets designed for flammable materials.

4. Fire-hazard chemicals shall be used only in vented hoods and away from sources of ignition.

5. Flammables with a Flashpoint at or below 100 degrees F that need to be stored or cooled below ambient room temperatures shall do so with ice or in a certified explosion proof refrigerator/freezer.

6. When transferring flammable substances from one container to another, metal containers must be grounded. If pouring from one metal container to another, the two metal containers must be wired to each other (use wire with two clips - this is called bonding), and one of the containers must be grounded.

D. PROCEDURES FOR CORROSIVE CHEMICALS AND CONTACT-HAZARD CHEMICALS

Corrosivity, allergenic, and sensitizer information is given in manufacturers' MSDS's and on labels. Also, guidelines on which chemicals are corrosive can be found in other OSHA standards and in regulations promulgated by DOT in 45 CFR and the EPA in 40 CFR.

1. A corrosive chemical is one that:
a. Fits the OSHA definition of corrosive in Appendix A of 29 CFR 1910.1200
b. Fits the EPA definition of corrosive in 40 CFR 261.22 (has a pH greater than 12 or less than 2.5), or
c. Is known or found to be corrosive to living tissue.

2. A contact hazard chemical is an allergen or sensitizer that:
a. Is so identified or described in the MSDS or on the label
b. Is so identified or described in the medical or industrial hygiene literature, or
c. Is known or found to be an allergen or sensitizer

3. Handle corrosive chemicals with all proper safety precautions, depending upon quantity and use you may be required to wear both safety goggles and face shield, gloves tested for absence of pinholes and known to be resistant to permeation or penetration, and a laboratory apron or laboratory coat (See PPE section for more detail) .

E. PROCEDURES FOR USE/STORAGE OF PEROXIDE FORMING CHEMICALS

Peroxide Forming Chemicals: Management, Retention and Storage

Hazards of Peroxides

A wide variety of organic compounds spontaneously form peroxides by a free radical reaction of the hydrocarbon with molecular oxygen. Under normal storage conditions, formed peroxides can accumulate in the chemical container and may explode when subjected to heat, friction or mechanical shock. For this reason, it is imperative that laboratories learn to recognize and safely handle peroxide-forming compounds.

Practices for Control of Peroxide Forming Materials

Purchase

Ideally, purchases of peroxide-forming chemicals should be restricted to ensure that these chemicals are used up completely before they can become peroxidized. This requires careful experiment planning. Researchers should purchase no more material than is needed to complete an experiment within the chemical’s safe shelf life.

Labeling and Shelf-Life Limitation

Peroxides tend to form in materials as a function of age. Therefore, it is imperative that researchers are keenly aware of the age of their peroxide-forming chemicals. Researchers must date each container upon arrival in the laboratory. Containers must be dated again when opened for the first time. An appropriate expiration date based on what type of peroxide susceptible chemical the item is should also be on the label. Track dates and dispose of items through VEHS prior to expiration.

Storage

Peroxide-forming chemicals shall be stored in sealed, air-impermeable, light-resistant containers and should be kept away from light (light can initiate peroxide formation). Peroxide-forming chemicals should be stored in their original manufacturer’s container whenever possible. This is very important in the case of diethyl ether because the iron in the steel containers that the material is shipped in acts as a peroxide inhibitor.

Inhibitors

Many methods can be used to stabilize or inhibit the peroxidation of susceptible chemicals. If it does not interfere with the use of the chemical and if available, peroxide-forming chemicals shall be ordered with inhibitor added and peroxide scavengers (inhibitors) shall be added in small quantities to items that have been redistilled.

Management and disposal of old containers

Older containers of peroxide-forming chemicals, or containers of unknown age or history, must be handled very carefully ad should never be opened by researchers. Any peroxide-forming chemicals with visible discoloration, crystallization or liquid stratification should be treated as potentially explosive. Older steel containers that have visible rust may also be extremely dangerous. If any of these conditions are observed on a peroxide-forming chemical container or if the origin and age are unknown, do not attempt to move or open the container. Contact EH&S @ 3310 to have the container inspected and if necessary disposed of properly.

Safe Distillation of Peroxide Forming Chemicals

Eliminate the peroxides with a chemical reducing agent or pass the solvent through activated alumina.

Adding mineral oil to the distillation pot has the combined effect of “cushioning” any bumping, maintaining dilution, and serving as a viscous reaction moderator in case the peroxides begin to decompose. Carefully monitor the distillation process to ensure that it does not dry out completely, and then overheat. Distillation can concentrate peroxides, especially of taken to a dry state. Peroxides will be present mainly in the still bottoms.

Small pieces of sodium metal can be added to the distillation vessel to reduce peroxides. Use benzophenone as an indicator for the presence of sodium metal (benzophenone in the presence of sodium metal forms a radical with a deep-blue color). When the blue color disappears, add more sodium metal to the vessel.

Classification of Peroxide Forming Materials and storage disposal time requirements

Chemicals that form peroxides are classified into three classes:

- **Class A: Peroxide Hazard on Storage – Without Concentration**
  These Chemicals can form peroxides that are difficult to detect and eliminate. Label these items with a date of receipt and date of opening and dispose of these items 3 months after opening or 12 months if unopened.

- **Class B: Hazard Due to Peroxide Concentration**
  These chemicals can undergo explosive polymerization initiated by dissolved oxygen. Label these items with a date of receipt and date of opening and dispose of these items 6 months after opening or 12 months if unopened. When alcohols listed are used for purposes that do not involve heating, chemical reaction, bulk evaporation or other activities that may stress the peroxidizable material, it is not necessary to track and test these containers for peroxidation.

- **Class C: Auto Polymerize as a Result of Peroxide Accumulation**
  These chemicals may explode when relatively small quantities of peroxides are formed. These items normally have an inhibitor (scavenger) added to the substance by the manufacturer in order to prevent peroxides from forming. This inhibitor can be removed if it interferes with the use of the chemical or the chemical is redistilled in the lab. If a lab procedure requires the use of an uninhibited item in the Class, please contact EH&S @ 3310. Label these items with a date of receipt and date of opening and dispose of inhibited items after 12 months and uninhibited items within 24 hours of use.

Peroxide Formers

Class A **Peroxides from Storage**	**Class B** **Peroxides from Concentration**	**Class C** **Peroxides from Polymerization**
Butadiene*	Acetal	Butadiene**
Chloroprene*	Acetaladehyde	Chlorobutadiene
Divinyl acetylene	Benzyl alcohol	Chloroprene**
Isopropyl ether	Chlorofluoroethylene	Chlorotrifluoroethylene
Potassium amide	Cumene (isopropylbenzene)	Styrene
Potassium metal	Cyclohexene	Tetrafluoroethylene**
Sodium amide	2-Cyclohexen-1-ol	Vinyl acetate
Tetrafluoroethylene*	Cyclopentene	Vinyl acetylene
Vinyldiene chloride	Decahydronaphthalene (decalin)	Vinyl chloride
	Diacetylene (butadiyne)	Vinyl pyridine
	Dicyclopentadiene	Vinyldiene chloride
	Diethylene glycol dimethyl	
	Ether (diglyme)	
	Dioxane	
*Indicates a peroxide former when stored as a liquid monomer.	Ethly ether	**Can form explosive levels of peroxides if stored as a liquid. When stored as gas, peroxide accumulation may cause autopolymerization.
	Furan	
	4-Heptanol	
	2-Hexanol	
	Methyl acetylene	
	3-Methyl-1-butanol	
	Methyl-isobutyl ketone	
	Methylcyclopentane	
	2-Pentanol	
	4-Penten-1-ol	
	Phenylethanol	
	Tetrahydrofuran	
	Tetrahydronaphthalene	
	Vinyl ethers	
	Other secondary alcohols	

Class A Label these items with a date of receipt and date of opening and dispose of these items 3 months after opening or 12 months if unopened.
Class B Label these items with a date of receipt and date of opening and dispose of these items 6 months after opening or 12 months if unopened.

Class C Label these items with a date of receipt and date of opening and dispose of inhibited items after 12 months and uninhibited items within 24 hours of use.

F. Procedures for NMR

NMR Safety

The hazards of associated with work in the nuclear magnetic resonance (NMR) instrumentation laboratory comes from the high magnetic fields, the handling of cryogens and high electrical voltages/RF sources. SUNY New Paltz uses a AVANCE III HDTM 400 HIGH PERFORMANCE DIGITAL NMR SPECTROMETER NMR which has a shielded magnet. In general, the NMR hazards can be minimized by limiting access to the NMR facility to only authorized users of the instruments, who have the requisite technical understanding and training.

The NMR facility lab manager is **Frantz Folmer-Anderson Dept of Chemistry (845) 257-3796 EMERGENCIES – (845) 257-2222 University Police**

Electrical Hazards

- No person may operate the equipment without proper training and authorization from the NMR manager.
- Extreme caution should be used whenever the instruments are being tuned or otherwise used in a way that makes it necessary to be near the console or magnet.
- Only authorized and qualified personnel shall access electrical panels or instrument consoles.
- Report any accumulation of water on the floor of the NMR lab to the NMR facility manager. Wet areas should be avoided to prevent electrocution.

Cryogenic Liquids

No person may use cryogenic liquids in the NMR laboratory without first having been trained in the safe handling of such substances.

- The NMR facility manager must be notified before using cryogenic liquids in the NMR lab.
- Protective clothing, including lab coats, gloves and eye protection will be worn by all individuals who handle, or are in close proximity when cryogenic liquids are being transferred.
- In the event of a magnet quench (the sudden evaporation of cryogenic liquids in the magnet), the NMR lab must be immediately evacuated. Close the door and call 845-257-2222 immediately. Do not allow any entry into the room because there might be an oxygen deficiency, warn emergency responders of the issue.
- Any accidental exposure to cryogenic liquids must be reported to the NMR facility manager and Human Resources through an accident/injury report for employees, student health center for students.

Magnetic Fields and Electromagnetic Radiation

- Users in the NMR laboratory are subject to exposure to static magnetic fields. Several studies have suggested that long term cumulative exposure to oscillating magnetic fields (60 Hz) may be associated with increased incidence of brain cancer. The cumulative doses for an effect were large, and represented no hazard outside the 5 Gauss line. ***All personnel should limit the amount of time spent inside this line.***
- No person may enter the NMR laboratory without authorization from the NMR facility manager.

- Persons with pacemakers, defibrillators, or metal surgical implants or prosthetics must stay at least 6 feet away from the magnets at all times.
- Personal articles such as hairpins or jewelry must be kept away from the magnets at all times.
- Metal tools, carts, and gas cylinders must be kept away from the magnet at all times.

Glass Tubes and Evacuated Storage Dewars

- NMR Tubes must be handled with extreme caution. They are thin-walled glass and can cause dangerous wounds. Never force an NMR tube into the NMR spinner holder ,and never force the cap on or off an NMR tube.
- Evacuated storage dewars are present in the probes on all the spectrometers, and are sometimes used externally around spectrometers. These are very dangerous when broken as the vacuum can cause implosion.
- Always make connections to storage dewars carefully and without force.
- External storage dewars should always be wrapped in plastic mesh or tape to prevent flying glass if they are broken.
- Broken glass should be cleaned up and disposed of in approved glass waste containers.

- All injuries related to broken glass must be reported to the NMR facility manager and Human Resources through an accident/injury report for employees, student health center for students.

Chemical Hazards

- NMR Solvents must be handled as specified in the Connecticut College Chemical Hygiene Plan. Because there are no fume hoods in the NMR laboratory, samples requiring a hood for safe handling must be prepared outside of the NMR laboratory.
- Chemical spills or accidental exposure to NMR solvents must be reported to the NMR facility manager and the Director of Environmental Health & Safety.
- Material Data Safety Sheets for all chemicals used in Laboratory can be found in the Dept's MSDS file

Physical Hazards

- To prevent falls, stepladders and footstools, must be used with caution.
- Care must be taken to avoid overturning of the magnets. No person should ever lean on the magnet or pull on the magnet when climbing up or down when tuning the magnet.
- Cryogenic storage dewars can also be overturned quite easily. They should never be pulled from the top, but rather from the handles provided.
- All injuries related to physical hazards in the NMR laboratory must be reported to the NMR facility manager and Human Resources through an accident/injury report for employees, student health center for students.

III. CONTROL MEASURES AND EQUIPMENT

Chemical safety is achieved by continual awareness of chemical hazards and by keeping the chemical under control by using precautions, including safeguards such as hoods. Laboratory personnel shall be familiar with the precautions to be taken. Laboratory supervisors should be alert to detect the malfunction of safeguards. All safeguards and controls must be properly maintained, inspected on a regular basis, and never overloaded beyond their design limits.

A. VENTILATION

1. Laboratory ventilation shall be not less than eight air changes per hour (calculated). This flow is not necessarily sufficient to prevent accumulation of chemical vapors. Work with toxic chemicals that have low air concentration limits, or that have high vapor pressures, shall always be done in a hood.
2. Fume hoods should provide 80 to 110 linear feet per minute of air flow.
3. Laboratory workers shall understand and comply with the following directives:

    a. A fume hood is a safety backup for condensers, traps, or other devices that collect vapors and fumes. It is not used to "dispose" of chemicals by evaporation unless the vapors are trapped and recovered for proper waste disposal.
    b. The apparatus inside the hood shall be placed on the floor of the hood at least six inches away from the front edge; if it is bulky, it should be raised 2" off the floor of the hood.
    c. Fume hood windows should be lowered to 8" to 15", except when necessary to open them to adjust the apparatus that is inside the hood.
    d. The hood fan should be kept "on" whenever a chemical is inside the hood, whether or not any work is being done in the hood.
    e. Laboratory workers shall be aware of the steps to be taken in the event of power failure or hood failure and, if necessary, contact maintenance or repair personnel, extension 3311. Volatile chemicals should be removed from the hood.
    g. Hoods shall not be used as storage areas for nonvolatile chemicals, apparatus, or other materials.

B. FLAMMABLE- LIQUID STORAGE

1. Fire hazard chemicals are often purchased in glass containers. The glass containers shall be kept in bottle jackets and carried in plastic protectors.
2. Cabinets designed for the storage of flammable materials shall be properly used and maintained, including electrical grounding. Read and follow the manufacturer's information and also follow these safety practices:

    a. Store only compatible materials inside a cabinet.
    b. Do not store paper, cardboard, or other combustible packaging material in a flammable-liquid storage cabinet.
    c. The manufacturer establishes quantity limits for various sizes of flammable-liquid storage cabinets; do not overload a cabinet.
    d. Cabinets must be vented according to manufacturer's and NFPA requirements.

C. WASH FOUNTAINS AND SAFETY SHOWERS

1. All laboratories shall have access to eyewashes and safety showers. These must be located so they can be reached from any point in or from the laboratory.
2. The functioning of eyewash fountains and safety showers shall be checked and the water flow

measured at selected intervals. Any facility that does not meet the water flow requirements shall be promptly repaired.
3. Access to eyewash fountains and safety showers shall not be restricted or blocked by temporary storage of objects or in any other way.

E. RESPIRATORS

1. Individuals must wear respirators whenever it is possible that engineering controls or work practices could become or are ineffective and that individuals might be exposed to vapor or particulate concentrations greater than the PEL, action level, TLV, or similar limit, whichever is the lowest.
2. The requirements of 29 CFR 1910.134 shall be followed, including in particular:

   a. Written standard operating procedures governing the selection and use of respirators.
   b. All individuals who are likely to need to use respirators must be trained in their proper use, inspection, and maintenance. (See "SUNY New Paltz Respirator Program” in the Safety Manual for details)

F. VAPOR DETECTION

Do not use odor as a means of determining that inhalation exposure limits are or are not being exceeded. Whenever there is reason to suspect that a toxic chemical inhalation limit might be exceeded, whether or not a suspicious odor is noticed, notify the supervisor. MSDS’s can help determine if a physical symptom displayed maybe an indication of an exceeded PEL or TLV. Laboratory workers must wear a respirator suitable for protection against the suspect chemical until measurements of the concentration of the suspect vapor in the air show that the limit is not exceeded. Under this circumstance, and if there is no reason to anticipate an increase in the concentration of the chemical, and if the laboratory director approves, the respirator can be removed and the work may continue.

G. FIRE EXTINGUISHERS

Fire extinguishers are provided in every laboratory and located along normal paths of travel. Access must be maintained and the location should be conspicuously marked in an appropriate manner. The fire extinguisher and type must be selected for the appropriate hazard and checked annually.

H. FIRE ALARMS

Fire alarms and pull stations are provided along normal paths of travel, along exit routes, and are conspicuously marked. Alarms are tested at regular intervals as per NFPA requirements.

IV. RECORDS AND RECORDKEEPING

A record keeping system is established and records maintained as follows:

1. Copies of Semi Annual Safety Self audits of each lab are to be maintained by each lab department , copies are to be forwarded to the EH&S office .
2. A detailed written report form shall be completed for each accident or exposure incident and retained in file (See SUNY New Paltz Injury/Illness Reporting and Emergency procedures).
3. Chemical Inventory and usage records including the amounts of these materials on hand, amounts used.
4. Medical records shall be retained by the institution in accordance with the requirements of state and federal regulations for all affected individuals (Human Resources will keep copies if all medical records.
5. A collection of Material Safety Data Sheets (MSDS), Safety Data Sheets (SDS) and a chemical inventory shall be maintained by the Lab Manager (a copy of the lab’s chemical inventory shall be

forwarded to the EH&S dept at least annually). Each laboratory shall have MSDS's available for the chemicals used therein and MSDS's/SDS’s shall be readily available to all laboratories.
6. Documents relating to the safety training of individuals shall be kept in departmental offices and copies sent to the EH&S Office.
7. Records of air concentration monitoring results, exposure assessments, must be maintained for at least 30 years and are kept and maintained by the EH&S Office.
8. Safety suggestions from individuals should be kept. A suggestion that is unusable today might be useful tomorrow. Even when a suggestion is clearly non-workable, it should be taken seriously, examined, and recorded.
9. Complaints from individuals. It is useful to keep a written record of all complaints, investigations, and outcomes. Copies forwarded to the EH&S dept.
10. The EPA and other federal and state agencies have special record keeping requirements. For example: Record keeping of allegations and the reporting of suspect hazards from the adverse effects of chemical exposure are required under Sections 8(c) and 8(e) of the Toxic Substances Control Act; see 40 CFR 716 and 717.

V. INFORMATION AND TRAINING

SUNY New Paltz shall to provide the necessary information and training to lab workers so that they may work safely with hazardous chemicals and minimize their exposure to them. Training methods will vary depending on the background and responsibilities of the employees.

A. Laboratory (Chemical Hygiene) Training

1. Employees who have professional degrees in chemistry, such as faculty members, may not need formal Laboratory (Chemical Hygiene) training since their professional training and graduate experience already qualify them to safely handle hazardous chemicals. These employees should, however, be provided with access to this program/policy and any written material such as SDS’s, and should be prepared to "pass" an evaluation of the effectiveness of instruction in matters pertaining both to safety and health hazards and to the precautions to be taken under the variety of circumstances extant in the laboratory where they work.
2. New employees, including teaching assistants, shall be provided, at the time of their assignment to a laboratory, information and training in the hazards associated with the materials or procedures that they will be using before they are allowed in the laboratories and the reading of this program/policy and the knowledge of the locations of and access to MSDS’s/SDS’s.
3. Lab workers shall have access to the PEL's, action levels, and other recommended exposure limits for hazardous chemicals used in the SUNY New Paltz campus laboratories and with the signs and symptoms associated with exposures to these materials as per the MSDS/SDS sheets for each chemical.
4. Lab workers shall know the location and have access to the MSDS's/SDS’s and other reference materials.
5. In general, lab workers' training shall include:
a. The methods and observations that shall be used to detect the presence or release of a hazardous chemical.
b. The specific hazards associated with the chemicals that they will be using.
c. The measures laboratory workers shall use to protect themselves from these hazards, including specific procedures, such as appropriate work practices, personal protective equipment to be used, and emergency procedures.
d. A copy of this Chemical Hygiene Plan and appropriate instruction as to its content and meaning.
e. Instruction in the contents and requirements of the OSHA Laboratory Standard.

B. Chemical Labels (See GHS Section for more information) .

Many chemical manufacturers use a simple, single word on the label to give an indication of the severity of hazard for that chemical. The three most commonly used, in order of increasing severity of risk, are: CAUTION, WARNING, and DANGER. This is a very general indication. Two private associations have developed risk ratings for use on labels which are increasingly widespread in use.

Global Harmonization from OSHA has added new warning signals for SDS’s and Labels, See Global Harmonization section for more details

The National Fire Protection Association (NFPA) has developed its “704M System” which rates risks from 0 (minimum risk) to 4 (maximum risk) in each of three areas: health, flammability and reactivity. The National Paint and Coatings Association (NPCA) has developed a similar system called Hazardous Materials Information System (HMIS). The labels are diamond-shaped and contain four smaller diamonds. Three of the diamonds contain a numerical rating for the three categories given above. The fourth diamond is used to designate other special hazards associated with the particular chemical (OXY for oxidizer, COR for corrosive, etc.). Pictorial symbols may also be used. If a chemical container has no label or cannot be identified from the information on the label, the substance must be assumed to be very hazardous in every hazard category and must be treated accordingly.

Manufacturer labels must be neither defaced nor removed. The manufacturer is generally only required to include the following information on the label: the identity of the material, the hazard warnings, the name, address, and emergency phone number of a responsible party from whom additional information can be obtained if needed

If you transfer a quantity of a chemical from one container to another for storage, use, or disposal, the new container must also have a label indicating the name of that chemical as it appears on the MSDS (no abbreviations , nomenclature, etc) and any hazards associated with it (i.e. Acetone, flammable).

C. Material Safety Data Sheets (MSDS) Safety Data Sheets (SDS)

The MSDS/SDS is a legal document containing physical properties, hazards and precautionary methods applicable to the chemical. Suppliers of hazardous chemicals are required to furnish MSDS/SDS to their customers. Labs are required to have MSDS on hand for all hazardous chemicals used on the premises; these sheets will be provided by the lab managers with no access barriers such as locked offices , cabinets etc. All lab employees must know the locations of the MSDS’s /SDS’s and how to obtain a copy. The MSDS/SDS must include the following information:

- Manufacturer's name and address and an emergency telephone number where more information can be obtained
- Identity of hazardous ingredient(s)
- Hazard identification – physical and health effects, exposure limits if any (PELs, TLVs, etc.)
- First aid measures
- Fire fighting measures - flash point, explosive limits, byproducts in fire situation, etc.
- Accidental release measures
- Handling and storage information
- Exposure controls / personal protection
- Physical and chemical properties
- Stability and reactivity

Other sections may be present covering toxicology, ecological effects, disposal, transport, and special regulations pertaining to the chemical.

Before a lab worker begins to work with a chemical they should read the MSDS, noting the hazards, precautionary measures and symptoms of exposure. The Chemistry Stockroom also has a paper file of all MSDS/SDS for the Science Center. If you need an MSDS/SDS which is not in our collection, make a written request including the proper name and CAS number to the Laboratory Manager

It is important to realize that MSDS/SDS are not perfect. Not all MSDS/SDS are prepared from reliable sources; not all fully describe the known hazardous properties of a substance, and some may describe or imply hazards that are not attributable to that substance. New information also becomes available on the hazards of chemicals, making older MSDS obsolete. When reading an MSDS, remember that information that is ABSENT may be as important as information that is PRESENT. Some of the typical problems found in current MSDS's /SDS's include:

- No identification of the "target organs" (liver, kidney, lungs, central nervous system, etc.) that are threatened by exposure to the chemical.
- Incomplete PEL statements (should include short-term excursion limits and ceilings).
- A statement that the percent volatile is "zero" or "not available" when the MSDS elsewhere states that the vapor pressure is 20 mm (or something similar) at 20°C.
- A statement that the chemical does not burn, coupled with the statement that a particular type of extinguisher should be used.
- Statement that fire situation byproducts "may" be toxic - they either are or are not.
- A description of certain consequences of overexposure, but no criteria to judge what constitutes to overexposure.
- A recommendation to wear impervious gloves without specifying the glove material. Most "impervious" gloves will resist penetration for only a few hours at most. In fact, most MSDS do not specify glove materials but that information is available elsewhere (see section Personal Protective Equipment).
- Failure to instruct procedures for an unconscious victim.
- Statement to keep removed from ignition sources without an indication of what distance is safe (vapors can travel a long ways and result in flames flashing back to the source).
- Disclaimer statements that say, in effect, that the supplier cannot guarantee that any of the information in the MSDS is correct. A statement on an individual item of information, such as "The health effects of this chemical have not been studied." is acceptable, as it is true in many cases.

Bottom line is every lab employee should know how to obtain or access the MSDS/SDS for any chemicals they work with.

VI. EXPOSURE ASSESSMENTS- SUSPECTED EXPOSURES TO TOXIC SUBSTANCES

There may be times when employees or supervisors suspect that a lab worker has been exposed to a hazardous chemical to a degree and in a manner that might have caused harm to the exposed person. If the circumstances suggest a reasonable suspicion of exposure, the exposed person is entitled to a medical consultation and, if so determined in the consultation, also to a medical examination at no cost with no loss of workday time attributed to the exposed person.

A. SUSPICION OF EXPOSURE

1. Promptly investigate all reported incidents in which there is even a remote possibility of overexposure to a toxic substance.
2. Events or circumstances that might reasonably constitute overexposure include:
a. A hazardous chemical leaked or was spilled or was otherwise rapidly released in an uncontrolled manner.

b. A laboratory worker had direct skin or eye contact with a hazardous chemical.
c. A laboratory worker manifests symptoms, such as headache, rash, nausea, coughing, tearing, irritation or redness of eyes, irritation of nose or throat, dizziness, loss of motor dexterity or judgment, etc., and
-Some or all of the symptoms disappear when the person is taken away from the exposure area and breathes fresh air, and
-The symptoms reappear soon after the employee returns to work with the same hazardous chemicals.
-Two or more persons in the same laboratory work area have similar complaints.

B. EXPOSURES

All complaints and their disposition, no matter what the ultimate disposition may be, are documented. If no further assessment of the event is deemed necessary, the reason for that decision is included in the documentation. If the decision is to investigate, a formal exposure assessment is initiated.

C. FORMAL EXPOSURE ASSESSMENT

In case of emergency, exposure assessments are conducted after the victim has been treated.

NOTE: It is not the purpose of an exposure assessment to determine that a failure on the part of the victim, or others, to follow proper procedures was the cause of an exposure.

The purpose of an exposure assessment is to determine that there was, or was not, an exposure that might have caused harm to one or more laboratory workers and, if so, to identify the hazardous chemical or chemicals involved. Other investigations might well use results and conclusions from an exposure assessment, along with other information, to derive recommendations that will prevent or mitigate any future overexposures. However, exposure assessments determine facts, they do not make recommendations.
1. Unless circumstances suggest other or additional steps, these actions constitute an exposure assessment:
a. The EH&S Dept member will interview the complainant and also the exposed person, if not the same person. A record of this interview will be kept by the EH&S Office.
b. List the essential information about the circumstances of the complaint, including:
-The chemical under suspicion
-Other chemicals used by the exposed person
-All chemicals being used by others in the immediate area
-Other chemicals stored in that area
-Symptoms exhibited or claimed by the exposed person
-How these symptoms compare to symptoms stated in the Material Safety Data Sheets for each of the identified chemicals
-Were control measures, such as personal protective equipment and hoods, used properly by the exposed person?
-Were any air sampling or monitoring devices in place? If so, are the measurements consistent with other information?
2. If an overexposure is suspected, the person responsible for the laboratory, the department chair or his designee, and the EH&S Dept member shall be informed.

VII. SUNY New Paltz LABORATORY EMERGENCY PROCEDURE PLAN

A. BASIC STEPS FOR EMERGENCY RESPONSE in Labs

DETERMINE THE NATURE OF THE EMERGENCY

1. High Hazard Emergency

If the emergency is immediately dangerous to life and health, involves a large area, major injury to personnel, is a threat to personnel and the public, involves radioactive materials, involves an infectious agent, or involves a highly toxic, corrosive or reactive hazardous material, then proceed as below:
--Isolate the area, if possible, and evacuate
--Call emergency response number (Call 911 from any campus phone or (845) 257-2222 from cell phone)and activate the building fire system.

Dial 911 from any campus phone---.
--When you call:
Identify yourself and the reason you are calling.
Identify the exact location of the emergency.
Identify the nature of the emergency, any injuries or symptoms involved, and any hazardous materials involved, if you know them.
--Keep others out of the area and take action to protect life and limb.
--Notify emergency personnel of possible location of victims.
--Provide rescue only if you are properly protected from the hazard. Never attempt to rescue someone unless you know you are properly protected from the hazard.
--Do not move a seriously injured person unless he/she is in immediate danger.
--Anyone overcome with smoke or chemical gases or vapors should be moved to uncontaminated air and treated.--Provide first aid if you have the capability.
--For chemical splash in the eyes or on the skin, rinse affected area for at least 15 minutes in emergency eyewash or shower, or use other water source. Remove all contaminated clothing, including undergarments and jewelry. Call 911 for emergency assistance.
--Identify yourself and be available to provide emergency response personnel information when they arrive. Collect Material Safety Data Sheets for chemicals involved and provide these to the emergency response personnel.

2. Low Hazard Emergency

If the emergency is small, there is no fire hazard, involves low to moderately toxic materials in small amounts, or involves a readily treatable injury, proceed as outlined below.
--For a minor injury, contact University police by dialing 911 from any campus phone or (845) 257-2222 from cell phone. If a student has been injured, request transport to the Student Health Services. Non-student laboratory workers may to the Student Health Services or to the health provide of their choice.
--For a small liquid spill (less than 1 liter), use an absorbent material that will neutralize the spill. Spill kits are available from the chemistry stockroom; they are in all research and instructional labs.
--A dustpan and brush should be used for solid spills, and protective clothing (e.g., rubber gloves and goggles) should be worn. The area should be decontaminated with soap and water after clean up. Residue should be placed in a hazardous waste container for disposal

3. Fire and Fire-related Emergency.

For a fire or fire-related emergency such as abnormal heating of material, hazardous gas leaks, hazardous material or flammable liquid spill, smoke, or odor of burning, immediately follow these procedures:
--Activate the building fire alarm system (pull fire station). If not immediately available or non-operational, verbally notify persons in the building.
--Notify via the emergency number 911 from any campus phone...
--Isolate the area and evacuate the building:
    Shut down laboratory equipment in the immediate area, if possible.
    Close doors to isolate the area.
    Use a portable fire extinguisher (if trained and if possible), to:

Assist yourself to evacuate.
Assist others to evacuate.

--Provide the fire/police teams with the details of the problem upon their arrival. Special hazard information you may know is essential.

If fire alarms are ringing in the building:
-Evacuate the building.-Move at least 150 feet away from the building.
-Stay clear of driveways, sidewalks, and other access ways to the building.
-Try to account for your coworkers and report any missing persons to the emergency personnel at the scene
-Assist emergency personnel, as requested
-Do not re-enter the building until directed to do so.
4. Mercury Spills
--For small spills, such as a thermometer break, use a trapped vacuum line attached to a tapered glass tube, similar to a medicine dropper, to pick up mercury droplets.
Cover small droplets in accessible areas with powdered sulfur. Place residue in container for hazardous waste disposal.
--For large spills, dial 911 from any campus phone.

VII. Definitions (also See Global Harmonization Section for more Definitions)

A. Hazardous chemical means a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees; that is, a chemical to which exposure above a certain level constitutes a health hazard. Health hazards include chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins (including teratogens and mutagens), irritants, corrosives, sensitizers, hepatotoxins (liver), nephrotoxins (kidney), neurotoxins, agents which act on the hematopoietic systems (bone marrow and lymph), and agents which damage the lungs, skin, eyes, or mucous membranes. Appendices A, B of the OSHA "Hazard Communication Standard" (HCS; 29 CFR 1910.1200) provide further guidance in defining the scope of health hazards, and determining whether or not a chemical is to be considered hazardous for the purposes of this standard.

B. Health hazard means a chemical by definition if there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed individuals. Included are:

allergens
embryotoxicants
carcinogens
toxic or highly toxic agents
reproductive toxicants
irritants/corrosives/sensitizers
hepatoxins (liver)
nephrotoxins (kidneys)
neurotoxins (nervous system)
hematopoietic systems agents (blood)
agents which damage the lungs, skin, eyes or mucous membranes
OSHA, 29 CFR 1910.1200 Subpart Z, Toxic and Hazardous Substances, Appendices A and B

The hazard(s) of a chemical may also be listed on its container label. Additionally, if the hazard of a chemical is not evident from the container label, the Material Safety Data Sheet (MSDS) for the chemical will list the specific hazards. For further help in determining the hazard of a chemical, the supervisor or instructor should be contacted.

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

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

E. Laboratory scale means work with substances in which the containers used for reactions, transfers and other handling are designed to be easily and safely manipulated by one person. Laboratory scale excludes work places whose function is to produce commercial quantities of materials.

F. Laboratory use of hazardous chemicals means handling or use of such chemicals in which all of the following conditions are met: (1) chemical manipulations are carried out on a laboratory scale; (2) multiple chemical procedures or chemicals are used; (3) the procedures involved are not part of a production process, nor in any way simulate a production process; and (4) "protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

G. Protective laboratory practices and equipment means those laboratory procedures, practices and equipment accepted by laboratory health and safety experts as effective, or that the employer can show to be effective, in minimizing the potential for employee exposure to hazardous chemicals.

H. TLV (Threshold Limit Value) - Time-weighted average concentration for a normal 8-hour workday to which nearly all healthy workers may be repeatedly exposed without adverse effect.

I. PEL (Permissible Exposure Level) - Generally the same as the TLV, as adopted by OSHA to set a legal standard. STEL (Short Term Exposure Limit) - Maximum concentration to which healthy workers can be exposed for periods up to 15 min. Such exposure should be limited to no more than four per day with periods of at least 60 min each between exposures; the total time-weighted exposure per day should not exceed the TLV value.

J. LD50 - lethal dose 50 - the single dose of a chemical that causes the death of 50% of an animal population from exposure to the substance by any route other than inhalation

K. Routes of Exposure. The following potential routes of exposure are defined:

1. Inhalation - most common - vapors, gases, mists, dusts. Can cause damage to mucous membranes, can be absorbed into blood stream; can be accumulated in the body. Avoided by preventing escape of these materials into the working atmosphere and ensuring adequate ventilation; i.e., avoid spills, work with small amounts, and work in hoods.

2. Ingestion - entry of substances through the mouth. Can cause damage to mucous membranes, can be absorbed into blood stream, can be accumulated in the body. Caused by splashes, contamination of hands, food, drink, and smoking material. Avoided by personal hygiene - wash after handling, especially before eating, smoking, applying cosmetics. Food, drink and smoking materials should not be stored or consumed in areas where chemicals are stored or used. Chemicals should not be tasted. No pipetting by mouth.

3. Contact - Splashes, spills. Can cause local skin irritation, be absorbed through skin and produce systemic poisoning, and/or be accumulated in the body. Contact with eyes can cause severe irritation, pain and loss of vision. Avoided by use of personal protective equipment - goggles, face shields, gloves, lab coats, tongs, glove boxes.

4. Injection - not common. Caused by mechanical injury from glass or metal contaminated by chemicals or accidents with syringes. Avoided by care and personal protective equipment.

IX. SELF LAB SAFETY AUDITS

A. General Information

Every Lab must conduct an annual self audit and complete deficiencies found during audit. Self audits shall be kept in auditable records of each lab and copies forwarded to the EH&S office. The Self Lab are attached to this section . Additional Self audits forms are available from the EH&S office. Self audits are an important tool in ensuring the health and safety of labs at SUNY New Paltz. The suggested dates of completion by the labs is June of each year.

Annual LAB SELF AUDIT CHECKLIST

Building ______________________________ Room __________ Lab Manager ______________________

Date _________

Audit Performed by _____________________________

	Y	N	NA	COMMENTS
A. General Work Environment				
1. Storage of combustible materials (cardboard, paper etc) minimized				
2. Trash removed promptly				
3. Aisles and passageways to exits kept clear				
4. Heavy items stored on lower shelves				
5. Means available to reach items stored above shoulder level				
6. Exits				
a. Illuminated signs working (hallways)				
b. Paths free from obstruction				
c. Alternate exits available				
d. Fire doors not blocked or wedged open				
e. Exit doors not locked				

B. Emergency Planning				
Facilities	**Y**	**N**	**N/A**	**Comments**
1. Fire extinguishers signed off on a monthly basis				
2. Fire extinguishers unobstructed				
3. Eyewash, deluge gun or safety showers available in close proximity to chemical use (50 feet or less)and unobstructed				
Inspections				
6. Eyewash/deluge guns tested weekly by lab				(lab to assign person to test/flush)
Procedures				
8. Spill control materials available and adequate to cover anticipated spills				
C. Required Information/Postings				
Information				
1. Material Safety Data Sheets Readily accessible				
2. Documentation of All Employees have read the Chemical Hygiene Plan in current year				

Postings	**Y**	**N**	**N/A**	**Comments**
6. Emergency Information Posters accurate and current				
7. Telephones posted with 911 sticker				
8. Ice making machines posted *Not for Human Consumption*				
D. Personal Protective Equipment				
1. Eye ,face and skin protection available where needed				
a. Goggles and face shields for corrosives > 1 liter				
b. A variety of gloves for hazards present				
2. Employees and students know of requirement to use eye and skin protection and are wearing the proper eye protection as outlined in the Chemical Hygiene Plan PPE Hazard Assessment..				
3. Open toe shoes prohibited in areas where corrosives are used				
E. Electrical Hazards				
1. Equipment cords/plugs not frayed or ground pin missing				
2. Cover plate in place for outlets and switches				
3. Circuit breaker panels unobstructed				
4. Machine/instrument access panels in place				
5. No exposed electrical conductors (50 volts or more)				
6. Multi outlet strip have overload protection				
7. No extension cords used				

8. Multi-outlet strip not plugged unto another multi-outlet strip (Daisy Chained)				

F. Chemical Storage and USE

Facilities	**Y**	**N**	**N/A**	
1. Refrigeration units for chemical storage labeled *No Food*				
2. No flammable chemicals are found in non explosion proof refrigerators.				
3. Chemical storage cabinets properly labeled				
4. Incompatibles such as acid and bases, oxidizers/flammables separated by distance or in separate spill tray/bucket within cabinet (see pg 36 for more incomp)				
Containers				
6. Containers clearly labeled **with chemical name(s) and primary hazard**				
7. Containers kept closed except during transfers				
8. Storage strictly limited in actively used fume hoods				
9. Containers compatible with the chemical				
Procedures				
10. Chemicals segregated to avoid incompatibilities				
11. Large/heavy containers stored on lower shelves				
12. Corrosives not stored above eye level				
13. Storage quantities minimized				

14. Secondary containers used during transport of more than one pint of chemicals				
15. Materials with shelf lives dated and disposed of per supplier’s recommendations				
G. Flammable Liquids				
1. Used in fume hood or well-ventilated area				
2. Stored in flammable liquid storage cabinet for more than 10 gallons per room				
3. Refrigeration units approved for flammables storage				
4. Flammables separated from strong oxidizers				
5. Class ABC fire extinguisher available				
6. Flammable liquids not stored near hot plates or other ignition sources				
H. Compressed Gases				
1. Used in well ventilated area				
2. Toxic, flammable, corrosive gases used in fume hood or exhausted equipment				
3. Secured from tipping in use, storage and transport				
4. Regulators compatible with gas cylinder				
5. Cylinder carts used for transport (secured on cart as well)				
6. Protective valve caps in place when not in use (storage/transport)				

7. Empty or unused gas cylinders promptly returned to supplier				
I. Cryogenics				
1. Personal protective equipment used to avoid skin contact, face shield , apron , cryogenic gloves				
2. Used/dispensed with good ventilation				
3. Containers vented or pressure relief devices provided				
4. Glass dewars shielded				
J. Waste Disposal				
1. Containers kept sealed except during active transfer (can not have funnel left in opening while not actively transferring)				
2. Containers labeled with the words *Hazardous Waste*				
3. Constituents of the waste described on the container label				
4. Separate disposal containers available for broken glass				
5. Containers compatible with waste				
6. All hazardous waste stored in designated satellite accumulation areas with signage/bucket				
K. Ventilation				
1. Each chemical fume hood has been monitored within 12 months and sticker affixed with dates)				
2. Fume hood vents (baffles) unobstructed				

3. Fume hoods used with sash in appropriate position				
4. Chemical storage not in hoods (Storage cabinets below hoods OK)				
5. Laminar Flow Cabinets posted with limitations of use				
L. Training/Awareness				
Training				
1. Workers have read Chemical Hygiene Plan				
Awareness: Do laboratory workers know				
1. what to do in the event of an emergency, such as fire, injury, including evacuation routes				
2. how to clean up chemical spills				
3. the location/contents of the Chemical Hygiene Plan				
4. what an MSDS is and where to find them				
5. what type of personal protective equipment to use and when to use it				
6. what to do with chemical waste				
7. laboratory workers have read the SUNY New Paltz Emergency Response Plan for Fac/Staff print out available : http://www.newpaltz.edu/emergency/erp_fs.pdf				

SUNY New Paltz
Annual Lab Hygiene Review and Lab Personal Protective Equipment Training Record

I____(print full name) certify that the following affected employees have read and understood the Lab Hygiene/Chemical Hygiene and the personal protective equipment (PPE) section which included with hands on training and observations the following: when PPE is necessary; what PPE is necessary; how to properly don, doff, adjust, and wear PPE; the limitations of the PPE; and the proper care, maintenance, useful life and disposal of the PPE.

Each of the affected employees has demonstrated an understanding of the above and an ability to use the PPE properly. This training is in compliance with 29 CFR 1910.132 (f).

Name	Date

(Signature)____ (Date) _________________________

Note to signer: maintain this certification with your permanent departmental records and send copy to EH&S Dept.

EMERGENCY REFERENCE GUIDE

In an EMERGENCY DIAL 911 from any campus phone

The University Police can be reached at X2222 at ANY TIME
Environmental Health & Safety Office can be reached at X3310 8am-4pm

YOU ARE IN (Building Room Name/Number):____

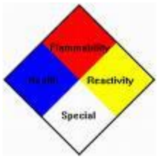
THE EMERGENCY CONTACT PERSON FOR THIS AREA IS: _______________________________@_________

THE AFTER HOURS/WEEKEND CONTACT IS: ______________________________________@ (   )

THE FIRST AID KIT FOR THIS AREA IS LOCATED:_______________________________

THE MSDS STATION FOR THIS AREA IS LOCATED: _______________________________

THE SPILL RESPONSE KIT FOR THIS AREA IS LOCATED: _________________________

EMERGENCY	***RESPONSE***
Personal Injury Minor Cuts, Burns, etc (Band-Aid variety)	Administer First Aid, Have Victim Visit Infirmary for Follow-Up
Serious or Life threatening Injury 	Call University Police at X2222 and Describe Situation. Police Officer will contact Rescue Squad and/or Assistance
Chemical Exposure	USE EMERGENCY SHOWER GUN OR EYE WASH as Necessary. If needed use fire Blanket for Privacy (lab coat may be available) Dial 911 or call University Police at X2222 and Describe Situation. Police Officer will contact Rescue Squad and/or Assistance
Fire or Explosive All Cases 	(1) Activate Fire Alarm AT Stairwell or Exit (2) Evacuate, Call X2222 and Describe Situation Use Extinguisher <u>after</u> (1) & (2) <u>only</u> if you are trained and determine it is appropriate and safe to do so
Chemical Spills 	Minor spills (less than 1 liter) of hazardous chemicals shall be taken care of immediately by trained lab personnel using proper cleanup and disposal methods such as goggles, gloves, face shield, and spill cleanup kits located in laboratories and stockrooms. Major spills of flammable or toxic substances or accidents involving any hazardous chemical should be resolved immediately according to SUNY New Paltz's Emergency Procedure plan by dialing 911 from any campus phone or (845) 257-2222 from cell phone.
Cleanup of Blood/Bodily Fluids All Cases 	Requires Training. Wear Gloves and Avoid Contact. Contact the University Police at X2222, and ask for The Housekeeping Blood Spill Team to Assist,

SPECIFIC CHEMICAL INCOMPATIBILITIES

Specific Chemical	Incompatible with
Acetic acid	Oxidizers, Nitric Acid , hydroxyl compounds, ethylene glycol
Acetone	Mixed concentrated nitric and sulfuric acids, oxidizers
Acetylene and monosubstituted Acetylenes	Halogens Alkali metals, alkaline earth metals & their salts
Ammonia and ammonium hydroxide	Halogens, halogenating agents Silver, mercury, aluminum, Acids
Ammonium nitrate	Acids, powdered metals, flammables, oxidizers, sulfur
Aniline	Nitric acid, hydrogen peroxide
Arsenical materials	Any reducing agent
Carbon, activated	Oxidizing agents (*see list above*)
Chromic acid and CrO_3	Acetic acid, glycerol, alcohol, combustibles
Chlorine, bromine	Ammonia, acetylene, butadiene, low MW alkane gases,hydrogen, sodium carbide, benzene, powdered metals,turpentine
Copper	Acetylene, azides, hydrogen peroxide
Hydrogen peroxide	Metals & their salts, flammables, solvents, acetic acid
Nitric acid	Metals, Acetic acid Sulfides, nitrites, reducing agents Chromic acid and chromates Permanganates
Mercury and its amalgams	Ammonia and ammonium hydroxide Nitric acid, acetylene, sodium azide
Oxalic acid	Silver, mercury
Phosphorus (yellow)	Oxygen, strong bases Oxidizing agents (*see list above*)
Phosphorus pentoxide	Water, halogenating agents
Sulfuric acid	Metals, chlorates, perchlorates Permanganates.

Appendix C- **SUNY New Paltz Glove Guide**

Glove Selection For Specific Lab Chemicals

Chemical	Incidental Contact	Extended Contact
Acetic acid	Nitrile	Neoprene, Butyl rubber
Acetic anhydride	Nitrile (8 mil), double glove	Butyl rubber, Neoprene
Acetone	[1]Natural rubber (Latex) (8 mil)	Butyl rubber
Acetonitrile	Nitrile	Butyl rubber, Polyvinyl acetate (PVA)
Acrylamide	Nitrile, or double Nitrile	Butyl rubber
bis-Acrylamide	Nitrile	
Alkali metals	Nitrile	
Ammonium hydroxide	Nitrile	Neoprene, Butyl rubber
Arsenic salts	Nitrile	
Benzotriazole, 1,2,3-	Nitrile	
Bismuth salts	Nitrile	
Butanol	Nitrile	Nitrile, Butyl rubber
Butyric acid	Nitrile	Butyl rubber, Neoprene
Cadmium salts	Nitrile	
Carbon disulfide	Nitrile (8 mil), double glove, or 15 mil or heavier	Viton, Polyvinyl acetate (PVA)
Carbon tetrachloride	Nitrile (8 mil), double glove, or 15 mil or heavier	Viton
Catechol	Nitrile	
Chloroform	Nitrile (8 mil), double glove, or 15 mil or heavier	Viton, Polyvinyl acetate (PVA)
Chlorosulfuron	Nitrile	
Chromium salts	Nitrile	
Cobalt chloride	Nitrile	Nitrile
Cobalt salts	Nitrile	
Copper (Cupric) sulfate	Nitrile	
Cyrogenic liquids	Cryogloves	
3,3’-Diaminobenzidine (DAB)	Nitrile	Nitrile, double glove
Diazomethane in Ether	Nitrile (8 mil), double glove, or 15 mil or heavier	Norfoil

Dichloromethane	Nitrile (8 mil), double glove	Polyvinyl acetate (PVA) or Viton
2,4-Dichlorophenoxy acetic acid	Nitrile	
Diethyl pyrocarbonate	Nitrile	Nitrile, double glove
Dimethyl sulfoxide	[1]Natural rubber (15-18mil)	Butyl rubber
1,4-Dioxane	Nitrile (8 mil), double glove, or 15 mil or heavier	Butyl rubber
Dithiothreitol	Nitrile	
Ethanol	Nitrile	
Ethidium bromide (EtBr)	Nitrile	Nitrile, double glove
Ethyl acetate	Nitrile (8 mil), double glove	Butyl rubber, PVA
Ethyl ether	Nitrile (8 mil), double glove, or 15 mil or heavier	Polyvinyl acetate (PVA)
Formaldehyde	Nitrile	
Formamide	Nitrile	Butyl rubber
Formic acid	Nitrile (8 mil), double glove	Butyl rubber, Neoprene (.28-.33mm)
Gallic acid	Nitrile	
Geneticin	Nitrile	
Glutaraldehyde	Nitrile	
Heavy metal salts	Nitrile	Nitrile, double glove
Heptane	Nitrile (8 mil), double glove, or 15 mil or heavier	Nitrile (35 mils or thicker), Viton, PVA
Hexamethylenediamine (1,6-Diaminohexane)	Nitrile (8 mil)	Neoprene
Hexane	Nitrile (8 mil), double glove, or 15 mil or heavier	Nitrile (35 mils or thicker), Viton, PVA
Hydrochloric acid	Nitrile	Neoprene, Butyl rubber
Hydrofluoric acid (HF)	Nitrile (8 mil), double glove, or 15 mil or heavier	Nitrile or Rubber sleeves
Hypophosphorous acid	Nitrile (4mil), double glove or 8 mil or heavier	
Isoamyl alcohol	Nitrile	
Isoctane	Nitrile	Heavy weight Nitrile
Isopropanol	Nitrile	
Kananmycin	Nitrile	
Lactic acid	Nitrile	Nitrile (double glove), or Neoprene or Butyl rubber
Laser dyes	Nitrile	
Lead acetate	Nitrile	Nitrile, double glove
Lead salts	Nitrile	

Mercuric chloride	Nitrile	Nitrile, double glove
Mercury	Nitrile	
Mercury salts	Nitrile	
Methanol (Methyl alcohol)	Nitrile	
Methylene chloride	Nitrile (8 mil), double glove	Polyvinyl acetate, Viton
Methylphosphonic acid	Nitrile (4 mil), double glove	8 mil or heavier Nitrile
Methyl sulfonic acid, Ethyl ester (EMS) (Ethyl methanesulfonate)	Nitrile	Nitrile, double glove
Monoethanolamine	Nitrile	
Nickel chloride	Nitrile	Nitrile, double glove
Nickel salts	Nitrile	Nitrile, double glove
Nitric acid	Nitrile (8 mil), double glove	Heavy weight (.28-.33mm) Butyl rubber or Neoprene
N-Methylethanolamine	Nitrile (8 mil), double glove	Viton, Neoprene, Butyl rubber
Octane	Nitrile	Heavy weight Nitrile or Viton
Organophosphorous compounds	Nitrile (8 mil), double glove, or 15 mil or heavier	
Osmium salts	Nitrile	
Osmium tetroxide	Nitrile	Nitrile, double glove
Paraformaldehyde	Nitrile	
Pentane	Nitrile (8mil), double glove	Heavy weight Neoprene, or Viton
Perchloroethylene (tetrachloroethylene)	Nitrile (8 mil), double glove	Nitrile (22mil or heavier)
Pesticides	heavy weight, unlined Nitrile (8-20 mils), or glove specified by pesticide label.	
Petroleum ether	Nitrile	Heavy weight Nitrile or Viton
Phenol	Nitrile (8 mil), double glove	Neoprene, Butyl rubber
Phenol-Chloroform mixtures	Nitrile (8 mil), double glove, or 15 mil or heavier	Viton
Phenylmethylsulfonyl fluoride (PMSF)	Nitrile	Nitrile, double glove
Phosphonic acid	Nitrile (4 mil), double glove, or 8 mil or heavier single	
Phosphoric acid	Nitrile (4 mil), double glove, or 8 mil or heavier	
Picloram (4-amino-3,5,6-trichloropicolinic acid)	Nitrile	
Polychlorinated Biphenyls (PCB's)	Nitrile (8 mil) glove over a Neoprene glove	Neoprene (20 mil)
Polyoxyethylene-sorbital-n-	Nitrile	

monolaurate (Tween 20)		
Potassium ferricyanide	Nitrile	
Potassium ferrocyanide	Nitrile	
Potassium permanganate	Nitrile	
Propanol	Nitrile	
Propionic acid	Nitrile	Neoprene or Butyl rubber
Propylene oxide	heavier weight (17 mil or greater) Butyl rubber or Neoprene	Norfoil
Psoralen	Nitrile	Nitrile, double glove
Pump oil	Butyl rubber	
Silane based silanization or derivatization compounds	Nitrile (8 mil), double glove, or 15 mil or heavier single	
Silver nitrate	Nitrile	Nitrile, double glove
Silver salts	Nitrile	
Sodium dodecyl sulfate (SDS)	Nitrile	
Sodium azide	Nitrile, or double glove	
Spermidine	Nitrile	
Sulfuric acid	Nitrile (8 mil)	Neoprene, Butyl rubber (20 mil or greater)
Tetrahydrofuran (THF)	Nitrile (8 mil), double glove, or 15 mil or heavier	Norfoil
3,3',5,5'-Tetramethyl-benzidine (TMB)	Nitrile	Nitrile, double glove
N,N,N',N'-Tetramethyl-ethylenediamine (TEMED)	Nitrile	Nitrile, double glove
Timetin	Nitrile	
Toluene	Nitrile (8 mil), double glove, or 15 mil or heavier	Viton, Polyvinyl acetate (PVA)
Trichloroethylene	Nitrile (8 mil), double glove	Viton, Polyvinyl acetate (PVA)
Trichloromethyl chloroformate (diphosgene)	Nitrile (8 mil) over Butyl rubber glove	This material must be used in a glove box.
Triton-X100	Nitrile	
Uranium salts	Nitrile	
Valeric acid	Nitrile	Nitrile, double gloves, or Neoprene or Butyl rubber
Xylene	Nitrile	Polyvinyl acetate (PVA), Viton

Note 1: If you are allergic to natural rubber products, you may double glove with 8 mil Nitrile gloves.

GLOVE SELECTION WEBSITES

DISCLAIMER: While the glove selection web links below are being provided as additional resources, SUNY New Paltz has not investigated the accuracy of the information contained within the webpages.

All Safety Products, Inc – Glove Selection Chart - http://www.allsafetyproducts.biz/site/323655/page/74172

Ansell Protective Products – See Ansell Chemical Resistance Guide - http://www.ansellpro.com/

Best Gloves - Comprehensive Guide to Chemical Resistant Best Gloves - http://www.bestglove.com/site/languageselection/?redirectpage=http:$$www.bestglove.com$site$chemrest$default.aspx

Cole Parmer – Safety Glove Selection Guide - http://www.coleparmer.com/techinfo/techinfo.asp?htmlfile=SelectingSGloves.htm&ID=692

Kimberly Clark Professional – Chemical Resistance Database - http://www.kcprofessional.com/us/mkt/ChemicalSelectorGuide/

Mapa Professional – Chemical Resistance Guide - http://www.mapaglove.com/ChemicalSearch.cfm?id=0

North Safety - Chemical Resistance Guide -

http://www.northsafety.com/ClientFormsImages/NorthSafety/CorpSite/E8D15F2E-1F59-454F-B8F0-147FA2B9D81D.pdf

Global Harmonization Section (GHS)

What is the GHS?

The GHS is an acronym for The Globally Harmonized System of Classification and Labeling of Chemicals. The GHS is a system for standardizing and harmonizing the classification and labeling of chemicals. It is a logical and comprehensive approach to:

- Defining health, physical and environmental hazards of chemicals;
- Creating classification processes that use available data on chemicals for comparison with the defined hazard criteria; and
- Communicating hazard information, as well as protective measures, on labels and Safety Data Sheets (SDS).

Many countries already have regulatory systems in place for these types of requirements. These systems may be similar in content and approach, but their differences are significant enough to require multiple classifications, labels and safety data sheets for the same product when marketed in different countries, or even in the same country when parts of the life cycle are covered by different regulatory authorities. This leads to inconsistent protection for those potentially exposed to the chemicals, as well as creating extensive regulatory burdens on companies producing chemicals. For example, in the United States (U.S.) there are requirements for classification and labeling of chemicals for the Consumer Product Safety Commission, the Department of Transportation, the Environmental Protection Agency, and the Occupational Safety and Health Administration.

The GHS itself is not a regulation or a standard. The GHS Document establishes agreed hazard classification and communication provisions with explanatory information on how to apply the system. The elements in the GHS supply a mechanism to meet the basic requirement of any hazard communication system, which is to decide if the chemical product produced and/or supplied is hazardous and to prepare a label and/or Safety Data Sheet as appropriate. Regulatory authorities in countries adopting the GHS will thus take the agreed criteria and provisions, and implement them through their own regulatory process and procedures rather than simply incorporating the text of the GHS into their national requirements. The GHS Document thus provides countries with the regulatory building blocks to develop or modify existing national programs that address classification of hazards and transmittal of information about those hazards and associated protective measures. This helps to ensure the safe use of chemicals as they move through the product life cycle from "cradle to grave."

Why was the GHS developed?

The production and use of chemicals is fundamental to all economies. The global chemical business is more than a $1.7 trillion per year enterprise. In the U.S., chemicals are more than a $450 billion business and exports are greater than $80 billion per year.

Chemicals directly or indirectly affect our lives and are essential to our food, our health, and our lifestyle. The widespread use of chemicals has resulted in the development of sector-specific regulations (transport, production, workplace, agriculture, trade, and consumer products). Having readily available information on the hazardous properties of chemicals, and recommended control measures, allows the production, transport, use and disposal of chemicals to be managed safely. Thus, human health and the environment are protected.

The sound management of chemicals should include systems through which chemical hazards are identified and communicated to all who are potentially exposed. These groups include workers, consumers, emergency responders and the public. It is important to know what chemicals are present and/or used, their hazards to human health and the environment, and the means to control them. A number of classification and labelling systems, each addressing specific use patterns and groups of chemicals, exist at the national, regional and international levels. The existing hazard classification and labelling systems address potential exposure to chemicals in all the types of use settings listed above.

While the existing laws and regulations are similar, they are different enough to require multiple labels for the same product both within the U.S. and in international trade and to require multiple safety data sheets for the same product in international trade. Several U.S. regulatory agencies and various countries have different requirements for hazard definitions as well as for information to be included on labels or material safety data sheets.

What are the benefits?

The basic goal of hazard communication is to ensure that employers, employees and the public are provided with adequate, practical, reliable and comprehensible information on the hazards of chemicals, so that they can take effective preventive and protective measure for their health and safety. Thus, implementation of effective hazard communication provides benefits for governments, companies, workers, and members of the public.

The GHS has maximum value if it is accepted in all major regulatory systems for chemical hazard communication. The diversity of hazard definitions is shown in Figures 1.2 and 1.3. The array of domestic and global labels for one product is shown in Figures 4.1 to 4.7. In the USA implementation of the GHS would harmonize hazard definitions and label information among U.S. regulatory agencies (CPSC, DOT, EPA, OSHA, etc.). If the GHS is implemented globally, consistent information will be communicated on labels and SDSs.

It is anticipated that application of the GHS will:

- Enhance the protection of human health and the environment by providing an internationally comprehensible system,
- Provide a recognized framework to develop regulations for those countries without existing systems,
- Facilitate international trade in chemicals whose hazards have been identified on an international basis,
- Reduce the need for testing and evaluation against multiple classification systems.

The tangible benefits to governments are:

- Fewer chemical accidents and incidents,
- Lower health care costs,
- Improved protection of workers and the public from chemical hazards,
- Avoiding duplication of effort in creating national systems,
- Reduction in the costs of enforcement,
- Improved reputation on chemical issues, both domestically and internationally.

Benefits to companies include:

- A safer work environment and improved relations with employees,
- An increase in efficiency and reduced costs from compliance with hazard communication regulations,
- Application of expert systems resulting in maximizing expert resources and minimizing labor and costs,
- Facilitation of electronic transmission systems with international scope

Are all chemicals covered by the GHS?

The GHS covers all hazardous chemicals. There are no complete exemptions from the scope of the GHS for a particular type of chemical or product. The term "chemical" is used broadly to include substances, products, mixtures, preparations, or any other terms that may be used by existing systems. The goal of the GHS is to identify the intrinsic hazards of chemical substances and mixtures and to convey hazard information about these hazards. The GHS is not intended to harmonize risk assessment procedures or risk management decisions, as described above.

"Articles" as defined in the OSHA Hazard Communication Standard (HCS) (29 CFR 1910.1200), or by similar definitions, are outside the scope of the GHS. Chemical inventory (e.g., TSCA, EINECS, etc.) and chemical control requirements in various countries are not harmonized by the GHS. Classification in the GHS is criteria-based, not limiting coverage to a list that can become outdated. It is not anticipated that the GHS will develop or maintain an international classification authority or international classification list. Several countries currently maintain regulatory lists. GHS classification criteria can be used to reclassify chemicals on lists, if desired. Existing lists, such as those provide by organizations that evaluate cancer hazards, could be used in conjunction with the GHS to promote harmonization.

Will all hazardous chemicals require a GHS label and Safety Data Sheet?

The need for GHS labels and/or Safety Data Sheets is expected to vary by product category or stage in the chemical's lifecycle from research/production to end use. For example, pharmaceuticals, food additives, cosmetics and pesticide residues in food will not be covered by the GHS at the point of consumption, but will be covered where workers may be exposed (workplaces), and in transport. Also, the medical use of human or veterinary pharmaceuticals is generally addressed in package inserts and is not part of existing hazard communication systems. Similarly, foods are generally not labeled under existing hazard communication systems. The exact requirements for labels and Safety Data Sheets will continue to be defined in national regulations.

GHS in the Workplace

In the workplace, it is expected that most of the GHS elements will be adopted, including;·

- GHS physical and health hazard criteria, as appropriate;
- Labels that have the harmonized core information under the GHS (signal words, hazard statements and symbols, etc.);
- Safety Data Sheets;
- Employee training to help ensure effective communication is also anticipated;

All workplace systems may not have the jurisdiction to adopt environmental hazards.

What is Classification?

Classification is the starting point for hazard communication. It involves the identification of the hazard(s) of a chemical or mixture by assigning a category of hazard/danger using defined criteria. The GHS is designed to be consistent and transparent. It draws a clear distinction between classes and categories in order to allow for "self classification". For many hazards a decision tree approach (e.g., eye irritation) is provided in the GHS Document. For several hazards the GHS criteria are semi-quantitative or qualitative. Expert judgment may be required to interpret these data.

Figure 3.1
Hazard Classification

The term "hazard classification is used to indicate that only the intrinsic hazardous properties of substances and mixtures are considered and involves the following 3 steps:

a) Identification of relevant data regarding the hazards of a substance or mixture;
b) Subsequent review of those data to ascertain the hazards associated with the substance or mixture; and
c) A decision on whether the substance or mixture will be classified as a hazardous substance or mixture and the degree of hazard, where appropriate, by comparison of the data with agreed hazard classification criteria.

Figure 3.1 shows the harmonized definition for hazard classification, which can be applied to all hazard categories in the system.

The data used for classification may be obtained from tests, literature, and practical experience. The GHS health and environmental hazard criteria/definitions are test method neutral. Accordingly, tests that determine hazardous properties conducted according to internationally recognized scientific principles can be used for purposes of hazard classification.

The GHS endpoints that cover physical, health and environmental hazards are listed in Figures 3.2 and 3.3, respectively. As mentioned earlier, the GHS hazard definitions are criteria-based. The following information provides an overview of the GHS definitions and classification criteria.

3.1 What are the GHS Physical Hazards?
The GHS physical hazards criteria, developed by the ILO and UNCETDG, were largely based on the existing criteria used by the UN Model Regulation on the Transport of Dangerous Goods. Therefore, many of the criteria are already being used on a worldwide basis. However, some additions and changes were necessary since the scope of the GHS includes all target audiences. The physical hazards classification process provides specific references to approved test methods and criteria for classification. The GHS physical hazard criteria apply to mixtures. It is assumed that mixtures will be tested for physical hazards.

In general, the GHS criteria for physical hazards are quantitative or semi-quantitative with multiple hazard levels within an endpoint. This is different from several of the existing systems that currently have qualitative criteria for various physical hazards (e.g., organic peroxide criteria under WHMIS and OSHA HCS). This could make classification under the GHS more consistent.

In developing GHS criteria for physical hazards it was necessary to define physical states. In the GHS,

- a gas is a substance or mixture which at 50°C has a vapor pressure greater than 300 kPa; or is completely gaseous at 20°C and a standard pressure of 101.3 kPa.
- a liquid is a substance or mixture that is not a gas and which has a melting point or initial melting point of 20°C or less at standard pressure of 101.3 kPa.
- a solid is a substance or mixture that does not meet the definitions of a liquid or a gas.

The GHS physical hazards are briefly described below. For many of the physical hazards the GHS Document contains Guidance Sections with practical information to assist in applying the criteria.

Figure 3.2
Physical Hazard

- Explosives
- Flammable Gases
- Flammable Aerosols
- Oxidizing Gases
- Gases Under Pressure
- Flammable Liquids
- Flammable Solids
- Self-Reactive Substances
- Pyrophoric Liquids
- Pyrophoric Solids
- Self-Heating Substances

- Substances which, in contact with water emit flammable gases
- Oxidizing Liquids
- Oxidizing Solids
- Organic Peroxides
- Corrosive to Metals

3.1.1 Explosives

An explosive substance (or mixture) is a solid or liquid which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings. Pyrotechnic substances are included even when they do not evolve gases. A pyrotechnic substance (or mixture) is designed to produce an effect by heat, light, sound, gas or smoke or a combination of these as the result of non-detonative, self-sustaining, exothermic chemical reactions.

Classification as an explosive and allocation to a division is a three-step process:

- Ascertain if the material has explosive effects (Test Series 1);
- Acceptance procedure (Test Series 2 to 4);
- Assignment to one of six hazard divisions (Test Series 5 to 7).

Table 3.1 Explosives

Division	Characteristics
1.1	Mass explosion hazard
1.2	Projection hazard
1.3	Fire hazard or minor projection hazard
1.4	No significant hazard
1.5	Very insensitive substances with mass explosion hazard
1.6	Extremely insensitive articles with no mass explosion hazard

Explosive properties are associated with certain chemical groups that can react to give very rapid increases in temperature or pressure. The GHS provides a screening procedure that is aimed at identifying the presence of such reactive groups and the potential for rapid energy release. If the screening procedure identifies the substance or mixture to be a potential explosive, the acceptance procedure has to be performed.

Substances, mixtures and articles are assigned to one of six divisions, 1.1 to 1.6, depending on the type of hazard they present. See, UN Manual of Tests and Criteria Part I Test Series 2 to 7. Currently, only the transport sector uses six categories for explosives.

3.1.2 Flammable Gases

Flammable gas means a gas having a flammable range in air at 20°C and a standard pressure of 101.3 kPa. Substances and mixtures of this hazard class are assigned to one of two hazard categories on the basis of the outcome of the test or calculation method (ISO 10156:1996).

3.1.3 Flammable Aerosols

Aerosols are any gas compressed, liquefied or dissolved under pressure within a non-refillable container made of metal, glass or plastic, with or without a liquid, paste or powder. The container is fitted with a release device allowing the contents to be ejected as solid or liquid particles in suspension in a gas, as a foam, paste or powder or in a liquid or gaseous state.

Aerosols should be considered for classification as either a Category 1 or Category 2 Flammable Aerosol if they contain any component classified as flammable according to the GHS criteria for flammable liquids, flammable gases, or flammable solids. Classification is based on:

- Concentration of flammable components;
- Chemical heat of combustion (mainly for transport/storage);
- Results from the foam test (foam aerosols) (mainly for worker/consumer);
- Ignition distance test (spray aerosols) (mainly for worker/consumer);
- Enclosed space test (spray aerosols) (mainly for worker/consumer).

Aerosols are considered:

- Nonflammable, if the concentration of the flammable components $\leq$ 1% and the heat of combustion is < 20 kJ/g.
- Extremely flammable, if the concentration of the flammable components >85% and the heat of combustion is $\geq$ 30 kJ/g to avoid excessive testing.

See the UN Manual of Tests and Criteria for the test method.

3.1.4 Oxidizing Gases

Oxidizing gas means any gas which may, generally by providing oxygen, cause or contribute to the combustion of other material more than air does. Substances and mixtures of this hazard class are assigned to a single hazard category on the basis that, generally by providing oxygen, they cause or contribute to the combustion of other material more than air does. The test method is ISO 10156:1996. Currently, several workplace hazard communication systems cover oxidizers (solids, liquids, gases) as a class of chemicals.

3.1.5 Gases under Pressure

Gases under pressure are gases that are contained in a receptacle at a pressure not less than 280 Pa at 20°C or as a refrigerated liquid. This endpoint covers four types of gases or gaseous mixtures to address the effects of sudden release of pressure or freezing which may lead to serious damage to people, property, or the environment independent of other hazards the gases may pose.

For this group of gases, the following information is required:

- vapor pressure at 50°C;
- physical state at 20°C at standard ambient pressure;
- critical temperature.

Criteria that use the physical state or compressed gases will be a different classification basis for some workplace systems.

Table 3.2 Gases under Pressure

Group	Criteria
Compressed gas	Entirely gaseous at -50°C
Liquefied gas	Partially liquid at temperatures > -50°C
Refrigerated liquefied gas	Partially liquid because of its low temperature
Dissolved gas	Dissolved in a liquid phase solvent

Data can be found in the literature, and calculated or determined by testing. Most pure gases are already classified in the UN Model Regulations. Gases are classified, according to their physical state when packaged, into one of four groups as shown in Table 3.2.

3.1.6 Flammable Liquids

Flammable liquid means a liquid having a flash point of not more than 93°C. Substances and mixtures of this hazard class are assigned to one of four hazard categories on the basis of the flash point and boiling point (See Table 3.3). Flash Point is determined by closed cup methods as provided in the GHS document, Chapter 2.5, paragraph 11.

Table 3.3 Flammable Liquids

Category	Criteria
1	Flash point < 23°C and initial boiling point ≤ 35°C (95°F)
2	Flash point < 23°C and initial boiling point > 35°C (95°F)
3	Flash point ≥ 23°C and ≤ 60°C (140°F)
4	Flash point ≥ 60°C (140°F) and ≤ 93°C (200°F)

3.1.7 Flammable Solids

Flammable solids are solids that are readily combustible, or may cause or contribute to fire through friction. Readily combustible solids are powdered, granular, or pasty substances which are dangerous if they can be easily ignited by brief contact with an ignition source, such as a burning match, and if the flame spreads rapidly.

Substances and mixtures of this hazard class are assigned to one of two hazard categories (Table 3.4) on the basis of the outcome of the UN Test N.1 (UN Manual of Tests and Criteria). The tests include burning time, burning rate and behavior of fire in a wetted zone of the test sample.

Table 3.4 Flammable Solids

Category	Criteria
1	Metal Powders: burning time ≤ 5 minutes Others: wetted zone does not stop fire & burning time < 45 seconds or burning > 2.2 mm/second
2	Metal Powders: burning time > 5 and ≤ 10 minutes Others: wetted zone stop fire for at least 4 minutes & burning time < 45 seconds or burning rat > 2.2mm/second

3.1.8 Self-Reactive Substances

Self-reactive substances are thermally unstable liquids or solids liable to undergo a strongly exothermic thermal decomposition even without participation of oxygen (air). This definition excludes materials classified under the GHS as explosive, organic peroxides or as oxidizing. These materials may have similar properties, but such hazards are addressed in their specific endpoints. There are exceptions to the self-reactive classification for material: (i) with heat of decomposition <300 J/g or (ii) with self-accelerating decomposition temperature (SADT) > 75°C for a 50 kg package.

Substances and mixtures of this hazard class are assigned to one of the seven 'Types', A to G, on the basis of the outcome of the UN Test Series A to H (UN Manual of Tests and Criteria). Currently, only the transport sector uses seven categories for self-reactive substances (Table 3.5).

Table 3.5 Self-Reactive Substances

Type	Criteria
A	Can detonate or deflagrate rapidly, as packaged.
B	Possess explosive properties and which, as packaged, neither detonates nor deflagrates, but is liable to undergo a thermal explosion in that package.
C	Possess explosive properties when the substance or mixture as package cannot detonate or deflagrate rapidly or undergo a thermal explosion.
D	• Detonates partially, does not deflagrate rapidly and shows no violent effect when heated under confinement; or • Does not detonate at all, deflagrates slowly and shows no violent effect when heated under confinement; or • Does not detonate or deflagrate at all and shows a medium effect when heated under confinement.
E	Neither detonates nor deflagrates at all and shows low or no effect when heated under confinement.
F	Neither detonates in the cavitated bubble state nor deflagrates at all and shows only a low or no effect when heated under confinement as well as low or no explosive power.
G	Neither detonates in the cavitated state nor deflagrates at all and shows non effect when heated under confinement nor any explosive power, provided that it is thermally stable (self-accelerating decomposition temperature is 60°C to 75°C for a 50 kg package), and, for liquid mixtures, a diluent having a boiling point not less than 150°C is used for desensitization.

Pyrophorics

3.1.9 Pyrophoric Liquids
A pyrophoric liquid is a liquid which, even in small quantities, is liable to ignite within five minutes after coming into contact with air. Substances and mixtures of this hazard class are assigned to a single hazard category on the basis of the outcome of the UN Test N.3 (UN Manual of Tests and Criteria).

3.1.10 Pyrophoric Solids
A pyrophoric solid is a solid which, even in small quantities, is liable to ignite within five minutes after coming into contact with air. Substances and mixtures of this hazard class are assigned to a single hazard category on the basis of the outcome of the UN Test N.2 (UN Manual of Tests and Criteria).

3.1.11 Self-Heating Substances
A self-heating substance is a solid or liquid, other than a pyrophoric substance, which, by reaction with air and without energy supply, is liable to self-heat. This endpoint differs from a pyrophoric substance in that it will ignite only when in large amounts (kilograms) and after long periods of time (hours or days). Substances and mixtures of this hazard class are assigned to one of two hazard categories on the basis of the outcome of the UN Test N.4 (UN Manual of Tests and Criteria).

3.1.12 Substances which on Contact with Water Emit Flammable Gases

Substances that, in contact with water, emit flammable gases are solids or liquids which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities. Substances and mixtures of this hazard class are assigned to one of three hazard categories on the basis of test results (UN Test N.5 UN Manual of Tests and Criteria) which measure gas evolution and speed of evolution.

Table 3.6 Substances which on Contact with Water Emit Flammable Gases

Category	Criteria
1	≥10 L/kg/1 minute
2	≥20 L/kg/ 1 hour + < 10 L/kg/1 min
3	≥1 L/kg/1 hour + < 20 L/kg/1 hour
Not classified	< 1 L/kg/1 hour

3.1.13 Oxidizing Liquids
An oxidizing liquid is a liquid which, while in itself not necessarily combustible, may, generally by yielding oxygen, cause or contribute to the combustion of other material. Substances and mixtures of this hazard class are assigned to one of three hazard categories on the basis of test results (UN Test O.2 UN Manual of Tests and Criteria) which measure ignition or pressure rise time compared to defined mixtures.

3.1.14 Oxidizing Solids
An oxidizing solid is a solid which, while in itself not necessarily combustible, may, generally by yielding oxygen, cause or contribute to the combustion of other material. Substances and mixtures of this hazard class are assigned to one of three hazard categories on the basis of test results (UN Test O.1 UN Manual

of Tests and Criteria) which measure mean burning time and re compared to defined mixtures. Currently, several workplace hazard communication systems cover oxidizers (solids, liquids, gases) as a class of chemicals.

3.1.15 Organic Peroxides

An organic peroxide is an organic liquid or solid which contains the bivalent -0-0- structure and may be considered a derivative of hydrogen peroxide, where one or both of the hydrogen atoms have been replaced by organic radicals. The term also includes organic peroxide formulations (mixtures). Such substances and mixtures may:

- be liable to explosive decomposition;
- burn rapidly;
- be sensitive to impact or friction;
- react dangerously with other substances.

Substances and mixtures of this hazard class are assigned to one of seven 'Types', A to G, on the basis of the outcome of the UN Test Series A to H (UN Manual of Tests and Criteria). Currently, only the transport sector uses seven categories for organic peroxides.

Table 3.7 Organic Peroxides

Type	Criteria
A	Can detonate or deflagrate rapidly, as packaged.
B	Possess explosive properties and which, as packaged, neither detonates nor deflagrates rapidly, but is liable to undergo a thermal explosion in that package.
C	Possess explosive properties when the substance or mixture as packaged cannot detonate or deflagrate rapidly or undergo a thermal explosion.
D	• Detonates partially, does not deflagrate rapidly and shows no violent effect when heated under confinement; or • Does not detonate at all, deflagrates slowly and shows no violent effect when heated under confinement; or • Does not detonate or deflagrate at all and shows a medium effect when heated under confinement.
E	Neither detonates nor deflagrates at all and shows low or no effect when heated under confinement.
F	Neither detonates in the caviated bubble state nor deflagrates at all and shows only a low or no effect when heated under confinements as well as low or non explosive power.
G	Neither detonates in the caviated state nor deflagrates at all and shows no effect when heated under confinement nor any explosive power, provided that it is thermally stable (self-accelerating decomposition temperature is 60°C to 75°C for a 50 kg package), and, for liquid mixtures, a diluent having a boiling point not less than 150°C is used for desensitization.

3.1.16 Substances Corrosive to Metal

A substance or a mixture that by chemical action will materially damage, or even destroy, metals is termed 'corrosive to metal'. These substances or mixtures are classified in a single hazard category on the basis of tests (Steel: ISO 9328 (II): 1991 - Steel type P235; Aluminum: ASTM G31-72 (1990) - non-clad types 7075-T6 or AZ5GU-T66). The GHS criteria are a corrosion rate on steel or aluminum surfaces exceeding 6.25 mm per year at a test temperature of 55°C.

The concern in this case is the protection of metal equipment or installations in case of leakage (e.g., plane, ship, tank), not material compatibility between the container/tank and the product. This hazard is not currently covered in all systems.

3.2 What are the GHS Health and Environmental Hazards?

The GHS health and environmental hazard criteria represent a harmonized approach for existing classification systems (see Figure 3.3). The work at the OECD to develop the GHS criteria included:

- A thorough analysis of existing classification systems, including the scientific basis for a system and its criteria, its rationale and an explanation of the mode of use;
- A proposal for harmonized criteria for each category. For some categories the harmonized approach was easy to develop because the existing systems had similar approaches. In cases where the approach was different, a compromise consensus proposal was developed.
- Health and environmental criteria were established for substances and mixtures.

Figure 3.3
Health Hazard

- Acute Toxicity
- Skin Corrosion/Irritation
- Serious Eye Damage/Eye Irritation

- Respiratory or Skin Sensitization
- Germ Cell Mutagenicity
- Carcinogenicity
- Reproductive Toxicology
- Target Organ Systemic Toxicity - Single Exposure
- Target Organ Systemic Toxicity - Repeated Exposure
- Aspiration Toxicity

Environmental Hazard

- Hazardous to the Aquatic Environment
    - Acute aquatic toxicity
    - Chronic aquatic toxicity
        - Bioaccumulation potential
        - Rapid degradability

The GHS Health and Environmental Endpoints

The following paragraphs briefly describe the GHS health and environmental endpoints. The criteria for classifying substances are presented first. Then the GHS approach to classifying mixtures is briefly discussed.

3.2.1 Acute Toxicity

Five GHS categories have been included in the GHS Acute Toxicity scheme from which the appropriate elements relevant to transport, consumer, worker and environment protection can be selected. Substances are assigned to one of the five toxicity categories on the basis of LD_{50} (oral, dermal) or LC_{50} (inhalation). The LC_{50} values are based on 4-hour tests in animals. The GHS provides guidance on converting 1-hour inhalation test results to a 4-hour equivalent. The five categories are shown in the Table 3.8 Acute Toxicity.

Table 3.8 Acute Toxicity

Acute toxicity	Cat. 1	Cat. 2	Cat. 3	Cat. 4	Category 5
Oral (mg/kg)	≤ 5	> 5 ≤ 50	> 50 ≤ 300	> 300 ≤ 2000	Criteria: • Anticipated oral LD50 between 2000 and 5000 mg/kg; • Indication of significant effect in humans;* • Any mortality at class 4;* • Significant clinical signs at class 4;* • Indications from other studies.* *If assignment to more hazardous class is not warranted.
Dermal (mg/kg)	≤ 50	> 50 ≤ 200	> 200 ≤ 1000	> 1000 ≤ 2000	
Gases (ppm)	≤ 100	> 100 ≤ 500	> 500 ≤ 2500	> 2500 ≤ 5000	
Vapors (mg/l)	≤ 0.5	> 0.5 ≤ 2.0	> 2.0 ≤ 10	> 10 ≤ 20	
Dust & mists (mg/l)	≤ 0.05	> 0.05 ≤ 0.5	> 0.5 ≤ 1.0	> 1.0 ≤ 5	

Category 1, the most severe toxicity category, has cut-off values currently used primarily by the transport sector for classification for packing groups. Some Competent Authorities may consider combining Acute Categories 1 and 2. Category 5 is for chemicals which are of relatively low acute toxicity but which, under certain circumstances, may pose a hazard to vulnerable populations. Criteria other than LD50/LC50 data are provided to identify substances in Category 5 unless a more hazardous class is warranted.

3.2.2 Skin Corrosion

Skin corrosion means the production of irreversible damage to the skin following the application of a test substance for up to 4 hours. Substances and mixtures in this hazard class are assigned to a single harmonized corrosion category. For Competent Authorities, such as transport packing groups, needing more than one designation for corrosivity, up to three subcategories are provided within the corrosive category. See the Skin Corrosion/Irritation Table 3.9.

Several factors should be considered in determining the corrosion potential before testing is initiated:

- Human experience showing irreversible damage to the skin;
- Structure/activity or structure property relationship to a substance or mixture already classified as corrosive;
- pH extremes of £ 2 and ³ 11.5 including acid/alkali reserve capacity.

Table 3.9 Skin Corrosion/Irritation

Skin Corrosion Category 1			Skin Irritation Category 2	Mild Skin Irritation Category 3
Destruction of dermal tissue: visible necrosis in at least one animal			Reversible adverse effects in dermal tissue Draize score: ≥ 2.3 < 4.0 or persistent inflammation	Reversible adverse effects in dermal tissue Draize score: ≥ 1.5 < 2.3
Subcategory 1A Exposure < 3 min. Observation < 1hr,	Subcategory 1B Exposure < 1hr. Observation < 14 days	Subcategory 1C Exposure < 4 hrs. Observation < 14 days		

3.2.3 Skin Irritation

Skin irritation means the production of reversible damage to the skin following the application of a test substance for up to 4 hours. Substances and mixtures in this hazard class are assigned to a single irritant category. For those authorities, such as pesticide regulators, wanting more than one designation for skin irritation, an additional mild irritant category is provided. See the Skin Corrosion/Irritation Table 3.9.

Several factors should be considered in determining the irritation potential before testing is initiated:

- Human experience or data showing reversible damage to the skin following exposure of up to 4 hours;
- Structure/activity or structure property relationship to a substance or mixture already classified as an irritant.

3.2.4 Eye Effects

Several factors should be considered in determining the serious eye damage or eye irritation potential before testing is initiated:

- Accumulated human and animal experience;
- Structure/activity or structure property relationship to a substance or mixture already classified;
- pH extremes like ≤ 2 and ≥ 11.5 that may produce serious eye damage.

Table 3.10 Eye Effects

Category 1 Serious eye damage	Category 2 Eye Irritation	
Irreversible damage 21 days after exposure Draize score: Corneal opacity ≥ 3 Iritis > 1.5	Reversible adverse effects on cornea, iris, conjunctiva Draize score: Corneal opacity ≥ 1 Iritis > 1 Redness ≥ 2 Chemosis ≥ 2	
	Irritant Subcategory 2A Reversible in 21 days	Mild Irritant Subcategory 2B Reversible in 7 days

Serious eye damage means the production of tissue damage in the eye, or serious physical decay of vision, following application of a test substance to the front surface of the eye, which is not fully reversible within 21 days of application. Substances and mixtures in this hazard class are assigned to a single harmonized category.

Eye irritation means changes in the eye following the application of a test substance to the front surface of the eye, which are fully reversible within 21 days of application. Substances and mixtures in this hazard class are assigned to a single harmonized hazard category. For authorities, such as pesticide regulators, wanting more than one designation for eye irritation, one of two subcategories can be selected, depending on whether the effects are reversible in 21 or 7 days.

3.2.5 Sensitization

Respiratory sensitizer means a substance that induces hypersensitivity of the airways following inhalation of the substance. Substances and mixtures in this hazard class are assigned to one hazard category.

Skin sensitizer means a substance that will induce an allergic response following skin contact. The definition for "skin sensitizer" is equivalent to "contact sensitizer". Substances and mixtures in this hazard class are assigned to one hazard category. Consideration should be given to classifying substances which cause immunological contact urticaria (an allergic disorder) as contact sensitizers.

3.2.6 Germ Cell Mutagenicity

Mutagen means an agent giving rise to an increased occurrence of mutations in populations of cells and/or organisms. Substances and mixtures in this hazard class are assigned to one of two hazard categories. Category 1 has two subcategories. See the Germ Cell Mutagenicity (Table 3.11) below.

Table 3.11 Germ Cell Mutagenicity

Category 1 Known/Presumed	Category 2 Suspected/Possible
Known to produce heritable mutations in human germ cells	• May include heritable mutations in human germ cells

Subcategory 1A Positive evidence from epidemiological studies	Subcategory 1B Positive results in: • In vivo heritable germ cell tests in mammals • Human germ cell tests • In vivo somatic mutagenicity tests, combined with some evidence of germ cell mutagenicity	• Positive evidence from tests in mammals and somatic cell tests • In vivo somatic genotoxicity supported by in vitro mutagenicity

3.2.7 Carcinogenicity

Carcinogen means a chemical substance or a mixture of chemical substances which induce cancer or increase its incidence. Substances and mixtures in this hazard class are assigned to one of two hazard categories. Category 1 has two subcategories. The Carcinogenicity Guidance Section in the GHS Document includes comments about IARC.

Table 3.12 Carcinogenicity

Category 1 Known or Presumed Carcinogen		Category 2 Suspected Carcinogen
Subcategory 1A Known Human Carcinogen Based on human evidence	Subcategory 1B Presumed Human Carcinogen Based on demonstrated animal carcinogenicity	Limited evidence of human or animal carcinogenicity

3.2.8 Reproductive Toxicity

Reproductive toxicity includes adverse effects on sexual function and fertility in adult males and females, as well as developmental toxicity in offspring. Substances and mixtures with reproductive and/or developmental effects are assigned to one of two hazard categories, 'known or presumed' and 'suspected'. Category 1 has two subcategories for reproductive and developmental effects. Materials which cause concern for the health of breastfed children have a separate category, Effects on or Via Lactation.

Table 3.13 Reproductive Toxicity

Category 1		Category 2 Suspected	Additional Category
Known or presumed to cause effects on human reproduction or on development		Human or animal evidence possibly with other information	Effects on or via lactation
Category 1A Known Based on human evidence	Category 1B Presumed Based on experimental animals		

3.2.9 Target Organ Systemic Toxicity (TOST): Single Exposure & Repeated Exposure

The GHS distinguishes between single and repeat exposure for Target Organ Effects. Some existing systems distinguish between single and repeat exposure for these effects and some do not. All significant health effects, not otherwise specifically included in the GHS, that can impair function, both reversible and irreversible, immediate and/or delayed are included in the non-lethal target organ/systemic toxicity class (TOST). Narcotic effects and respiratory tract irritation are considered to be target organ systemic effects following a single exposure.

Substances and mixtures of the single exposure target organ toxicity hazard class are assigned to one of three hazard categories in Table 3.14.

Table 3.14 TOST: Single Exposure

Category 1	Category 2	Category 3
Significant toxicity in humans	Presumed to be harmful to human health	Transient target organ effects
- Reliable, good quality human case studies or epidemiological studies Presumed significant toxicity in humans - Animal studies with significant and/or severe toxic effects relevant to humans at generally low exposure (guidance)	- Animal studies with significant toxic effects relevant to humans at generally moderate exposure (guidance) - Human evidence in exceptional cases	- Narcotic effects - Respiratory tract irritation

Substances and mixtures of the repeated exposure target organ toxicity hazard class are assigned to one of two hazard categories in Table 3.15.

Table 3.15 TOST: Repeated Exposure

Category 1	Category 2
Significant toxicity in humans - Reliable, good quality human case studies or epidemiological studies Presumed significant toxicity in humans - Animal studies with significant and/or severe toxic effects relevant to humans at generally low exposure (guidance)	Presumed to be harmful to human health - Animal studies with significant toxic effects relevant to humans at generally moderate exposure (guidance) - Human evidence in exceptional cases

In order to help reach a decision about whether a substance should be classified or not, and to what degree it would be classified (Category 1 vs. Category 2), dose/concentration 'guidance values' are provided in the GHS. The guidance values and ranges for single and repeated doses are intended only for guidance purposes. This means that they are to be used as part of the weight of evidence approach, and to assist with decisions about classification. They are not intended as strict demarcation values. The guidance value for repeated dose effects refer to effects seen in a standard 90-day toxicity study conducted in rats. They can be used as a basis to extrapolate equivalent guidance values for toxicity studies of greater or lesser duration.

3.2.10 Aspiration Hazard

Aspiration toxicity includes severe acute effects such as chemical pneumonia, varying degrees of pulmonary injury or death following aspiration. Aspiration is the entry of a liquid or solid directly through the oral or nasal cavity, or indirectly from vomiting, into the trachea and lower respiratory system. Some hydrocarbons (petroleum distillates) and certain chlorinated hydrocarbons have been shown to pose an aspiration hazard in humans. Primary alcohols, and ketones have been shown to pose an aspiration hazard only in animal studies.

Table 3.16 Aspiration Toxicity

Category 1: Known (regarded) human	Category 2: Presumed human
- human evidence - hydrocarbons with kinematic viscosity ? 20.5 mm^2/s at 40° C.	- Based on animal studies - surface tension, water solubility, boiling point - kinematic viscosity ? 14 mm^2/s at 40°C & not Category 1

Substances and mixtures of this hazard class are assigned to one of two hazard categories this hazard class on the basis of viscosity.

3.3 Environmental Hazards

3.3.1 Hazardous to the Aquatic Environment

The harmonized criteria are considered suitable for packaged goods in both supply and use in multi-modal transport schemes. Elements of it may be used for bulk land transport and bulk marine transport under MARPOL (International Convention for the Prevention of Pollution from Ships) insofar as this uses aquatic toxicity. Two Guidance Documents (Annexes 8 and 9 of the GHS Document) cover issues such as data interpretation and the application of the criteria to special substances. Considering the complexity of this endpoint and the breadth of the application, the Guidance Annexes are important in the application of the harmonized criteria.

3.3.1.1 Acute Aquatic Toxicity

Acute aquatic toxicity means the intrinsic property of a material to cause injury to an aquatic organism in a short-term exposure. Substances and mixtures of this hazard class are assigned to one of three toxicity categories on the basis of acute toxicity data: LC_{50} (fish) or EC_{50} (crustacea) or ErC_{50} (for algae or other aquatic plants). In some regulatory systems these acute toxicity categories may be subdivided or extended for certain sectors.

3.3.1.2 Chronic Aquatic Toxicity

Chronic aquatic toxicity means the potential or actual properties of a material to cause adverse effects to aquatic organisms during exposures that are determined in relation to the lifecycle of the organism. Substances and mixtures in this hazard class are assigned to one of four toxicity categories on the basis of acute data and environmental fate data: LC_{50} (fish) or EC_{50} (crustacea) or ErC_{50} (for algae or other aquatic plants) and degradation/bioaccumulation.

While experimentally derived test data are preferred, where no experimental data are available, validated Quantitative Structure Activity Relationships (QSARs) for aquatic toxicity and log KOW may be used in the classification process. The log K_{OW} is a surrogate for a measured Bioconcentration Factor (BCF), where such a measured BCF value would always take precedence.

Chronic Category IV is considered a "safety net" classification for use when the available data do not allow classification under the formal criteria, but there are some grounds for concern.

Table 3.17 Acute & Chronic Aquatic Toxicity

<table>
<tr><td colspan="2">Acute Cat. I
Acute toxicity ≤ 1.00 mg/l</td><td colspan="2">Acute Cat. II
Acute toxicity > 1.00 but ≤ 10.0 mg/l</td><td colspan="2">Acute Cat. III
Acute toxicity ≤ 10.0 but < 100 mg/l</td></tr>
<tr><td>Chronic Cat. I
Acute toxicity
≤ 1.00 mg/l and lack of rapid degradability and log $K_{ow} \geq 4$ unless BCF < 500</td><td colspan="2">Chronic Cat. II
Acute toxicity
> 1.00 but ≤ 10.0 mg/l and lack of rapid degradability and log $K_{ow} \geq 4$ unless BCF < 500 and unless chronic toxicity > 1 mg/l</td><td colspan="2">Chronic Cat. III
Acute toxicity
> 10.0 but ≤ 100.0 mg/l and lack of rapid degradability and log $K_{ow} \geq 4$ unless BCF < 500 and unless chronic toxicity > 1 mg/l</td><td>Chronic Cat. IV
Acute toxicity
> 100 mg/l and lack of rapid degradability and log $K_{ow} \geq 4$ unless BCF < 500 and unless chronic toxicity > 1 mg/l</td></tr>
</table>

3.4 What is the GHS approach to classifying mixtures?

For consistency and understanding the provisions for classifying mixtures, the GHS defines certain terms. These working definitions are for the purpose of evaluating or determining the hazards of a product for classification and labelling.

Substance: Chemical elements and their compounds in the natural state or obtained by any production process, including any additive necessary to preserve the stability of the product and any impurities deriving from the process used, but excluding any solvent which may be separated without affecting the stability of the substance or changing its composition.

Mixture: Mixtures or solutions composed of two or more substances in which they do not react.

Alloy: An alloy is a metallic material, homogeneous on a macroscopic scale, consisting of two or more elements so combined that they cannot be readily separated by mechanical means. Alloys are considered to be mixtures for the purpose of classification under the GHS.

Where impurities, additives or individual constituents of a substance or mixture have been identified and are themselves classified, they should be taken into account during classification if they exceed the cutoff value/concentration limit for a given hazard class.

Figure 3.4
Tier Approach to Classification of Mixtures

Generally, use test data for the mixture, if available,
⬇
Compared to substance hazard criteria
Use bridging principles, if applicable
⬇
Estimate hazard(s) based on the known component information

As mentioned previously, the GHS physical hazard criteria apply to mixtures. It is assumed that mixtures will be tested for physical hazards. Each health and environmental endpoint chapter in the GHS contains specific criteria for classifying mixtures as well as substances.

The process established for classifying a mixture allows the use of (a) available data for the mixture itself and/or (b) similar mixtures and/or (c) data for ingredients of the mixture. The GHS approach to the classification of mixtures for health and environmental hazards is tiered, and is dependent upon the amount of information available for the mixture itself and for its components. The process for the classification of mixtures is based on the following steps:

(1) Where test data are available for the mixture itself, the classification of the mixture will be based on that data (See exception for carcinogens, mutagens & reproductive toxins in the GHS Document); (2) Where test data are not available for the mixture itself, then the appropriate bridging principles (as described below) in the specific chapter should be used; (3) If (i) test data are not available for the mixture itself, and (ii) the bridging principles cannot be applied, then use the calculation or cutoff values described in the specific endpoint to classify the mixture.

3.5 What are bridging principles?

Bridging principles are an important concept in the GHS for classifying untested mixtures. When a mixture has not been tested, but there are sufficient data on the components and/or similar tested mixtures, these data can be used in accordance with the following bridging principles:

- Dilution: If a mixture is diluted with a diluent that has an equivalent or lower toxicity, then the hazards of the new mixture are assumed to be equivalent to the original.
- Batching: If a batch of a complex substance is produced under a controlled process, then the hazards of the new batch are assumed to be equivalent to the previous batches.
- Concentration of Highly Toxic Mixtures: If a mixture is severely hazardous, then a concentrated mixture is also assumed to be severely hazardous
- Interpolation within One Toxic Category: Mixtures having component concentrations within a range where the hazards are known are assumed to have those known hazards.
- Substantially Similar Mixtures: Slight changes in the concentrations of components are not expected to change the hazards of a mixture and substitutions involving toxicologically similar components are not expected to change the hazards of a mixture
- Aerosols: An aerosol form of a mixture is assumed to have the same hazards as the tested, non-aerosolized form of the mixture unless the propellant affects the hazards upon spraying.

All bridging principles do not apply to every health and environmental endpoint. Consult each endpoint to determine which bridging principles apply.

When the bridging principles do not apply or ca not be used, the health and environmental hazards of mixtures are estimated based on component information. In the GHS, the methodology used to estimate these hazards varies by endpoint. Figure 3.5 summarizes the GHS mixtures approach for the various health and environmental endpoints.

3.6 What testing is required?

The GHS itself does not include requirements for testing substances or mixtures. Therefore, there is no requirement under the GHS to generate test data for any hazard class. Some parts of regulatory systems may require data to be generated (e.g., for pesticides), but these requirements are not related specifically to the GHS. The GHS criteria for determining health and environmental hazards are test method neutral, allowing different approaches as long as they are scientifically sound and validated according to international procedures and criteria already referred to in existing systems. Test data already generated for the classification of chemicals under existing systems should be accepted when classifying these chemicals under the GHS, thereby avoiding duplicative testing and the unnecessary use of test animals. The GHS physical hazard criteria are linked to specific test methods. It is assumed that mixtures will be tested for physical hazards.

Figure 3.5 GHS Mixtures Comments

Hazard Endpoint	Classification Approach	Bridging Principles	
Acute toxicity	Acute Toxicity Estimate (ATE): 2 formulas	All	Conversion values, relevant components usually at ³ 1%
Serious Eye Damage & Eye Irritation	Mostly additivity approach, sometimes cutoffs	All	Relevant components usually at ³ 1%, exceptions for certain chemical classes
Skin corrosion & Skin Irritation	Mostly additivity approach, sometimes cutoffs	All	Relevant components usually at ³ 1%, exceptions for certain chemical classes
Skin Sensitization	Cutoffs with CA options	Dilution, Batching, Substantially similar mixtures, Aerosols	
Respiratory Sensitization	Cutoffs with CA options	Dilution, Batching, Substantially similar mixtures, Aerosols	
Germ Cell Mutagenicity	Cutoffs	Dilution, Batching, Substantially similar mixtures	Mixture test data only case-by case
Carcinogenicity	Cutoffs with CA options	Dilution, Batching, Substantially similar mixtures	Mixture test data only case-by-case
Reproductive Toxicity	Cutoffs with CA options	Dilution, Batching, Substantially similar mixtures	Mixture test data only case-by-case
Target Organ Systemic Toxicity	Cutoffs with CA options	All	
Aspiration Toxicity	Cutoffs	Dilution, Batching, Concentration of highly toxic mixtures, Interpolation within one toxicity category, Substantially similar mixtures	
Hazardous to the Aquatic Environment	Additivity Formula (Acute only); Summation Method (Acute or Chronic); Combination of Additivity Formula & Summation Method	Dilution, Batching, Concentration of highly toxic mixtures, Interpolation within one toxicity category, Substantially similar mixtures	Relevant components usually at ³ 1%, Mixture test data only case-by-case for chronic

4.0 Hazard Communication

Section 3, explained that classification is the starting point for the GHS. Once a chemical has been classified, the hazard(s) must be communicated to target audiences. As in existing systems, labels and Safety Data Sheets are the main tools for chemical hazard communication. They identify the hazardous properties of chemicals that may pose a health, physical or environmental hazard during normal handling or use. The goal of the GHS is to identify the intrinsic hazards found in chemical substances and mixtures, and to convey information about these hazards.

The international mandate for the GHS included the development of a harmonized hazard communication system, including labelling, Safety Data Sheets and easily understandable symbols, based on the classification criteria developed for the GHS.

4.1 What factors influenced development of the GHS communication tools?

Early in the process of developing the GHS communication tools, several significant issues were recognized. One of the most important was comprehensibility of the information provided. After all, the aim of the system is to present hazard information in a manner that the intended audience can easily understand and that will thus minimize the possibility of adverse effects resulting from exposure. The GHS identifies some guiding principles to assist in this process:

- Information should be conveyed in more than one way, e.g., text and symbols;
- The comprehensibility of the components of the system should take account of existing studies and literature as well as any evidence gained from testing;
- The phrases used to indicate degree (severity) of hazard should be consistent across the health, physical and environmental hazards.

Comprehensibility is challenging for a single culture and language. Global harmonization has numerous complexities. Some factors that affected the work include:

- Different philosophies in existing systems on how and what should be communicated;
- Language differences around the world;
- Ability to translate phrases meaningfully;

- Ability to understand and appropriately respond to symbols/pictograms.

These factors were considered in developing the GHS communication tools.

4.2 Labels

4.2.1 What does a label look like?

Existing systems have labels that look different for the same product. We know that this leads to worker confusion, consumer uncertainty and the need for additional resources to maintain different systems. In the U.S. as well as in other countries, chemical products are regulated by sector/target audience. Different agencies regulate the workplace, consumers, agricultural chemicals and transport. Labels for these sectors/target audiences vary both in the U.S. and globally.

In order to understand the value of the GHS and its benefits to all stakeholders, it is instructive to look at the different labels for one fictional product. In the U.S. the product, ToxiFlam, which has a flash point of 120°F and has an oral LD50 of 275 mg/kg, has different labels for different sectors/target audiences. Label examples as seen in the U.S.A. are shown first, followed by international examples.

4.2.2 USA Examples:

Workplace and Workers

In the U.S., regulatory requirements for workplace labels are 'performance oriented'. This results at a minimum in a straightforward label that has a product identity, hazard statement and supplier identification (Figure 4.1). Some products can also have additional labelling requirements depending on their end use.

Figure 4.1
ToxiFlam
TOXIC
COMBUSTIBLE LIQUID AND
VAPOR

My Company, My Street, MyTown NJ
00000
Tel. 444 999 9999

However, many companies follow the voluntary ANSI Z129.1 Precautionary Labelling Standard for workplace labelling and often use it also for labelling consumer products. The American National Standards Institute (ANSI) standard includes several label elements that are core to the GHS as well as other helpful elements to assist users in safe handling (Figure 4.2).

Figure 4.2
ToxiFlam (Contains XYZ)

WARNING! HARMFUL IF SWALLOWED, FLAMMABLE LIQUID AND VAPOR

Do not taste or swallow. Do not take internally. Wash thoroughly after handling. Keep away from heat, sparks and flame. Keep container closed. Use only with adequate ventilation.

FIRST AID: If swallowed, do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person.
In case of Fire, use water fog, dry chemical, CO_2, or alcohol foam. Water may be ineffective.
Flash Point = 120°F. Residue vapor may explode or ignite on ignition; do not cut, drill, grind, or weld on or near the container.

See Material Safety Data Sheet for further details regarding safe use of this product.

My Company, My Street, MyTown NJ 00000 Tel. 444 999 9999

Consumer Products and Consumers

Figure 4.3
ToxiFlam
(Contains XYZ)

WARNING! HARMFUL IF SWALLOWED, FLAMMABLE LIQUID AND VAPOR

Do not taste or swallow. Do not take internally. Wash thoroughly after handling. Keep away from heat, sparks and flame. Keep container closed. Use only with adequate ventilation.

FIRST AID
If swallowed, do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person.
Keep out of reach of children

My Company, My Street, MyTown NJ 00000 Tel. 444 999 9999

In several countries consumer products are regulated separately from workplace chemicals. In the U.S. the CPSC regulates consumer products. Consumer products have required label elements, but only the signal words are specified. The ANSI labelling standard is often used in developing consumer labels.

Transport and Emergency Responders

For hazardous products being transported, outer containers have required label elements, product identifier and hazard symbols. Transportation requirements are in addition to workplace or end use label requirements.

Figure 4.4
Flammable liquids, toxic, n.o.s. (contains XYZ)
UN 1992

MyCompany, MyStreet NJ 00000

Agricultural Chemicals and Pesticides

In many systems, agricultural chemicals often have special label requirements. In the U.S. the EPA is the agency covering these chemicals. A pesticide product with the same hazards as ToxiFlam would have a label developed using FIFRA requirements. FIFRA has requirements for product identity, chemical identity, signal word, hazard statements, and precautionary measures including first aid.

Figure 4.5
ToxiFlam
Active/ Inerts: Contains XYZ %

KEEP OUT OF THE REACH OF CHILDREN

PRECAUTIONARY STATEMENTS - HAZARDS TO HUMANS AND DOMESTIC ANIMALS:
WARNING: May be fatal if swallowed. Wash thoroughly with soap and water after handling and before eating, drinking or using tobacco .
PHYSICAL AND CHEMICAL HAZARDS: Combustible. Do not use or store near heat or open flame.
FIRST AID:
If swallowed
- Call a poison control center or doctor immediately for treatment advice.
- Have person sip a glass of water if able to swallow.
- Do not induce vomiting unless told to do so by a poison control center or doctor.
- Do not give anything by mouth to an unconscious person.

My Company, My Street, MyTown AZ 00000, Tel: 444 999 9999

EPA Est . No. 5840-AZ-1 EPA Reg. No. 3120-280

4.2.3 International Examples
All the previous examples are specific to the U.S. Many companies do business globally. So in addition to the U.S. regulations, these companies would need to comply with the corresponding regulations in the countries to which they export products. Canada and the EU are two existing systems that were considered in the development of the GHS. To illustrate the differences in labeling, it is interesting to examine an EU and Canadian label for ToxiFlam.

European Union Label

Labels in the EU have chemical identity, symbols, and R/S (Risk and Safety) phrases which are hazard statements, precautionary measures and first aid.

Figure 4.6
ToxiFlam (contains XYZ)

KEEP OUT OF THE REACH OF CHILDREN

Harmful If Swallowed. (R22)
Flammable. (R10)
Keep away from food, drink and animal feeding stuffs. (S13)
Wear suitable protective clothing. (S36)
If swallowed, seek medical advice immediately and show this

Container label. (S46)
In case of fire, use water, fog, CO2, or alcohol foam. (S43)

My Company, My Street, MyTown XX 00000, Tel: 44 22 999 9999

Canadian Workplace Hazardous Materials Identification System (WHMIS) Label

The WHMIS label requires product identifier, hazard symbol, hazard statement, precautionary measures, first aid, MSDS statement and supplier identification. In addition to these common label elements, WHMIS requires a hatched border.

Figure 4.7
ToxiFlam

TOXIC
COMBUSTIBLE LIQUID AND VAPOR

Do not taste or swallow. Do not take internally. Wash thoroughly after handling. Keep away from heat, sparks and flame. Keep container closed. Use only with adequate ventilation.

FIRST AID
If swallowed, do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person.

See Material Safety Data Sheet for further details regarding safe use of this product.
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4.3 What are the GHS label elements?

Some GHS label elements have been standardized (identical with no variation) and are directly related to the endpoints and hazard level. Other label elements are harmonized with common definitions and/or principles. See Figure 4.8 for an illustration of the GHS label elements.

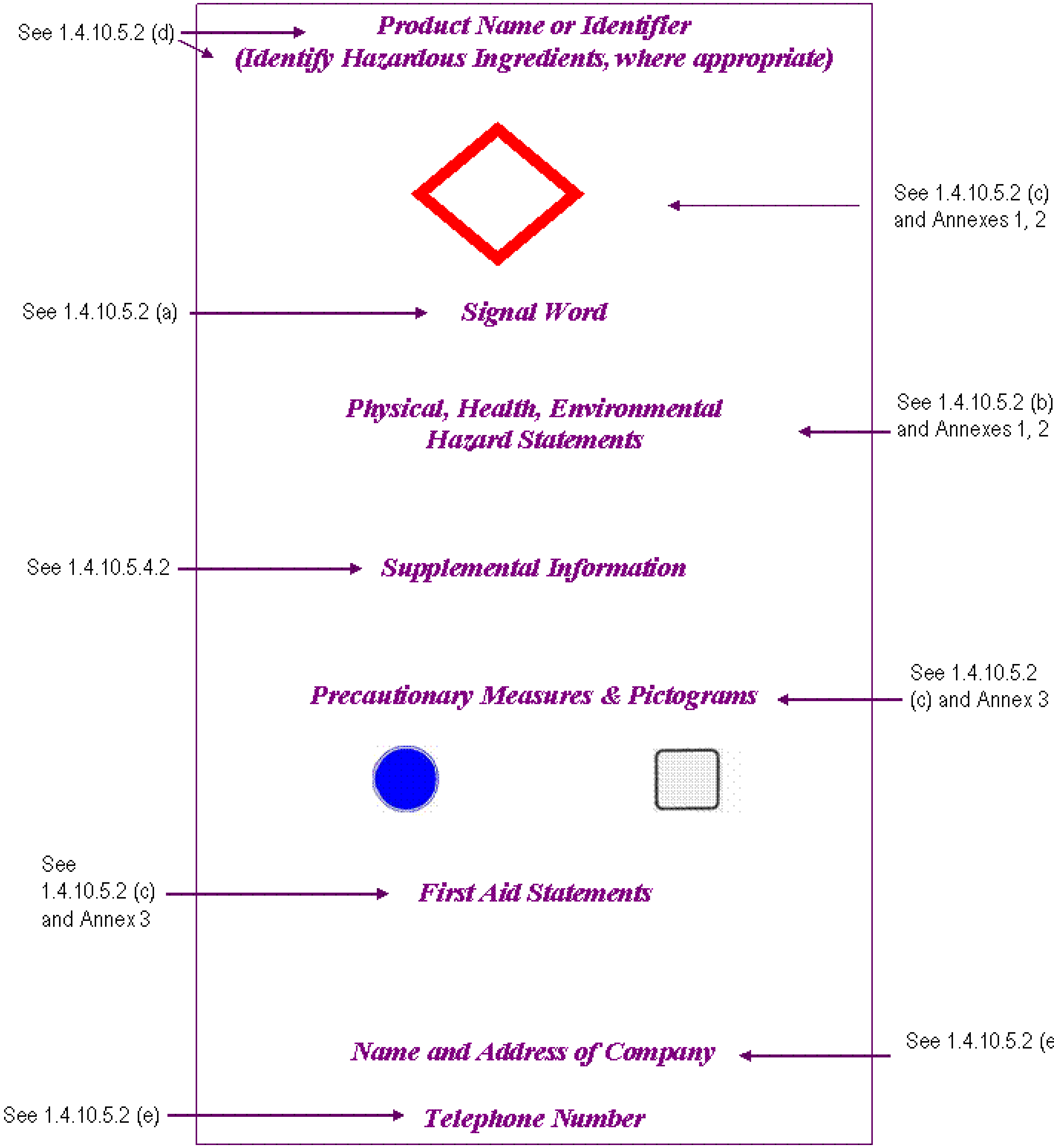
The standardized label elements included in the GHS are:

- Symbols (hazard pictograms): Convey health, physical and environmental hazard information, assigned to a GHS hazard class and category.
- Signal Words: "Danger" or "Warning" are used to emphasize hazards and indicate the relative level of severity of the hazard, assigned to a GHS hazard class and category.
- Hazard Statements: Standard phrases assigned to a hazard class and category that describe the nature of the hazard.

The symbols, signal words, and hazard statements have all been standardized and assigned to specific hazard categories and classes, as appropriate. This approach makes it easier for countries to implement the system and should make it easier for companies to comply with regulations based on the GHS. These standardized elements are not subject to variation, and should appear on the GHS label as indicated in the GHS for each hazard category/class in the system. The use of symbols, signal words or hazard statements other than those that have been assigned to each of the GHS hazards would be contrary to harmonization.

Figure 4.8

GHS Label Elements



4.3.1 Symbols/Pictograms

The GHS symbols have been incorporated into pictograms for use on the GHS label. Pictograms include the harmonized hazard symbols plus other graphic elements, such as borders, background patterns or colors which are intended to convey specific information. For transport, pictograms (Table 4.10) will have the background, symbol and colors currently used in the UN Recommendations on the Transport of Dangerous Goods, Model Regulations. For other sectors, pictograms (Table 4.9) will have a black symbol on a white background with a red diamond frame. A black frame may be used for shipments within one country. Where a transport pictogram appears, the GHS pictogram for the same hazard should not appear.

4.3.2 Signal Words

The signal word indicates the relative degree of severity a hazard. The signal words used in the GHS are

"Danger" for the more severe hazards, and
"Warning" for the less severe hazards.

Signal words are standardized and assigned to the hazard categories within endpoints. Some lower level hazard categories do not use signal words. Only one signal word corresponding to the class of the most severe hazard should be used on a label.

4.3.3 Hazard Statements

Hazard statements are standardized and assigned phrases that describe the hazard(s) as determined by hazard classification. An appropriate statement for each GHS hazard should be included on the label for products possessing more than one hazard. Figure 4-11 illustrates the assignment of standardized GHS label elements for the acute oral toxicity categories.

Figure 4.9

GHS Pictograms and Hazard Classes		
		
• Oxidizers	• Flammables • Self Reactives • Pyrophorics • Self-Heating • Emits Flammable Gas • Organic Peroxides	• Explosives • Self Reactives • Organic Peroxides
		
• Acute toxicity (severe)	• Corrosives	• Gases Under Pressure
		
• Carcinogen • Respiratory Sensitizer	• Environmental Toxicity	• Irritant • Dermal Sensitizer

• Reproductive Toxicity • Target Organ Toxicity • Mutagenicity • Aspiration Toxicity		• Acute toxicity (harmful) • Narcotic Effects • Respiratory Tract • Irritation

Figure 4.10

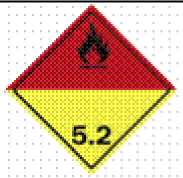
Transport "Pictograms"		
		
Flammable Liquid Flammable Gas Flammable Aerosol	Flammable solid Self-Reactive Substances	Pyrophorics (Spontaneously Combustible) Self-Heating Substances
		
Substances, which in contact with water, emit flammable gases (Dangerous When Wet)	Oxidizing Gases Oxidizing Liquids Oxidizing Solids	Explosive Divisions 1.1, 1.2, 1.3
		
Explosive Division 1.4	Explosive Division 1.5	Explosive Division 1.6
		
Compressed Gases	Acute Toxicity (Poison): Oral, Dermal, Inhalation	Corrosive
		
Marine Pollutant	Organic Peroxides	

Figure 4.11

ACUTE ORAL TOXICITY - Annex 1					
	Category 1	Category 2	Category 3	Category 4	Category 5
LD_{50}	£ 5 mg/kg	> 5 < 50 mg/kg	³ 50 < 300 mg/kg	³ 300 < 2000 mg/kg	³ 2000 < 5000 mg/kg
Pictogram					No symbol
Signal word	Danger	Danger	Danger	Warning	Warning
Hazard statement	Fatal if swallowed	Fatal if swallowed	Toxic if swallowed	Harmful if swallowed	May be harmful if swallowed

Other GHS label elements include:

- Precautionary Statements and Pictograms: Measures to minimize or prevent adverse effects.
- Product Identifier (ingredient disclosure): Name or number used for a hazardous product on a label or in the SDS.
- Supplier identification: The name, address and telephone number should be provided on the label.
- Supplemental information: non-harmonized information.

4.3.4 Precautionary Statements and Pictograms

Precautionary information supplements the hazard information by briefly providing measures to be taken to minimize or prevent adverse effects from physical, health or environmental hazards. First aid is included in precautionary information. The GHS label should include appropriate precautionary information.

4.3.5 Product Identifier (Ingredient Disclosure)

A product identifier should be used on a GHS label and it should match the product identifier used on the SDS. Where a substance or mixture is covered by the UN Model Regulations on the Transport of Dangerous Goods, the UN proper shipping name should also be used on the package.

The GHS label for a substance should include the chemical identity of the substance (name as determined by IUPAC, ISO, CAS or technical name). For mixtures/alloys, the label should include the chemical identities of all ingredients that contribute to acute toxicity, skin corrosion or serious eye damage, germ cell mutagenicity, carcinogenicity, reproductive toxicity, skin or respiratory sensitization, or Target Organ Systemic Toxicity (TOST), when these hazards appear on the label. Where a product is supplied exclusively for workplace use, the Competent Authority may give suppliers discretion to include chemical identities on the SDS, in lieu of including them on labels. The Competent Authority rules for confidential business information (CBI) take priority over the rules for product identification.

4.3.6 Supplier Identification

The name, address and telephone number of the manufacturer or supplier of the product should be provided on the label.

4.3.7 Supplemental Information

Supplemental label information is non-harmonized information on the container of a hazardous product that is not required or specified under the GHS. In some cases this information may be required by a Competent Authority or it may be additional information provided at the discretion of the manufacturer/distributor. The GHS provides guidance to ensure that supplemental information does not lead to wide variation in information or undermine the GHS information. Supplemental information may be used to provide further detail that does not contradict or cast doubt on the validity of the standardized hazard information. It also may be used to provide information about hazards not yet incorporated into the GHS. The labeler should have the option of providing supplementary information related to the hazard, such as physical state or route of exposure, with the hazard statement.

4.4 How are multiple hazards handled on labels?

Where a substance or mixture presents more than one GHS hazard, there is a GHS precedence scheme for pictograms and signal words. For substances and mixtures covered by the UN Recommendations on the Transport of Dangerous Goods, Model Regulations, the precedence of symbols for physical hazards should follow the rules of the UN Model Regulations. For health hazards the following principles of precedence apply for symbols:

(a) if the skull and crossbones applies, the exclamation mark should not appear;
(b) if the corrosive symbol applies, the exclamation mark should not appear where it is used for skin or eye irritation;
(c) if the health hazard symbol appears for respiratory sensitization, the exclamation mark should not appear where it is used for skin sensitization or for skin or eye irritation.

If the signal word 'Danger' applies, the signal word 'Warning' should not appear. All assigned hazard statements should appear on the label. The Competent Authority may choose to specify the order in which they appear.

4.5 Is there a specific GHS label format / layout?

The GHS hazard pictograms, signal word and hazard statements should be located together on the label. The actual label format or layout is not specified in the GHS. National authorities may choose to specify where information should appear on the label or allow supplier discretion.

Figure 4.12 shows an example of a GHS label for the fictional product 'ToxiFlam'. The core GHS label elements are expected to replace the need for the array of different labels shown earlier for ToxiFlam. (Figure 4.8 also illustrates the GHS label elements.)

Figure 4.12 Example GHS Inner Container Label (e.g., bottle inside a shipping box)

ToxiFlam (Contains: XYZ)

Danger! Toxic If Swallowed, Flammable Liquid and Vapor

Do not eat, drink or use tobacco when using this product. Wash hands thoroughly after handling. Keep container tightly closed. Keep away from heat/sparks/open flame. - No smoking. Wear protective gloves and eye/face protection. Ground container and receiving equipment. Use explosion-proof electrical equipment. Take precautionary measures against static discharge.
Use only non-sparking tools. Store in cool/well-ventilated place.

IF SWALLOWED: Immediately call a POISON CONTROL CENTER or doctor/physician. Rinse mouth.

In case of fire, use water fog, dry chemical, CO_2, or "alcohol" foam.

See Material Safety Data Sheet for further details regarding safe use of this product.

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There has been discussion about the size of GHS pictograms and that a GHS pictogram might be confused with a transport pictogram or "diamond". Transport pictograms (Table 4.10) are different in appearance than the GHS pictograms (Table 4.9). So that generally the GHS pictograms would be smaller than the transport pictograms.

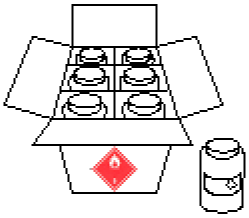

Figure 4.13 Combination Packaging (Outer box with inner bottles)

Figure 4.13 shows an arrangement for a combination packaging with an outer shipping box and inner bottles. The shipping box has a transportation pictogram. The inner bottles have a GHS label with a GHS pictogram.

Are workplace containers covered in the GHS ?

Products falling within the scope of the GHS will carry the GHS label at the point where they are supplied to the workplace, and that label should be maintained on the supplied container in the workplace. The GHS label or label elements can also be used for workplace containers (e.g., storage tanks). However, the Competent Authority can allow employers to use alternative means of giving workers the same information in a different written or displayed format when such a format is more appropriate to the workplace and communicates the information as effectively as the GHS label. For example, label information could be displayed in the work area, rather than on the individual containers. Some examples of workplace situations where chemicals may be transferred from supplier containers include: containers for laboratory testing, storage vessels, piping or process reaction systems or temporary containers where the chemical will be used by one worker within a short timeframe.

What is the GHS Safety Data Sheet (SDS)?

The (Material) Safety Data Sheet (SDS) provides comprehensive information for use in workplace chemical management. Employers and workers use the SDS as sources of information about hazards and to obtain advice on safety precautions. The SDS is product related and, usually, is not able to provide information that is specific for any given workplace where the product may be used. However, the SDS information enables the employer to develop an active program of worker protection measures, including training, which is specific to the individual workplace and to consider any measures that may be necessary to protect the environment. Information in a SDS also provides a source of information for other target audiences such as those involved with the transport of dangerous goods, emergency responders, poison centers, those involved with the professional use of pesticides and consumers.

The SDS should contain 16 headings (Figure 4.14). The GHS MSDS headings, sequence and content are similar to the ISO, EU and ANSI MSDS/SDS requirements, except that the order of sections 2 and 3 have been reversed. The SDS should provide a clear description of the data used to identify the hazards. Figure 4.14 provide the minimum information that is required in each section of the SDS. Examples of draft GHS SDSs are provided in Appendix B of this guidance document.

Other resources for SDSs include:

- ILO Standard under the Recommendation 177 on Safety in the Use of Chemicals at Work,
- International Standard 11014-1 (1994) of the International Standard Organization (ISO) and ISO Safety Data Sheet for Chemical Products 11014-1: 2003 DRAFT,
- American National Standards Institute (ANSI) Standard Z400.1,
- European Union SDS Directive 91/155/-EEC.

Figure 4.14

Minimum information for an SDS

1.	Identification of the substance or mixture and of the supplier	• GHS product identifier. • Other means of identification. • Recommended use of the chemical and restrictions on use. • Supplier's details (including name, address, phone number, etc.). • Emergency phone number.
2.	Hazards identification	• GHS classification of the substance/mixture and any national or regional information. • GHS label elements, including precautionary statements. (Hazard symbols may be provided as a graphical reproduction of the symbols in black and white or the name of the symbol, e.g., flame, skull and crossbones.) • Other hazards which do not result in classification (e.g., dust explosion hazard) or are not covered by the GHS.
3.	Composition/information on ingredients	Substance • Chemical identity. • Common name, synonyms, etc. • CAS number, EC number, etc. • Impurities and stabilizing additives which are themselves classified and which contribute to the classification of the substance. Mixture • The chemical identity and concentration or concentration ranges of all ingredients which are hazardous within the meaning of the GHS and are present above their cutoff levels. NOTE: For information on ingredients, the competent authority rules for CBI take priority over the rules for product identification.
4.	First aid measures	• Description of necessary measures, subdivided according to the different routes of exposure, i.e., inhalation, skin and eye contact, and ingestion. • Most important symptoms/effects, acute and delayed. • Indication of immediate medical attention and special treatment needed, if necessary.
5.	Firefighting measures	• Suitable (and unsuitable) extinguishing media. • Specific hazards arising from the chemical (e.g., nature of any hazardous combustion products). • Special protective equipment and precautions for firefighters.

6.	Accidental release measures	• Personal precautions, protective equipment and emergency procedures. • Environmental precautions. • Methods and materials for containment and cleaning up.
7.	Handling and storage	• Precautions for safe handling. • Conditions for safe storage, including any incompatibilities.
8.	Exposure controls/personal protection.	• Control parameters, e.g., occupational exposure limit values or biological limit values. • Appropriate engineering controls. • Individual protection measures, such as personal protective equipment.
9.	Physical and chemical properties	• Appearance (physical state, color, etc.). • Odor. • Odor threshold. • pH. • melting point/freezing point. • initial boiling point and boiling range. • flash point. • evaporation rate. • flammability (solid, gas). • upper/lower flammability or explosive limits. • vapor pressure. • vapor density. • relative density. • solubility(ies). • partition coefficient: n-octanol/water. • autoignition temperature. • decomposition temperature.
10.	Stability and reactivity	• Chemical stability. • Possibility of hazardous reactions. • Conditions to avoid (e.g., static discharge, shock or vibration). • Incompatible materials. • Hazardous decomposition products.
11.	Toxicological information	Concise but complete and comprehensible description of the various toxicological (health) effects and the available data used to identify those effects, including: • information on the likely routes of exposure (inhalation, ingestion, skin and eye contact); • Symptoms related to the physical, chemical and toxicological characteristics; • Delayed and immediate effects and also chronic effects from short- and long-term exposure; • Numerical measures of toxicity (such as acute toxicity estimates).
12.	Ecological information	• Ecotoxicity (aquatic and terrestrial, where available). • Persistence and degradability.

		- Bioaccumulative potential. - Mobility in soil. - Other adverse effects.
13.	Disposal considerations	- Description of waste residues and information on their safe handling and methods of disposal, including the disposal of any contaminated packaging.
14.	Transport information	- UN Number. - UN Proper shipping name. - Transport Hazard class(es). - Packing group, if applicable. - Marine pollutant (Yes/No). - Special precautions which a user needs to be aware of or needs to comply with in connection with transport or conveyance either within or outside their premises.
15.	Regulatory information	- Safety, health and environmental regulations specific for the product in question.
16.	Other information including information on preparation and revision of the SDS	

What is the difference between the GHS SDS and existing MSDSs/SDSs?

SDSs are in use globally. So it is useful to have an understanding of the similarities and differences in the existing MSDS/SDS content and format and the GHS SDS content and format. A table comparing MSDS/SDS content/format is provided in Appendix A of this guidance document.

When should SDSs and labels be updated?

All hazard communication systems should specify a means of responding in an appropriate and timely manner to new information and updating labels and SDS information accordingly. Updating should be carried out promptly on receipt of the information that necessitates the revision. The Competent Authority may choose to specify a time limit within which the information should be revised.

Suppliers should respond to "new and significant" information they receive about a chemical hazard by updating the label and safety data sheet for that chemical. New and significant information is any information that changes the GHS classification and leads to a change in the label information or information that may affect the SDS.

More Definitions under GHS

Aerosols means any non-refillable receptacles made of metal, glass or plastics and containing a gas compressed, liquefied or dissolved under pressure, with or without a liquid, paste or powder, and fitted with a release device allowing the contents to be ejected as solid or liquid particles in suspension in a gas, as a foam, paste or powder or in a liquid state or in a gaseous state. Aerosol includes aerosol dispensers.

Alloy means a metallic material, homogeneous the naked eye, consisting of two or more elements so combined that they cannot be readily separated by mechanical means. Alloys are considered to be mixtures for the purpose of classification under the GHS.

Aspiration means the entry of a liquid or solid chemical product into the trachea and lower respiratory system directly through the oral or nasal cavity, or indirectly from vomiting;

ASTM means the "American Society of Testing and Materials".

BCF means "bioconcentration factor".

BOD/COD means "biochemical oxygen demand/chemical oxygen demand".

CA means "competent authority".

Carcinogen means a chemical substance or a mixture of chemical substances which induce cancer or increase its incidence.

CAS means "Chemical Abstract Service".

CBI means "confidential business information".

Chemical identity means a name that will uniquely identify a chemical. This can be a name that is in accordance with the nomenclature systems of the International Union of Pure and Applied Chemistry (IUPAC) or the Chemical Abstracts Service (CAS), or a technical name.

Competent authority means any national body(ies) or authority(ies) designated or otherwise recognized as such in connection with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Compressed gas means a gas which when packaged under pressure is entirely gaseous at -50°C; including all gases with a critical temperature £ -50°C.

Contact sensitizer means a substance that will induce an allergic response following skin contact. The definition for "contact sensitizer" is equivalent to "skin sensitizer".

Corrosive to metal means a substance or a mixture which by chemical action will materially damage, or even destroy, metals.

Criteria means the technical definition for the physical, health and environmental hazards;

Critical temperature means the temperature above which a pure gas cannot be liquefied, regardless of the degree of compression.

Dermal Corrosion: see skin corrosion;

Dermal irritation: see skin irritation.

Dissolved gas means a gas which when packaged under pressure is dissolved in a liquid phase solvent.

EC_{50} means the effective concentration of a substance that causes 50% of the maximum response.

EC Number or (ECN°) is a reference number used by the European Communities to identify dangerous substances, in particular those registered under EINECS.

ECOSOC means the "Economic and Social Council of the United Nations".

EINECS means "European Inventory of Existing Commercial Chemical Substances".

End Point means physical, health and environmental hazards;

ErC_{50}means EC_{50} in terms of reduction of growth rate.

EU means "European Union".

Explosive article means an article containing one or more explosive substances.

Explosive substance means a solid or liquid substance (or mixture of substances) which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings. Pyrotechnic substances are included even when they do not emit gases.

Eye irritation means the production of changes in the eye following the application of test substance to the front surface of the eye, which are fully reversible within 21 days of application.

Flammable gas means a gas having a flammable range with air at 20°C and a standard pressure of101.3kPa.

Flammable liquid means a liquid having a flash point of not more than 93°C.

Flammable solid means a solid which is readily combustible, or may cause or contribute to fire through friction.

Flash point means the lowest temperature (corrected to a standard pressure of 101.3 kPa) at which the application of an ignition source causes the vapors of a liquid to ignite under specified test conditions.

Gas means a substance which (i) at 50 °C has a vapor pressure greater than 300 kPa; or (ii) is completely gaseous at 20 °C at a standard pressure of 101.3 kPa.

GESAMP means "the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection of IMO/FAO/UNESCO/WMO/WHO/IAEA/UN/UNEP."

GHS means "the Globally Harmonized System of Classification and # Labelling of Chemicals".

Hazard category means the division of criteria within each hazard class, e.g., oral acute toxicity includes five hazard categories and flammable liquids includes four hazard categories. These categories compare hazard severity within a hazard class and should not be taken as a comparison of hazard categories more generally.

Hazard class means the nature of the physical, health or environmental hazard, e.g., flammable solid carcinogen, oral acute toxicity.

Hazard statement means a statement assigned to a hazard class and category that describes the nature of the hazards of a hazardous product, including, where appropriate, the degree of hazard;

IARC means the "International Agency for the Research on Cancer".

ILO means the "International Labor Organization".

IMO means the "International Maritime Organization".

Initial boiling point means the temperature of a liquid at which its vapor pressure is equal to the standard pressure (101.3kPa), i.e., the first gas bubble appears.

IOMC means the "Inter-organization Program on the Sound Management of Chemicals".

IPCS means the "International Program on Chemical Safety".

ISO means International Standards Organization.

IUPAC means the "International Union of Pure and Applied Chemistry".

Label means an appropriate group of written, printed or graphic information elements concerning a hazardous product, selected as relevant to the target sector(s), that is affixed to, printed on, or attached to the immediate container of a hazardous product, or to the outside packaging of a hazardous product.

Label element means one type of information that has been harmonized for use in a label, e.g., pictogram, signal word.

LC_{50} (50% lethal concentration) means the concentration of a chemical in air or of a chemical in water which causes the death of 50% (one-half) of a group of test animals.

LD_{50} means the amount of a chemical, given all at once, which causes the death of 50% (one half) of a group of test animals.

$L(E)C_{50}$ means LC_{50} or EC_{50}.

Liquefied gas means a gas which when packaged under pressure, is partially liquid at temperatures above-50°C. A distinction is made between.

(i) High pressure liquefied gas: a gas with a critical temperature between -50°C and+65°C; and
(ii) Low pressure liquefied gas: a gas with a critical temperature above +65°C.

Liquid means a substance or mixture which at 50°C has a vapor pressure of not more than 300kPa (3bar), which is not completely gaseous at 20 °C and at a standard pressure of 101.3kPa, and which has a melting point or initial melting point of 20°C or less at a standard pressure of 101.3 kPa. A viscous substance or mixture for which a specific melting point cannot be determined shall be subjected to the ASTM D 4359-90 test; or to the test for determining fluidity (penetrometer test) prescribed in section 2.3.4 of Annex A of the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR).

MARPOL means the "International Convention for the Prevention of Pollution from Ships".

Mixture means a mixture or a solution composed of two or more substances in which they do not react.

MSDS means "Material Safety Data Sheet" and in this document is used interchangeably with Safety Data Sheet (SDS).

Mutagen means an agent giving rise to an increased occurrence of mutations in populations of cells and /or organisms.

Mutation means a permanent change in the amount or structure of the genetic material in a cell;

NGO means "non-governmental organization".

NOEC means the "no observed effect concentration".

OECD means "The Organization for Economic Cooperation and Development".

Organic peroxide means a liquid or solid organic substance which contains the bivalent -0-0- structure and may be considered a derivative of hydrogen peroxide, where one or both of the hydrogen atoms have been replaced by organic radicals. The term also includes organic peroxide formulation (mixtures).

Oxidizing gas means any gas which may, generally by providing oxygen, cause or contribute to the combustion of other material more than air does.

Oxidizing liquid means a liquid which, while in itself not necessarily combustible, may, generally by yielding oxygen, cause, or contribute to, the combustion of other material.

Oxidizing solid means a solid which, while in itself not necessarily combustible, may, generally by yielding oxygen, cause, or contribute to, the combustion of other material.

QSAR means "quantitative structure-activity relationships".

Pictogram means a graphical composition that may include a symbol plus other graphic elements, such as a border, background pattern or color that is intended to convey specific information.

Precautionary statement means a phrase (and/or pictogram) that describes recommended measures that should be taken to minimize or prevent adverse effects resulting from exposure to a hazardous product, or improper storage or handling of a hazardous product. Product identifier means the name or number used for a hazardous product on a label or in the SDS. It provides a unique means by which the product user can identify the substance or mixture within the particular use setting (e.g. transport, consumer or workplace).

Pyrophoric liquid means a liquid which, even in small quantities, is liable to ignite within five minutes after coming into contact with air.

Pyrophoric solid means a solid which, even in small quantities, is liable to ignite within five minutes after coming into contact with air.

Pyrotechnic article means an article containing one or more pyrotechnic substances;

Pyrotechnic substance means a substance or mixture of substances designed to produce an effect by heat, light, sound, gas or smoke or a combination of these as the result of non-detonative, self-sustaining exothermic (heat-related) chemical reactions.

Readily combustible solid means powdered, granular, or pasty substance or mixture which is dangerous if it can be easily ignited by brief contact with an ignition source, such as a burning match, and if the flame spreads rapidly.

Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria means the latest revised edition of the United Nations publication bearing this title, and any published amendment thereto.

Recommendations on the Transport of Dangerous Goods, Model Regulations means the latest revised edition of the United Nations publication bearing this title, and any published amendment thereto.

Refrigerated liquefied gas means a gas which when packaged is made partially liquid because of its low temperature.

Respiratory sensitizer means a substance that induces hypersensitivity of the airways following inhalation of the substance.

RID means The Regulations concerning the International Carriage of Dangerous Goods by Rail [Annex 1 to Appendix B (Uniform Rules concerning the Contract for International Carriage of Goods by Rail) (CIM) of COTIF (Convention concerning international carriage by rail)], as amended.

SAR means "Structure Activity Relationship".

SDS means "Safety Data Sheet" and in this document is used interchangeably with Material Safety Data Sheet (MSDS).

Self-Accelerating Decomposition Temperature (SADT) means the lowest temperature at which self-accelerating decomposition may occur with substance as packaged.

Self-heating substance means a solid or liquid substance, other than a pyrophoric substance, which, by reaction with air and without energy supply, is liable to self-heat; this substance differs from a pyrophoric substance in that it will ignite only when in large amounts (kilograms) and after long periods of time (hours or days).

Self-reactive substance means a thermally unstable liquid or solid substance liable to undergo a strongly exothermic decomposition even without participation of oxygen (air). This definition excludes substances or mixtures classified under the GHS as explosive, organic peroxides or as oxidizing.

Serious eye damage means the production of tissue damage in the eye, or serious physical decay of vision, following application of a test substance to the front surface of the eye, which is not fully reversible within 21 days of application.

Signal word means a word used to indicate the relative level of severity of hazard and alert the reader to a potential hazard on the label. The GHS uses 'Danger' and 'Warning' as signal words.

Skin corrosion means the production of irreversible damage to the skin following the application of a test substance for up to 4 hours.

Skin irritation means the production of reversible damage to the skin following the application of a test substance for up to 4 hours.

Skin sensitizer means a substance that will induce an allergic response following skin contact. The definition for "skin sensitizer" is equivalent to "contact sensitizer".

Solid means a substance or mixture which does not meet the definitions of a liquid or gas.

SPR means "Structure Property Relationship".

Substance means chemical elements and their compounds in the natural state or obtained by any production process, including any additive necessary to preserve the stability of the product and any impurities deriving from the process used, but excluding any solvent which may be separated without affecting the stability of the substance or changing its composition.

Substance which, in contact with water, emits flammable gases means a solid or liquid substance or mixture which, by interaction with water, is liable to become spontaneously flammable or to give off flammable gases in dangerous quantities.

Supplemental label element means any additional non-harmonized type of information supplied on the container of a hazardous product that is not required or specified under the GHS. In some cases this information may be required by other competent authorities or it may be additional information provided at the discretion of the manufacturer/distributor.

Symbol means a graphical element intended to succinctly convey information.

Technical name means a name that is generally used in commerce, regulations and codes to identify a substance or mixture, other than the IUPAC or CAS name, and that is recognized by the scientific community. Examples of technical names include those used for complex mixtures (e.g., petroleum fractions or natural products), pesticides (e.g., ISO or ANSI systems), dyestuffs (Color Index system) and minerals.

UNCED means the "United Nations Conference on Environment and Development".

UNCETDG/GHS means the "United Nations Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labeling of Chemicals".

UNITAR means the "United Nations Institute for Training and Research";

UNSCEGHS means the "United Nations Sub-Committee of Experts on the Globally Harmonized System of Classification and Labeling of Chemicals".

UNSCETDG means the "United Nations Sub-Committee of Experts on the Transport of Dangerous Goods".