Hazard Communication

Right to Know
OSHA 29 CFR 1910.1200
COMAR 09.12.33

You have a Right to Know about the hazards that you might encounter on the job.

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Introduction

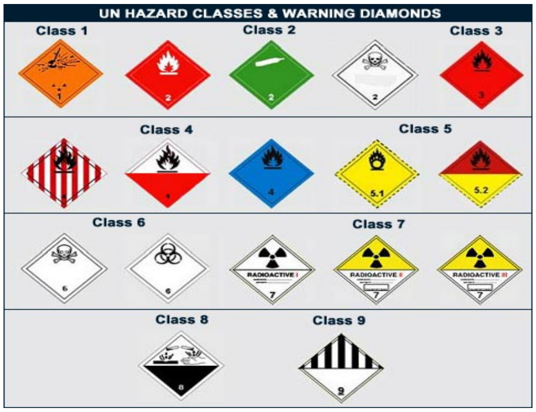
The University of Maryland Center for Environmental Science (UMCES) recognizes the responsibility of protecting the safety and welfare of our campus communities and visitors. **Hazard Communication (HC)** is also termed the Employee **Right to Know Law (RTK)**. You have a Right to Know about the hazards that you might encounter on the job. Employees who work with or around hazardous material must have some knowledge of the materials and have a right to understand how the materials can hurt them and how to protect themselves from such harm. Hazard Communication is a requirement of State and Federal laws:

- Occupational Safety and Health Administration (OSHA) regulation
    - 29 CFR 1910.1200
- Maryland regulations
    - COMAR 09.12.33 and
    - Title 5, Subtitle 4, §5-401 thru 410 of the Annotated Code of Maryland – Labor and Employment Article (Access to Information about Hazardous and Toxic Substances).

In order to ensure chemical safety in the workplace, information about the identities and hazards of the chemicals must be available and understandable to workers. The transmittal of information is to be accomplished by means of a comprehensive hazard communication program. Although the Hazard Communication Standard applies mainly to employers, hazard communication is not effective unless you also do your part in working safely with materials. As an employee, you must be able to identify the possible hazards of using a chemical <u>before</u> you start to use it. Don't wait until you have already been exposed to find out that you've put yourself in danger. Read chemical labels and Safety Data Sheets (SDSs) and understand the information they contain. You can search the web using the name of the chemical and the manufacturer and "SDS". Always follow instructions and warnings about how to use hazardous materials safely. These include written instructions on labels, Safety Data Sheets (SDSs), verbal instructions, and safety information you may receive from supervisors. All the safety information in the world won't help protect you if you don't listen, pay attention, or understand the information you are given. Remember, you should never hesitate to ask questions so that you clearly understand what it takes to protect yourself from hazards of potentially dangerous materials.

Each laboratory contains a combination of different classes of chemicals. There are 9 classes of chemicals:

Explosives (Class 1)
Compressed Gases (Class 2)
Flammable Liquids (Class 3)
Flammable solids (Class 4)
Oxidizing Materials (Class 5)
Poisonous Materials (Class 6)
Radioactive Materials (Class 7)
Corrosives (Class 8)
Miscellaneous (Class 9)



Hazardous chemicals can be found in laboratory refrigerators, freezers, cabinets, and bench tops. Never eat or store your lunch and snacks in the lab. Surfaces and appliances have all had hazardous materials in or on them at some time and you don't want to contaminate what you will be eating. Do not throw food wrappers or containers in the laboratory trash cans – this is a state and federal regulation and could incur a fine if OSHA were to visit. No food/beverage or their containers should ever be found in the lab.

RISKS

The risks associated with the possession and use of a hazardous chemical are dependent upon a multitude of factors, all of which must be considered before acquiring and using a hazardous chemical. Important elements to examine and address include:

- the knowledge of and commitment to safe chemical use practices of all who handle the chemical;
- its physical, chemical, and biological properties and those of its derivatives;
- the quantity received and the manner in which it is stored and distributed;
- the manner in which it is used;
- the manner of disposal of the substance and its derivatives;
- the length of time it is on the premises, and
- the number of persons who work in the area and have open access to the substance.

The decision to procure a specific quantity of a specific hazardous chemical is a commitment to handle it responsibly from receipt to ultimate disposal. The manner in which chemicals are handled and each period between operations presents opportunities for misadventure.

HAZARDS

There are two types of harmful hazardous materials:

- those that cause **health hazards** and
- those that cause **physical hazards** or **both**.

Health Hazards

A "health hazard" is a chemical for which there is statistically significant evidence that acute or chronic health effects may occur in exposed employees. The goal of defining precisely, in measurable terms, every possible health effect that may occur in the workplace as a result of chemical exposures cannot realistically be accomplished. This does not negate the need for employees to be informed of such effects and protected from them.

Health hazards, depending on the exposure, may cause significant changes in the body. These changes are generally indicated by the occurrence of signs and symptoms in the over-exposed person, such as shortness of breath, skin irritant, feeling ill, or getting cancer. The determination of occupational health hazards is complicated by the fact that many of the effects or signs and symptoms occur commonly in non-occupationally exposed populations, so that effects of exposure are difficult to separate from normally occurring illnesses. Not all people are affected to the same degree by the same chemical.

Each individual has different levels of susceptibility depending on a variety of factors including: age, inherited characteristics (relating to body chemistry and metabolism), weight, general health, and etcetera. Any chemical that meets any of the following definitions are considered health hazards. However, this is not intended to be an exclusive categorization.

- **Carcinogens** cause cancer
- **Toxic** or **highly toxic** agents can cause illness, organ damage, and possible death
    - Reproductive toxins affect the reproductive capabilities including chromosomal damage.
- **Irritants** cause a temporary or reversible inflammation of living tissue (such as eyes, skin, or respiratory system).
- **Corrosives** burn/destroy skin or eyes on contact.
- **Sensitizers** cause an allergic reaction in normal tissue after repeated exposure to the chemical.
- **Target organ effects**:
    - **Hepatoxtoxins** cause liver injury.
    - **Nephrotoxins** cause kidney damage.
    - **Neurotoxins** are capable of causing damage to nerves or nerve tissue.
    - **Hematopoietic toxin**s act on the blood or hematopoietic system depriving the body of oxygen.
    - **Lung toxins** irritate or damage pulmonary tissue.
    - **Reproductive toxins** affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis.

Health Effects

There have been many attempts to categorize health effects and to define them in various ways. Generally, the terms "acute" and "chronic" are used to delineate between effects on the basis of severity or duration.

- "**Acute**" effects usually occur rapidly as a result of short-term exposures, and may be of short duration. The acute effects referred to most often are irritation, corrosion, sensitization, narcosis (light headedness) and death.
- “**Delayed effects**” appear hours after exposure. Delayed pain and irreversible damage is begun before you are aware of it. Delayed effects may begin from the slow onset of disease after exposure.
- "**Chronic**" effects generally occur as a result of long-term exposure, and may be of long duration. Similarly, the term chronic effects is often used to cover only **carcinogenesis** (cancer**), teratogenesis**, (effects on the unborn) and **mutagenesis** (chromosomal damage). These effects are obviously a concern in the workplace, but do not adequately cover the area of chronic effects, including, for example, such **as anemia, chronic bronchitis** and **liver atrophy**..

Toxicology

The science of toxicology is based on the principle that there is a relationship between a toxic reaction (the response) and the amount of poison received (the dose). An important assumption in this relationship is that there is almost always a dose below which no response occurs or can be measured. A second assumption is that once a maximum response is reached, any further increases in the dose will not result in any increased effect. Knowing the dose/response relationship is a necessary part of understanding the cause and effect relationship between chemical exposure and illness. "The right dose differentiates a poison from a remedy”.

One of the more commonly used measures of toxicity is the LD50. The LD50 (the lethal dose for 50 percent of the animals tested) of a poison is usually expressed in milligrams of chemical per kilogram of body weight (mg/kg). A chemical with a small LD50 (like 5 mg/kg) is very highly toxic. The more toxic a material, the smaller amount necessary to cause harm. A chemical with a large LD50 (1,000 to 5,000 mg/kg) is practically non-toxic. Recognize that the LD50 says nothing about non-lethal toxic effects though. A chemical may have a large LD50, but may produce illness at very small exposure levels. It is incorrect to say that chemicals with small LD50s are more dangerous than chemicals with large LD50s, they are simply more toxic. The more toxic a material is, the smaller the amount of it necessary to be absorbed before harmful effects are caused. The lower the toxicity, the greater the quantity is needed for it to be absorbed and be harmful. The danger, or risk of adverse effect of chemicals, is mostly determined by how they are used, not by the inherent toxicity of the chemical itself.

PHYSICAL HAZARDS

Physical hazard means a chemical that is classified as posing one of the following hazardous effects: explosive; flammable (gases, aerosols, liquids, or solids); oxidizer (liquid, solid or gas); self-reactive; pyrophoric (liquid or solid); self-heating; organic peroxide; corrosive to metal; gas under pressure; or in contact with water emits flammable gas (29CFR 1910.1200—Physical Hazard Criteria). Some chemicals have both health and physical hazards associated with them. Physical hazards from chemicals are the most common and will be present in most workplaces at one time or another. They include unsafe conditions that can cause injury, illness and death.

The **auto ignition temperature** or kindling point of a substance is the lowest temperature at which it will spontaneously ignite in a normal atmosphere without an external source of ignition, such as a flame or spark.

Compressed gas causes asphyxiation, fire, explosions, and can penetrate the skin like a needle injection.

The **flash point** of a volatile material is the lowest temperature at which it can vaporize to form an ignitable mixture in air. Measuring a flash point requires an ignition source. The lower the flashpoint the more dangerous it is. Gasoline is more flammable than diesel. Gasoline will ignite from negative 45°F and upwards. Whereas, diesel needs to be at 144°F before it will ignite. Materials that have a flashpoint below 100 degrees Fahrenheit (38^{0}C) are considered flammable. Materials with a flashpoint between 100^{0}F -200^{0}F are considered combustible.

Fuel	**Flash Point**	**Auto ignition temp.**
Gasoline	-43°C (-45°F)	280^{o}C (536^{o}F)
Ethanol 70%	16.6°C (61.9°F)	363^{o}C (685^{o}F)
Diesel	>62°C (144°F)	210^{o}C (410^{o}F)
Fuel	**Flash Point**	**Auto ignition temp.**
Jet Fuel >	>60°C(140°F)	210^{o}C (410^{o}F)
Kerosene	>38°-72°C (100-162°F)	220^{o}C (428^{o}F)

An **explosive** chemical causes a sudden almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

The lower explosion limit (**LEL**) or lower flammable limit (**LFL**) is the lowest concentration of vapor in air which will burn or explode upon contact with a source of ignition. Below the LEL/LFL, the mixture is too lean (i.e. there is insufficient fuel) to burn or explode.

The upper explosion limit (**UEL**) or upper flammable limit (**UFL**) is the highest concentration of vapor in air which will burn or explode upon contact with a source of ignition. Above the UEL, the mixture is too rich (i.e. there is insufficient oxygen) to burn or explode. The LEL and UEL are usually indicated by the percentage by volume of vapor in air. It is the vapor that burns or explodes not the material itself. Example - For Acetaldehyde, the LEL is 4% and the UEL is 60% by volume of air. The range between 4% and 60% is the dangerous range of Acetaldehyde.

LEL/LFL and UEL/UFL

Fuel	**LEL/LFL %**	**UEL/UFL %**
Acetaldehyde	4	60
Ethyl Alcohol,	3	19
Benzene	1.35	6.65
Gasoline	1.4	7.6
Fuel Oil	0.7	5
Hydrogen sulfide	4.3	46
Toluene	1.27	6.75

Oxidizers bring about an oxidation reaction causing a fire of itself or through the release of oxygen or other gases.

Pyrophoric materials will ignite spontaneously in air at 130^0F or below without an ignition source.

Reactive chemicals cause damage by the release of gases that will burn, explode, or produce high pressure that can cause injury to a person. Organic peroxides, unstable materials, and water reactive materials are examples of reactive chemicals.

Specific gravity (SG) is the weight of a liquid compared to the weight of water at the same temperature and pressure, with water being equal to “1”. Pressure is nearly always 1 atmosphere (atm.) equal to 101.325 kPa. Specific gravity is commonly used as a simple means of obtaining information about the concentration of solutions of various materials such as brines, hydrocarbons, sugar solutions (syrups, juices, honeys, etc.) and acids. Substances with a specific gravity of 1 are neutrally buoyant in water, those with SG greater than 1 are denser than water, and so (ignoring surface tension effects) will sink. Those with an SG of less than one are less dense than water, and so will float.

Vapor density is the density of a vapor in relation to the weight of air with air being "1". The vapor density would indicate whether a gas is denser (greater than 1) or less dense (less than 1) than air. The density has implications for container storage and personnel safety—if a container can release a dense gas, its vapor could sink and, if flammable, vapors can collect until it is at a concentration sufficient for ignition. Even if not flammable, it could collect in the lower floor or level of a confined space and displace air, possibly presenting a smothering hazard to individuals entering the lower part of that space. Vapors lighter than air rise and dissipate quicker and pose less of a hazard.

Exposure Limits

To guard against both acute and chronic health effects, scientists have identified exposure limits for different kinds of materials.

- The **PEL**, or permissible exposure limit, is often expressed as the quantity of hazardous chemical that an average employee can safely be exposed to in an 8-hour workday without ill effects.
- Threshold limit values (**TLV**s) are air quality standards developed by the American Conference of Governmental Industrial Hygienists. They are the model for many other air quality limits such as OSHA's PELs. TLVs are the amounts of materials in the air that almost all healthy adult workers are predicted to be able to tolerate without adverse effects.
- Time-weighted average (**TWA**) refers to the average time, over a given work period (such as an 8-hour workday) of a person's exposure to a chemical or agent.
- Short-term exposure limit (**STEL**) is the maximum concentration to which workers can be exposed to a chemical or agent for a short period of time (<u>15 minutes</u>) four times throughout the eight hour day, with at least one hour between exposures.
- Concentrations of chemicals in the environment are most commonly expressed as parts per million (**ppm**) and parts per billion (**ppb**). Government tolerance limits for various poisons usually use these abbreviations.

Routes of Entry

In order for a chemical to become hazardous to a person's health, it must first contact or enter the body and the chemical must have some biological effect on the body. There are four major routes of entry:

- **Inhalation** (breathing)
  Breathing of contaminated air (fumes, dusts, mists, vapors) is the most common way that workplace chemicals enter the body. Use the fume hood when opening or using chemicals that produce harmful vapors (i.e. acids; bases; flammable and explosive materials).
- **Absorption** (skin/eye contact)
  Some chemicals, when contacted, can be absorbed through the skin into the blood stream, especially organic solvents, materials dissolved in the solvents, acids, and bases. The eyes may also be a route of entry.
- **Ingestion** (eating)
  Less commonly, workplace chemicals may be swallowed accidentally if food, chapstick, lipstick, gum, your hands, or cigarettes are contaminated. For this reason workers should not drink, eat, or smoke, chew gum, or apply chapstick or lipstick in

areas where they may be exposed to toxic chemicals. Never eat or store your lunch and snacks in the lab. Surfaces and appliances have all had hazardous materials in or on them at some time and you don’t want to contaminate what you will be eating. Do not throw food wrappers or containers in the laboratory trash cans – this is a State and Federal regulation and could incur a fine if OSHA were to visit. No food/beverage or their containers should ever be found in the lab.

- **Injection**

  Injection is the fourth way chemicals may enter the body. While uncommon in most workplaces, it can occur when a sharp object (e.g., needle, shard of glass or a stream of high pressure gas) punctures the skin and “injects” a chemical or bio-hazard directly into the bloodstream. For example: If a beaker contains a chemical solution and it breaks and a piece of the glass gets injected into your foot, hand, etc. it will inject the chemical that is adhered to the piece of glass.

Regardless of the way the chemical gets into the body, once it is in the body it is distributed throughout the body by the blood stream. In this way, the chemicals can attack and harm organs which are far away from the original point of entry as well as where they entered the body.

PROTECTIVE EQUIPMENT

Fume Hood

In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors, the primary objective shall be to prevent atmospheric contamination. This shall be accomplished as far as feasible by accepted engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation, use of a fume hood, and substitution of less toxic materials). The fume hood is often the primary control device for protecting laboratory workers when working with chemicals with vapors, fumes, mists, dusts. However, they do not absolutely eliminate exposure even under ideal conditions. Careless work practices can result in considerable exposure to users who may believe they are protected. Here are some Do’s and Don’ts for fume hoods:

- Never allow your head to enter the plane of the hood. Work with the sash at proper operating level.
- Use appropriate eye protection, gloves, and lab coat.
- Do not block airflow through the baffles or through the baffle exhaust slots.
- Keep materials inside the hood at least 6 inches back from the sash opening. When not working in the hood, close the sash to a 6 inch opening.
- Do not store chemicals inside the hood. This interrupts the air flow and reduces the effectiveness of the hood.
- Report any hood malfunction and indicate “do no use” until repairs are completed.
- Elevate large equipment (ie. Centrifuge) at least 2 inches off the base of the hood interior. Respirators should never be used in lieu of using a fume hood.
- Have a plan of action in case of an emergency (power failure)

PERSONAL PROTECTIVE EQUIPMENT

When adequate engineering and administrative hazard controls are not technically, operationally, or financially feasible, personal protective equipment must be considered as a supplement. "**Personal protective equipment**" **(PPE)** includes a wide variety of items worn by an individual to isolate the person from chemical hazards. PPE includes articles to protect the eyes, skin, and the respiratory tract (e.g. goggles, face shields, coats, aprons, gloves, shoes, and respirators). PPE does not eliminate hazards but merely minimizes damage from hazards. The effectiveness of PPE is highly dependent on the user. Each type of PPE has specific applications, advantages, limitations, and potential problems associated with their misuse. PPE must match the hazards and the conditions of use and be properly maintained in order to be effective. Those using PPE must be fully knowledgeable of these considerations. Their misuse may directly or indirectly contribute to the hazard or create a new hazard. The material of construction must be resistant with the chemical's hazards and must maximize protection, dexterity, and comfort. Employers must provide appropriate personal protective equipment (PPE) for employees.

Respirators

Respirators should never be used in lieu of using a fume hood. When effective engineering controls are not feasible, appropriate respirators shall be used. The following definitions are important terms used in the respiratory protection program.

- **Air-purifying respirator** means a respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants (chemical and or radioactive) by passing ambient air through the air-purifying element.
- **Atmosphere-supplying respirator** means a respirator that supplies the respirator user with breathing air from a source independent of the ambient atmosphere, and includes supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.
- **Filtering facepiece (dust mask)** means a particulate respirator with the entire facepiece composed of the filtering medium. Dust masks are only used for dusts and some mists.
- **Powered air-purifying respirator (PAPR)** means an air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.

Using a respirator may place a physiological burden on employees that varies with the type of respirator worn, the job and workplace conditions in which the respirator is used, and the medical status of the employee. The employer shall provide a **medical evaluation** to determine the employee's ability to use a respirator. Before an employee may be required to use any respirator with a negative or positive pressure tight-fitting facepiece, the employee must be **fit tested** with the same make, model, style, and size of respirator that will be used. The employer shall not permit respirators with tight-fitting face-pieces to be worn by employees who have:

- Facial hair that comes between the sealing surface of the facepiece and the face or that interferes with valve function; or
- Any condition that interferes with the face-to-facepiece seal or valve function.

If an employee wears corrective glasses or goggles or other personal protective equipment, the employer shall ensure that such equipment is worn in a manner that does not interfere with the seal of the facepiece to the face of the user. For all tight-fitting respirators, the employer shall ensure that employees perform a user seal check each time they put on the respirator as demonstrated to them during their fit test. The respiratory protection program requires a yearly medical evaluation and fit test. If there is a change in work area conditions, degree of employee exposure, stress, weight gain or loss, new dentures, or any situation that may affect respirator effectiveness prior to the annual medical and fit test, the employer shall reevaluate the situation accordingly. Contact the Environmental Safety Compliance Office (ESCO) if your situation requires the use of a respirator. The ESCO will walk you through the necessary steps. umces-safety@umces.edu

Gloves

No single glove type can serve as protection from all chemicals. Protective gloves should be worn when handling hazardous materials, toxic chemicals, corrosive chemicals, radioactive materials, bio-hazardous materials, rough or sharp edged objects, and very hot or very cold materials. Disposable latex, vinyl or nitrile gloves are usually appropriate when handling chemicals in a laboratory. These gloves will offer protection from incidental splashes or contact. The appropriate glove material should be selected based on chemical compatibility. The following characteristics should be considered when selecting the appropriate material:

- Degradation
- Breakthrough time
- Permeation rate.
-

Degradation is the change in one or more of the physical properties of a glove caused by contact with a chemical. Degradation typically appears as hardening, stiffening, swelling, shrinking, or cracking of the glove. The worst example is that the material may actually dissolve in the chemical. The slower the degradation occurs in the presence of a chemical the more protective the material is for that specific chemical. There is no standardized test for degradation; each manufacturer generally has its own test.

Breakthrough time: Breakthrough time is how much time it takes from the initial contact of the chemical with the material until it is detected on the opposite side of the material (essentially, when it begins to soak through). Obviously, the greater the breakthrough time, the more protective the material is for that particular chemical. Breakthrough is measured using a standardized test (ASTM F739).

Permeation rate: Permeation rate is a measurement of how quickly a chemical passes through a material at the molecular level. It can be thought of as a slow leak, similar to how air seeps through plastic soda bottles and makes your soda go flat (hence the expiration date on the bottles!). Thicker materials tend to have slower permeation rates. Permeation rates are reported differently by different manufacturers, but a higher number generally means a quicker penetration rate. Please note, however that permeation and degradation do not always correlate.

Gloves should fit the user's hands comfortably – they should not be too loose or too tight. Gloves are sometimes worn for several hours and need to stand up to the task. Once contaminated, gloves can become a means for spreading infectious materials to yourself, others or environmental surfaces. Therefore, the way YOU use gloves can influence the risk of hazards in your work setting. These are the most important do's and don'ts of glove use:

- Work from clean to dirty—this will help prevent contamination
- Don't touch your face or adjust PPE with contaminated gloves
- Don't touch environmental surfaces – doorknobs, keyboards, computer mouse, cell phone. This means when leaving the laboratory TAKE OFF YOUR GLOVES. If you need to wear a

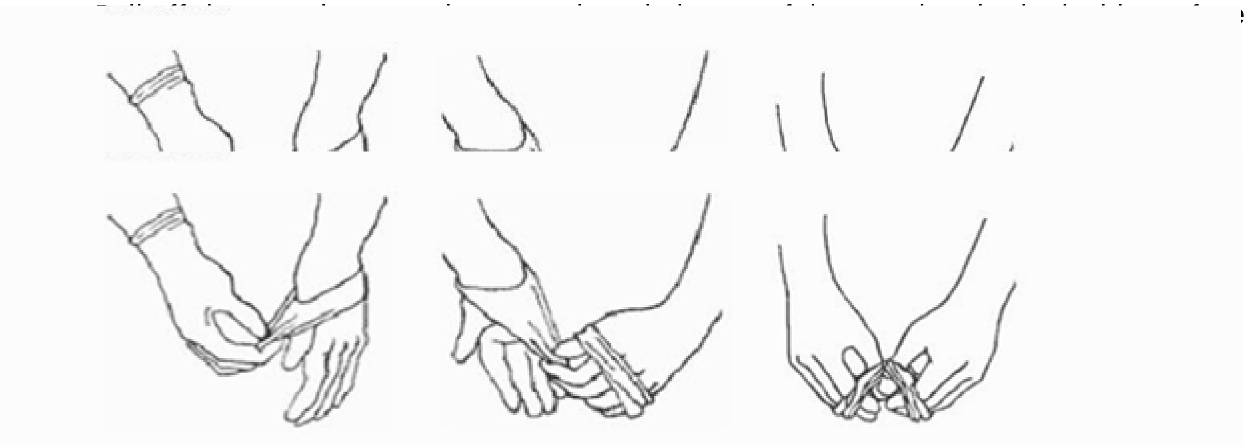
glove in the hallway to carry a sample, make sure that the gloved hand is carrying the sample and the non- gloved hand is operating door handles, elevator buttons, etc.

- Change gloves as required according to the manufacturer and the hazardous material(s) you are working with.
- Discard gloves inside out after use, never wash or reuse disposable gloves.

Proper Glove Removal

Just as important as knowing what is the proper glove to wear, is knowing how to remove a disposable glove without contaminating yourself and other surfaces.

- Grasp one of the gloves and cuff and pull it partway off. The glove will turn inside out. It is important to keep the first glove partially on your hand before removing the second glove. This protects you from touching the outside of either glove with your bare hands.
- Leaving the first glove over your fingers, grasp the second glove near the cuff and pull it part of the way off. The glove will turn inside out. It is important to keep the second glove partially on your hand to protect you from touching the outside surface of the first glove with your bare hand.
- Pull off [illegible] es of



Guide to the Selection of Skin Protection

Hazard	Degree of Hazard	Protective Material
Abrasion	Severe	Reinforced heavy rubber, staple-reinforced heavy leather
	Less Severe	Rubber, plastic, leather, polyester, nylon, cotton
Sharp Edges	Severe	Metal mesh, staple-reinforced heavy leather, Kevlar® aramid-steel mesh
	Less Severe	Leather, terry cloth (aramid fiber)
	Mild with delicate work	Lightweight leather, polyester, nylon, cotton
Chemicals and fluids	Risk varies according to the chemical, its concentration, and time of contact among other factors. Refer to the manufacturer, or product SDS.	**Dependant on chemical**. Examples include: Natural rubber, neoprene, nitrile rubber, butyl rubber, PTFE (polytetrafluoroethylene), Teflon®, Vitom®, polyvinyl chloride, polyvinyl alcohol, Saranex™, 4H®, Chemrel®, Responder®, Trellchem®
Cold		Leather, insulated plastic or rubber, wool, cotton
Heat	High temperatures (over 350 deg C)	Asbestos, Zetex®
	Medium high (up to 350 deg C)	Nomex®, Kevlar®, neoprene-coated asbestos, heat-resistant leather with linings
	Warm (up to 200 deg C)	Nomex®, Kevlar®, heat-resistant leather, terry cloth (aramid fiber)
	Less warm (up to 100 deg C)	Chrome-tanned leather, terry cloth
General Duty		Cotton, terry cloth, leather
Product Contamination		Thin-film plastic, lightweight leather, cotton, polyester, nylon
Radiation		Lead-lined rubber, leather, nitrile, latex, etc. depending on the type of radioactive material.

Note: The mention of trade name products in the above table is not intended as a recommendation or endorsement of any product.. This document lists trade names of protective clothing material mentioned in OSH Answersl. Check with your supplier or the manufacturer to find out if a particular glove meets your requirements. This list is not intended to be comprehensive; you may know of other products that meet your needs.

Eye Protection – ANSI Z87.1

Thousands of people are blinded each year from work-related eye injuries that could have been prevented with the proper selection and use of eye and face protection. Appropriate eye or face protection is required when exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or potentially injurious light radiation. There are numerous commercial products available which meet the standards for eye protection in OSHA 29 CFR 1910.133. This standard is based on ANSI standard Z87.1-1989.

Safety glasses protect from impact of flying particles and objects. Side shields are used to protect the eyes from flying objects from the side. Personal prescription lenses do not provide optimal eye protection and should not be used as a substitute for safety glasses. Safety glasses are not effective protection from chemical splash and vapors.

Goggles should be selected when the hazard assessment calls for protection from chemical splash or chemical. Goggles should fit snuggly over and around the eyes or personal prescription lenses. The goggles should "breathe" (they should not fog up). They should provide good peripheral vision. Goggles must also be sufficiently comfortable to be accepted by the users. A pair of goggles pushed up on the forehead or lying on the bench top does not afford eye protection.

Face shields protect from impact hazards such as flying fragments, objects, large chips, and particles. If the probability of a vigorous reaction appears to be substantial, or the material involved in the work in progress is very corrosive to tissue, a face mask should be used to supplement the goggles and provide additional protection to the face and throat. Where there is a risk of a minor explosion, an explosion shield should be placed between the worker and the reaction vessel. The face shield should cover the forehead, extend below the chin, and wrap around the side of the face. When worn alone, face shields do not protect employees from impact hazards. Use face shields in combination with safety spectacles or goggles, even in the absence of dust or potential splashes, for additional protection beyond that offered by spectacles or goggles alone. Face shield windows are made with different transparent materials and in varying degrees or levels of thickness. These levels should correspond with specific tasks.

Contact lenses were historically prohibited in chemical environments. This was based upon the best medical judgment and opinions of healthcare professionals concerned with the absorption and adsorption of chemicals to the contact lens surface, as well as complications associated with emergency treatment for chemical splashes to the eye. In June 2005, the National Institute for Occupational Safety and Health (NIOSH) reviewed these guidelines and they recommended that workers be permitted to wear contact lenses when handling hazardous chemicals. Their recommendations do not address hazards from heat, radiation, or high-dust or high-particulate environments. However, contact lenses are not eye protective devices, and wearing them does not reduce the requirement for eye and face protection. An eye injury hazard evaluation should be conducted and at a minimum include:

- Concentration of material
- Permissible exposure limits,
- Known eye irritant/injury properties,

- Form of chemical (powder, liquid, or vapor),
- Possible routes of exposure.

The assessment for contact lens wearers should include a review of the available information about lens absorption and adsorption for the class of chemicals in use.

Lab Coats

Lab coats can serve a number of purposes – protection from chemical splash, fire resistance, clothing protection, or just to look like a scientist! There are a wide variety of lab coats available. Lab coats also have permeation, breakthrough, and degradation properties just like gloves. Check with the vendor to choose the material that will protect you from the hazardous materials you will be working with. Laboratory coats or protective aprons should provide reasonably complete coverage of the skin and clothing. Best practice is to wear a knee length, long sleeved laboratory coat when working with hazardous chemicals. It provides a protective layer for street clothes and bare skin and can be easily removed upon contamination or in the event of an accident. The presence of certain physical hazards or other specific elements of the procedure may dictate caution in the choice of style so as to not create additional hazards, for example, short sleeves may be preferable if there is a possibility that long sleeves could get caught in a mechanical operation. Disposable outer garments (i.e., Tyvek suits) may be useful when cleaning and when decontamination of reusable clothing is difficult. Used lab coats should never be worn outside the lab or laundered with other clothes. Loose clothing (such as overlarge lab coats or ties), skimpy clothing (such as shorts), torn clothing and unrestrained hair may also pose a hazard in the laboratory. Take the time to minimize your exposure to the hazards present.

Shoes

Closed-toed shoes should be worn at all times in laboratories where chemicals are stored or used. Exposed toes are a magnet for chemical spills, dropped objects, and trip hazards. The top of your foot is just as susceptible to caustic chemicals as your toes. Sandals and perforated shoes should not be worn in laboratories or where mechanical work is conducted. Such shoes offer no barrier between the laboratory worker and chemicals, broken glass, or heavy objects. Steel-toed safety shoes may be necessary when there is a risk of heavy objects falling or rolling onto the feet. Shoes with open backs are allowed at the discretion of the Supervisor. Sandals or flip flops may be worn while at your desk and to and from work only if you have an appropriate pair of closed toe shoes, chemical resistant boots, or steel toed shoes with you to wear in the laboratory or work area.

Prudent Practices in the Laboratory – Handling and disposing of Chemicals.
National Research Council. 1995

- "Clothing that leaves large areas of skin exposed is inappropriate in laboratories where hazardous chemicals are used. The worker's personal clothing should be fully covering. Appropriate laboratory coats should be worn, buttoned, with the sleeves rolled down."
- "Unrestrained long hair and loose clothing such as neckties, baggy pants and coats are inappropriate in a laboratory where hazardous chemicals are in use. Such items can catch fire, be dipped in chemicals and get caught in equipment. Similarly, rings, bracelets, watches or other jewelry that could be damaged, trap chemicals close to the skin, come in contact with electrical sources or get caught in machinery should not be worn. Leather

clothing or accessories should not be worn in situations where chemicals could be absorbed in the leather and held close to the skin."

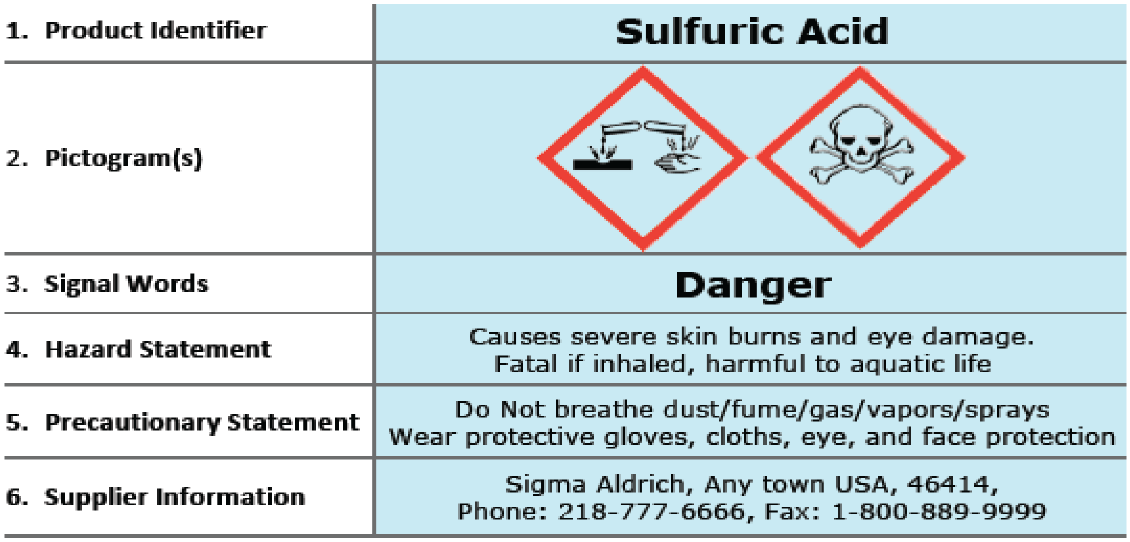
GLOBAL HARMONIZATION STANDARD (GHS)

The Hazard Communication Standard (HCS)/Right to Know (RTK) is now aligned with the Globally Harmonized System of Classification and Labeling of Chemicals. This revision of OSHA's Hazard Communication standard is a UN approved universal communication system for the handling of potentially hazardous materials. It is designed to replace the various classification and labeling standards used in different countries by using consistent criteria for classification and labeling on a global level. This update to the Hazard Communication Standard will provide a common and coherent approach to classifying chemicals and communicating hazard information on labels and Safety Data Sheets (SDSs). By June 1, 2015, manufacturers and distributors must reclassify their chemicals and produce GHS-formatted Safety Data Sheets (SDSs) to replace the current Material Safety Data Sheets (MSDSs) and labels for their products. June 1, 2016 employers must be fully compliant with OSHA's adoption of GHS. Employers must complete necessary updates to their hazard programs and labeling procedures, and all affected employees must be trained on the new hazard SDSs and signage on labels. Once fully implemented it will:

- Enhance worker comprehension of hazards, especially for low and limited literacy workers, reduce confusion in the workplace, facilitate safety training, and result in safer handling and use of chemicals;
- Provide workers quicker and more efficient access to information on the SDSs.
- Result in cost savings to American businesses of more than $475 million in productivity improvements, fewer safety data sheet and label updates and simpler new hazard communication training; and
- Reduce trade barriers by harmonizing with systems around the world.

Labels

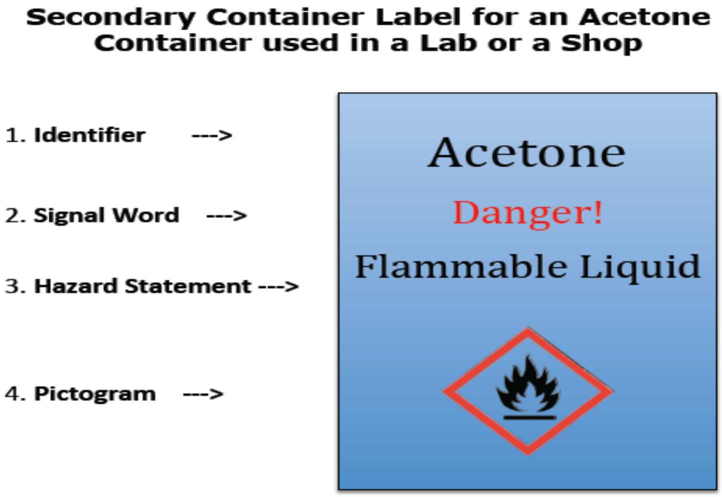
There will be six important components to all GHS labels:



1. Product Identifier	**Sulfuric Acid**
2. Pictogram(s)	
3. Signal Words	**Danger**
4. Hazard Statement	Causes severe skin burns and eye damage. Fatal if inhaled, harmful to aquatic life
5. Precautionary Statement	Do Not breathe dust/fume/gas/vapors/sprays Wear protective gloves, cloths, eye, and face protection
6. Supplier Information	Sigma Aldrich, Any town USA, 46414, Phone: 218-777-6666, Fax: 1-800-889-9999

Secondary Labels

Secondary labels are those that <u>you</u> place on containers used to hold reagents, decanted material, standards, etc. All secondary containers must be labeled. Label containers with receiving, opening and disposal dates. Labels help you and also to protect anyone else who is in or may enter the lab. Should someone accidentally knock over or break a container when no one is around, they automatically want to clean it up and then find someone to inform them. If, this material looked innocuous but was actually very caustic they could be injured as they tried to clean it up. However, if there was a label on it they would be more likely to take the appropriate precautions or find someone to notify rather than jumping in and getting hurt. Even if the material is going to be in that container for a very short period of time it must have the following four components on the label:



Two important chemical hazard labeling systems used are:

- the Hazardous Materials Identification System (HMIS®) which uses the bar code and
- the National Fire Protection Association (NFPA) which uses the diamond code. At first glance, the HMIS® and NFPA labeling systems appear quite similar:
  - Both have four sections colored blue, red, yellow and white.
  - The colors indicate the type of hazard with blue indicating the level of **health hazard**, red for **flammability**, orange for a **physical hazard**.
  - The number ratings range from 0-4. Zero was no hazard and 4 was a severe hazard.

Despite their similarities, the two systems are not identical and each system serves a specific purpose. The HMIS system was developed by the American Coatings Association as a compliance aid for the OSHA Hazard Communication Standard. The NFPA system was developed for short term, often acute exposure to materials under conditions of fires or spills.

Differences between NFPA and HMIS Systems

NFPA	HMIS
Quick identifier to determine basic hazards associated with a chemical to alert fire fighters	Compliance aid for the OSHA Hazard Communication Standard (HCS) for employers and employees.
Uses four diamonds	Uses vertically stacked bars
White diamond is other hazards (radioactive, no water, acid, alkaline, oxidizer, corrosive)	White bar is personal protective equipment
The numbers assume that a fire is present	Numbers do not assume a fire is present and are used to convey broader health warning information. Therefore, numbers may differ from the NFPA system.

Before 2002 the fire diamond (NFPA) and the color bar (HMIS) both had sections colored blue, red, white, and yellow. After April 2002, with the release of HMIS III, yellow in the color bar (which stood for reactivity) was replaced by orange, standing for physical hazard.

An important difference between NFPA/HMIS systems and GHS/HazCom is the way they use numbers.

- With GHS, the lower the categorization number, the greater the severity of the hazard. This is opposite of the way numbers and severity relate to each other under NFPA and HMIS.
- With NFPA, the higher the number, the greater the severity.

The numbers in the GHS system, as adopted by OSHA, do not show up on the label, instead they are used to determine what goes on the label. The numbers do appear on GHS formatted safety data sheets (SDs), in Section 2, but OSHA believes the use of numbers there will be less confusing since there is much more contextual information available to help the reader understand the hazard information.

GHS vs NFPA/HMIS

GHS
1 = Severe Hazard
4 = Minor Hazard

NFPA/HMIS
1 Minor Hazard
4 = Severe Hazard

The big question many employers, chemical manufacturers and distributors have is: "Can I continue to use NFPA and HMIS systems and labels?"

The short answer is yes. However, whether or not they should (or will even want to over the long run) and exactly how they will do it are much more complex questions to answer. Most U.S. employers will most likely gravitate exclusively to the GHS system and not choose to have both systems in play. In the meantime, employees must understand the hazards of the chemicals they work with and that they are comfortable with the variety of hazard information presented

SIGNAGE

Hazard warning signs are posted at the entrance(s) to each laboratory or other areas that utilize hazardous materials. This signage is designed to fulfill regulatory signage requirements as well as alert lab users and visitors to specific

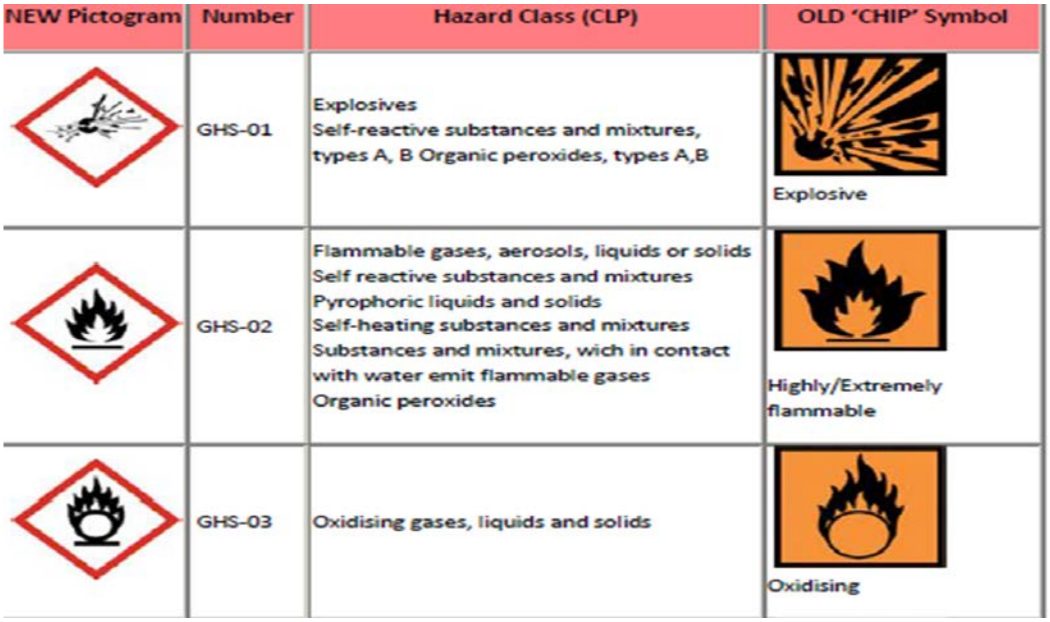
hazards located in individual laboratories. It also gives emergency contact information for the Principal Investigator, laboratory safety, radiation safety, and a number for after hour facility maintenance. The signs do not exemplify every known hazard that may be present in that area, and should not be used to replace general laboratory and chemical safety training or practices.

GHS Pictograms and Hazards

GHS chemical hazard pictograms are intended to provide the basis for or to replace national systems of hazard pictograms. Transport pictograms come in a wider variety of colors and may contain additional information such as subcategory number.

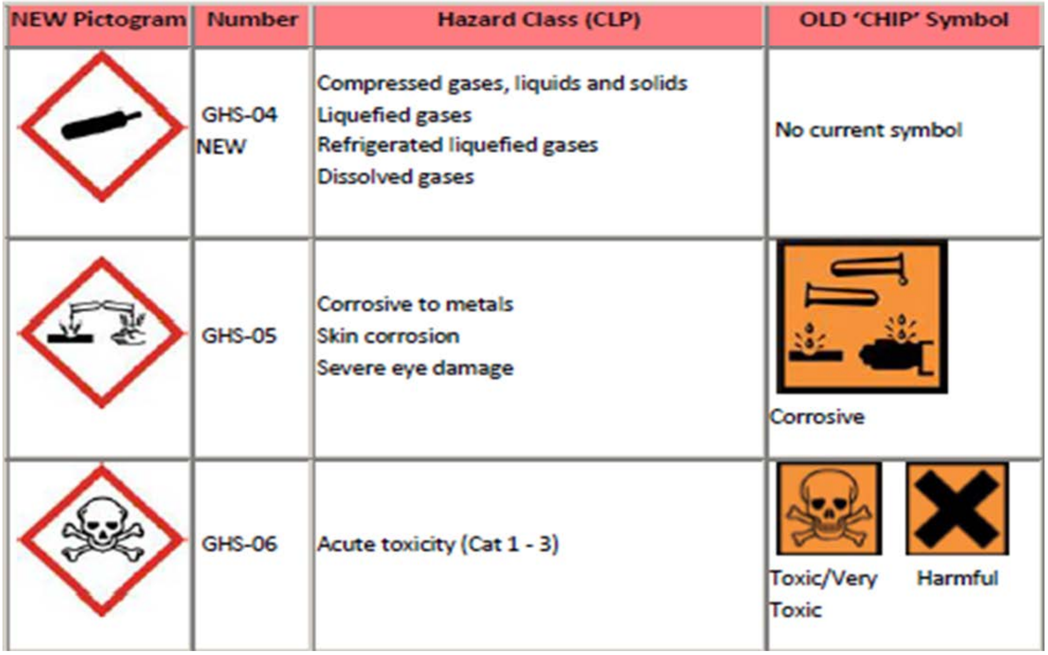
CMR (Carcinogenicity, mutagenicity, and toxicity for reproduction) Specific Target Organ Toxicity (STOT)

New Signage vs Old Signage



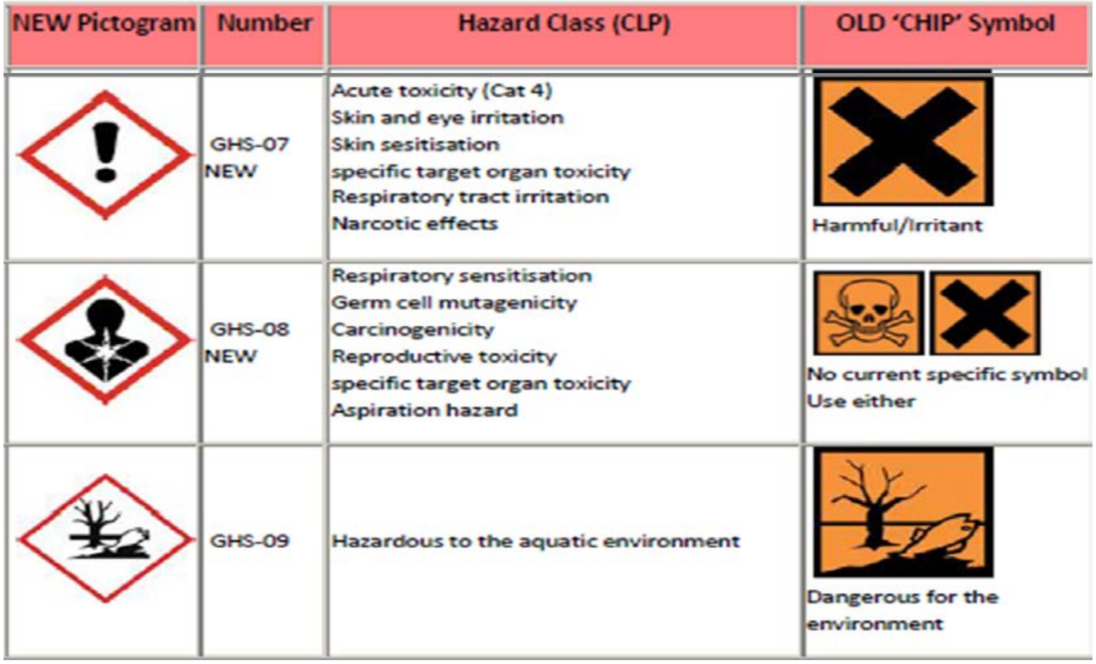
NEW Pictogram	Number	Hazard Class (CLP)	OLD 'CHIP' Symbol
	GHS-01	Explosives Self-reactive substances and mixtures, types A, B Organic peroxides, types A,B	Explosive
	GHS-02	Flammable gases, aerosols, liquids or solids Self reactive substances and mixtures Pyrophoric liquids and solids Self-heating substances and mixtures Substances and mixtures, wich in contact with water emit flammable gases Organic peroxides	Highly/Extremely flammable
	GHS-03	Oxidising gases, liquids and solids	Oxidising

New Signage vs Old Signage



NEW Pictogram	Number	Hazard Class (CLP)	OLD 'CHIP' Symbol
	GHS-04 NEW	Compressed gases, liquids and solids Liquefied gases Refrigerated liquefied gases Dissolved gases	No current symbol
	GHS-05	Corrosive to metals Skin corrosion Severe eye damage	Corrosive
	GHS-06	Acute toxicity (Cat 1 - 3)	Toxic/Very Toxic Harmful

New Signage vs Old Signage



NEW Pictogram	Number	Hazard Class (CLP)	OLD 'CHIP' Symbol
	GHS-07 NEW	Acute toxicity (Cat 4) Skin and eye irritation Skin sesitisation specific target organ toxicity Respiratory tract irritation Narcotic effects	Harmful/Irritant
	GHS-08 NEW	Respiratory sensitisation Germ cell mutagenicity Carcinogenicity Reproductive toxicity specific target organ toxicity Aspiration hazard	No current specific symbol Use either
	GHS-09	Hazardous to the aquatic environment	Dangerous for the environment

STORAGE OF CHEMICALS

The improper storage or mixing of chemicals can result in serious accidents and even disasters. Violent reactions could occur due to the storing or mixing incompatible chemicals. Designate a storage place for each chemical and return it to that place after each use. Inspect chemical storage areas at least annually for outdated or unneeded items, illegible labels, leaking containers, etc. Each laboratory is to maintain an inventory of the chemicals stored in the laboratory. The following information is to offer guidance on the basic principles of safe chemical storage and segregation of chemicals in our laboratories.

- Ensure all containers of hazardous chemicals are properly labeled with identity of the hazardous chemical(s) and appropriate hazard warnings.
- Segregate incompatible chemicals – (e.g. oxidizing acids and flammable solvents in separate locations) to prevent inadvertent mixing of incompatible chemicals which can produce harmful gases/vapors, heat, fire and explosions. The color codes on labels can be used as a guide for storage groups.
- Store hazardous materials away from heat and direct sunlight.
- Do not store hazardous materials under sinks.
- Do Not store chemicals alphabetically except within a grouping of compatible chemicals.
- Ensure caps and lids are securely tightened on containers.
- Use approved flammable storage lockers or flammable storage containers to store flammable and combustible liquids. Flammable solvents should not be stored in fume hoods or vented cabinets, since the airflow will fan any fire and spread it quickly.

- Liquids should be stored in unbreakable or double-contained packaging, should the container break/leak.
- Store inorganic acids in corrosive or acid storage cabinets
- Store acids in a dedicated acid cabinet. Nitric acid may be stored there also but only if it is kept isolated from all other acids.
- Label refrigerators used for storing chemicals, samples or media as follows: **“Caution—Do Not Store Food or Beverages in This Refrigerator.”**
- Flammable solvents that require storage at reduced temperature (such as isopentane) should be stored in refrigerators or freezers designed for storage of flammable liquids. Ordinary household refrigerators are not appropriate for flammable liquids because of the interior arcing contacts. Cold rooms with closed air circulation systems that recirculate escaped vapors within the chamber are not acceptable for storage of flammables, dry ice, highly toxic liquid chemicals or compressed gases.
- Do not store hazardous materials in fume hoods as containers block proper air flow in the hood and reduce available work space.
- Avoid stockpiling chemicals. Store minimum levels of chemicals in the laboratory
- Only compressed gas cylinders that are in use and secured in place shall be kept in the laboratory. All others, including empties shall be sent to the compressed gas cylinder storage area.

See:
Table 1 for Examples of Incompatible Chemicals
Table 2 for Basic Chemical Segregation
Table 3 for Suggested Storage Time Limits for Common Peroxidizable Conpounds

GHS SAFETY DATA SHEETS (SDSs)

The safety data sheet (The GHS has dropped the word “material” from Material Safety Data Sheet (MSDS). It will now be called the Safety Data Sheet or SDS. It provides comprehensive information about the chemical product that allows employers and workers to obtain concise, relevant and accurate information that can be put in perspective with regard to the hazards, uses and risk management of the chemical product in the workplace. The SDS contains 16 sections. While there were some differences in existing industry recommendations, and requirements of countries, there was widespread agreement on a 16 section SDS that includes the following headings in the order specified:

1. Identification of the substance or mixture and of the supplier
2. Hazards identification
3. Composition/information on ingredients
4. First aid measures
5. Firefighting measures
6. Accidental release measures
7. Handling and storage
8. Exposure controls/personal protection
9. Physical and chemical properties
10. Stability and reactivity

11. Toxicological information
12. Ecological information
13. Disposal considerations
14. Transport information
15. Regulatory information
16. Other information including information on preparation and revision of the SDS

The primary difference between the GHS requirements in terms of headings and sections and the international industry recommendations is that sections 2 and 3 have been reversed in order for the SDS as opposed to the MSDS.

Section 1. Identification of the substance or mixture and of the supplier GHS product identifier.

- 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.
-

Section 2. Hazards identification GHS classification of the substance/mixture and any national or regional information.

- GHS classification of the substance/mixture and any national or regional information.
- GHS label elements, including precautionary statements (Danger). 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.
-

Section 3. Composition/Information on Ingredients
This section identifies the ingredient(s) contained in the product indicated on the SDS, including impurities and stabilizing additives. Required information:

Substances

- Chemical name
- Common name and synonyms
- Chemical Abstracts Service (CAS) number and other unique identifiers
- Impurities and stabilizing additives, which are classified and which contribute to the classification of the chemical.

Mixtures

Same information required for substances. The chemical name and concentration (i.e. exact percentage) of all ingredients that are classified as health hazards and are:

- Present above their cut-off/concentration limits or
- Present a health risk below the cut-off/concentration limits.
- The concentration (exact percentages) of each ingredient must be specified except concentration ranges may be used in the following situations:
- A trade secret claim is made
- There is batch-to-batch variation, or
- The SDS is used for a group of substantially similar mixtures.

Chemicals where a trade secret is claimed
A statement that the specific chemical identity and/or exact percentage (concentration) of composition has been withheld as a trade secret is required.

Section 4. First-Aid Measures

This section describes the initial care that should be given by untrained responders to an individual who has been exposed to the chemical. Required information:

- Necessary first-aid instructions by relevant routes of exposure (inhalation, skin and eye contact, and ingestion).
- Description of the most important symptoms or effects, and any symptoms that are acute or delayed.
- Recommendations for immediate medical care and special treatment needed, when necessary.

Section 5. Fire-Fighting Measures

This section provides recommendations for fighting a fire caused by the chemical. Required information:

- Recommendations of suitable extinguishing media,
- Advice on specific hazards that develop from the chemical during the fire, such as any hazardous combustion products created when the chemical burns.
- Recommendations on special protective equipment or precautions for firefighters.

Section 6. Accidental release measures

- Personal precautions, protective equipment and emergency procedures. Environmental precautions.
- Methods and materials for containment and cleaning up.

Section 7. Handling and Storage

- Precautions for safe handling.
- Conditions for safe storage, including any incompatibilities.

Section 8. Exposure controls/personal protection.

- Control parameters, e.g., occupational exposure limit values (PEL) or biological limit values.
- Appropriate engineering controls.
- Individual protection measures, such as personal protective equipment (PPE)

Section 9. Physical and Chemical Properties

- Appearance (physical state, color, etc.)..
- 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.
- Auto-ignition temperature.
- Decomposition temperature

Section 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.

Section 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).

Section 12. Ecological Information

- Eco-toxicity (aquatic and terrestrial, where available).
- Persistence and degradability.
- Bio-accumulative potential.
- Mobility in soil.
- Other adverse effects

Section 13. Disposal Considerations

- Description of waste residues and information on their safe handling and methods of disposal, including the disposal of any contaminated packaging..

Section 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.

Section 15. Regulatory Information

- Safety, health and environmental regulations specific for the product.

Section 16. Other Information

- Any information not covered by the previous 15 sections including information on preparation and revision of the SDS.

EMERGENCY PROCEDURES

Knowing proper emergency procedures is another important part of chemical safety. That's why you should always read the label and SDS for every chemical to find out exactly what to do in case you or a co-worker is overexposed. For emergencies, including fires, accidents, explosions, and medical emergencies, dial 911.

Medical Emergency

Take the SDS of the chemical that caused the injury to the Emergency Room if possible. Know where eyewash stations, emergency showers, and first aid kits are located for your work area. Emergency procedures may include:

- Flushing eyes with water for 15 minutes in case of chemical contact.
- Washing skin with soap and water, and removing contaminated clothing;
- Moving to fresh air if a person has been inhaling hazardous dust, fumes, or vapors
- Getting emergency medical assistance if a person has swallowed a hazardous chemical. There are no general measures for swallowing – vomiting may cause more harm, diluting with water may increase the risk. Call 911 and have the appropriate SDS available.

Chemicals on Skin or Clothing

- Flush with water for no less than 15 minutes (except for Hydrofluoric Acid, Flammable solids or >10% phenol). For larger contamination the safety shower should be used. Do not waste time because of modesty. Remove all contaminated clothing or jewelry.
- Do not use solvents to wash skin. Solvents remove the natural protective oils from the skin and can cause irritation and inflammation. Washing with a solvent also facilitates absorption of toxics.
- For flammable solids on skin, first brush off as much as possible, then flush with water for at least 15 minutes. Read the SDS and make sure the flammable solid is not reactive with water before you rinse.
- For hydrofluoric acid rinse with water for at least 15 minutes.
- For phenol concentrations >10%, flush with water for 15 minutes or until the affected area turns from white to pink.
- In all cases of severe contamination seek medical attention.

Inhalation

- Close containers, move to fresh air.
- If symptoms such as headaches, nose or throat irritation, dizziness, or drowsiness persist, seek medical attention. Explain what chemicals you were using and if possible take the appropriate SDS with you.

Ingestion

- Call 911 or the Poison Control Center (800-222-1222).
- **Do not induce vomiting** unless directed to do so by a health care provider.

Injection

- Wash area with soap and water and seek medical attention, if necessary.

Spills

All spills of chemicals and hazardous materials must be properly cleaned up in order to prevent adverse impacts to the campus environment. Prevention and control of hazardous material spills will ensure a safe campus working environment and prevent illegal discharges to the environment. It is the responsibility of each employee to be aware of the proper storage, handling, and spill clean-up of hazardous materials. Clean up all minor spills and leaks immediately using the spill control material and personal protective equipment in your area. If it is a larger spill or very hazardous spill:

- Notify persons in the immediate area about the spill
- Evacuate all personnel from the spill area and adjoining areas that may be impacted by vapors or a potential fire, if necessary
- If the spilled material if flammable turn off all potential ignition sources. Avoid breathing vapors of the spilled materials. Be aware that some materials either have no odors or induce olfactory fatigue (ie the odor is detectable only briefly)
- Leave on or establish exhaust ventilation if it is safe to do so.
- Close doors to slow down the spread of odors.
- Notify EHSCO and facilities management
- Essential personnel familiar with the incident need to stay in communication with responders.

Fire

Individuals are not required to fight fires, but those who choose to do so may fight small, incipient fires (no bigger than a wastepaper basket) as long as they have been trained in the proper use of fire extinguishers. Fight the fire from a positon where you can escape and only if you are confident that you will be successful. If the fire is large or spreading activate the fire alarm. Evacuate the building and wait for the fire department's arrival to inform them of the exact location, details of the fire, and chemicals that are stored and used in the area.

Other Safety Tips

- Do not purchase these compounds in quantities greater than can be used in the specified storage time period.
- Label containers with receiving, opening and disposal dates.
- Ethers should be stored in the dark and under nitrogen if possible.
- Always check for the presence of peroxides before distilling any peroxide-former.
- Consult safety references (i.e. SDSs) before working with peroxidizable compounds.
    - If old containers of peroxide-forming chemicals are found, do not move them. Contact the Office of Health and Safety for assistance in disposing of the container.

RADIATION SAFETY

Another occupational hazard present at UMCES is **radioactive materials**. This hazard is not covered by the Right to Know law. A brief description is included for your information. UMCES works under the Broad Scope Radioactive Material License held by University of Maryland College Park (UMCP). Maryland is an “Agreement State”. This means that Maryland has signed a formal agreemen*t* with the U. S. Nuclear Regulatory Commission (NRC) pursuant to Section 274 of the Atomic Energy Act authorizing the State of Maryland to regulate certain uses of radioactive materials within the *State*. This license is monitored and strictly audited by Maryland Department of the Environment.

Radioactive materials are powerful research tools in biological and physical research. Strict exposure limits apply. As a result of controls which are in effect, the risk of work involving exposure to these sources of radiation is insignificant. No one may use, bring, purchase, or remove any radioactive material or radiation producing devices without the approval of the Radiation Safety Officer and the Radiation Safety Committee at UMCP. Contact UMCES’ ESCO for more information

Restricted Area

Any laboratory that stores or uses radioactive material or radiation producing devices is classified as a “**restricted area**” by the Code of Maryland Regulations (COMAR) 26.12.01.01. A pre-requisite of entering that area requires that you are informed of the hazards involved. These areas (labs) are indicated by the radiation symbols which are on the outside of the door to the lab. Outside each lab there is a notice posted for personnel who do not use radioactive materials that must be read and signed prior to entering the restricted area.

If a pregnant employee (student) encounters a restricted area in the course of designated work, she can make a declaration in writing of her pregnancy to her supervisor and the ESCO. She will then be provided with special monitoring devices during the course of pregnancy to ensure that her exposure does not exceed 10% (0.5rem) of that normally allowed for adult workers (5rem). This declaration is fully optional to the individual.

ALARA Policy

At all times, the amount of radiation received by an individual is to be kept -- **A**s **L**ow **A**s **R**easonably **A**chievable (**ALARA**). Qualifications of each applicant are thoroughly reviewed by the Radiation Safety Committee (RSC) to ensure that they have the required formal training, on the job training, history of past use of radioactive material, etc. All protocols are reviewed and approved by the RSC and the RSO prior to use. Personnel using radioactive material are trained in ALARA techniques (time, distance, and shielding). Users of radioactive material keep logs that record any contamination and the immediate measures to remove any contamination after doing an experiment or, monthly whichever comes first. In addition, the ESCO checks these records on a monthly basis and does a wipe survey quarterly for each laboratory with radioactive material, UMCP Radiation Safety does an annual audit and Maryland Department Of the Environment Radiation Section occasionally does an unannounced inspection. During these audits/inspections the licensee (user) must defend their results and methods of carrying out ALARA.

☢ Radioactive material and radiation producing devices are labeled with the same radioactive symbol that is on the door signage. When radioactive materials are not being actively used by a trained employee they must be secured behind a locked area (refrigerator, freezer, cabinet, or laboratory door). If you are working in a laboratory that has radioactive materials or equipment check with the Principal Investigator where and how the material is stored. If radioactive material/samples are not in a locked cabinet, refrigerator, or freezer the main door(s) to that laboratory must be locked at all times.

For additional information concerning radioactive material and the training program contact UMCES' Environmental Safety Compliance Officer umces-safety@umces.edu.

Table 1. Examples of Incompatible Chemicals from the CDC

The following list is not a complete listing of incompatible materials. It contains some of the more common incompatible materials. Always research materials you work with in order to work safely in the lab.

Chemicals listed in Column A should not be stored with or used near items in Column B

Column A	**Column B**
Acetic Acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates
Acetic anhydride	Hydroxyl-containing compounds such as ethylene glycol, perchloric acid
Acetone	Concentrated nitric and sulfuric acid mixtures, hydrogen peroxide
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Alkali and alkaline earth	Water, carbon tetrachloride or other chlorinated hydrocarbons, metals such as powdered carbon dioxide, halogens, magnesium, sodium, potassium
Ammonia (anhydrous	Mercury, halogens, calcium hypochlorite, hydrofluoric acid
Ammonium nitrate	Acids, metal powders, flammable liquids, chlorates, nitrites, sulfur, finely divided organic or combustible materials
Aniline	Nitric acid, hydrogen peroxide
Arsenical materials	Any reducing agent
Azides	Acids, heavy metals and their salts, oxidizing agents
Calcium oxide	Water
Carbon, activated	All oxidizing agents, calcium hypochlorite
Carbon tetrachloride	Sodium
Chlorates	Ammonium salts, acids, metal powders, sulfur, finely divided organic or combustible material,
Chlorine dioxide	Ammonia, methane, phosphine, hydrogen sulfide
Chromic acid	Acetic acid, alcohol, camphor, glycerol, naphthalene, chromium trioxide, and flammable liquids in general
Copper	Acetylene, hydrogen peroxide
Cumene hydroperoxide	Acid
Cyanides	Acid
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens, other oxidizing agents
Fluorine	All other chemicals
Hydrides	Water
Hydrocarbons (e.g., butane)	Fluorine, chlorine, bromine, chromic acid, peroxides propane
Hydrocyanic acid	Nitric acid, alkalis
Hydrofluoric acid (anhydrous)	Ammonia (aqueous or anhydrous)

Chemicals listed in Column A should not be stored with or used near items in Column B

Column A	Column B
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, any flammable liquid (i.e., alcohols, acetone), combustible materials, aniline, nitromethane
Hydrogen sulfide	Fuming nitric acid, oxidizing gases
Hypochlorites	Acids, activated carbon
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen
Mercury	Acetylene, fulminic acid, ammonia
Metal hydrides	Acids, water
Nitrates	Acids
Nitroparaffins	Inorganic bases, amines
Oxalic acid	Mercury and silver and their salts
Perchloric acid	Acetic anhydride, alcohol, bismuth, paper, wood, grease, oils
Permanganates	Concentrated sulfuric acid, glycerol, ethylene glycol, benzaldehyde
Peroxides, organic	Acids (organic or mineral), avoid friction, store cold
Phosphorus, white	Air, oxygen, alkalis, reducing agents
Potassium	Carbon tetrachloride, carbon dioxide, water
Potassium chlorate	Sulfuric and other acids, ammonium salts, metal powders, sulfur, finely divided organics, combustibles
Potassium perchlorate	Sulfuric and other acids (see also chlorates
Potassium permanganate	Glycerol, ethylene glycol, benzaldehyde, sulfuric acid Silver and silver salts
Sodium	Carbon tetrachloride, carbon dioxide, other chlorinated hydrocarbons, water
Sodium nitrate	Ammonium nitrate and other ammonium salts
Sodium peroxide	Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural
Sulfides	Acids
Sulfuric acid	Chlorates, perchlorates, permanganates

Adapted from *Prudent Practices in the Laboratory: Handling and Disposal of Chemicals*, National Research Council, 1995, with additions from OHS.

Table 2. Basic Chemical Segregation

http://www.ehso.com/ChemicalStorageGuidelines.htm

Hazard Class of Chemical	Recommended Storage Method	Examples	Incompatibilities
Compressed gases - Flammable	Store in a cool, dry area, away from oxidizing gases. Securely strap or chain cylinders to a wall or bench.	Methane Hydrogen Acetylene Propane	Oxidizing and toxic compressed gases, oxidizing solids.
Compressed gases - Oxidizing	Store in a cool, dry area, away from flammable gases and liquids. Securely strap or chain cylinders to a wall or bench.	Oxygen Chlorine Bromine	Flammable gases
Compressed gases - Poisonous	Store in a cool, dry area, away from flammable gases and liquids. Securely strap or chain cylinders to a wall or bench.	Carbon monoxide Hydrogen sulfide Nitrogen dioxide	Flammable and/or oxidizing gases.
Corrosives - Acids	Store separately in acid storage cabinet. Segregate oxidizing acids (i.e., Chromic, nitric, sulfuric, and perchloric acids) from organic acid	Acetic acid Phenol Sulfuric acid Chromerge Nitric acid Perchloric acid Chromic acid Hydrochloric acid	Flammable liquids, flammable solids, bases, oxidizers
Corrosives - Bases	Store in separate corrosive storage cabinet. Store solutions of inorganic hydroxides in labeled polyethylene containers	Ammonium hydroxide Sodium hydroxide Calcium hydroxide	Flammable liquids, oxidizers, poisons, and acids
Flammable Liquids	Store in flammable storage cabinet and away from sources of ignition. Store highly volatile flammable liquids in an explosion-proof refrigerator.	Acetone Benzene Diethyl ether Methanol Ethanol Toluene Glacial acetic acid	Acids, bases, oxidizers, and poisons
Flammable Solids	Store in a separate dry, cool area away from oxidizers, corrosives, flammable liquids	Phosphorus, yellow Calcium carbide Picric acid Benzoyl peroxide	Acids, bases, oxidizers, and poisons

Table 2. Basic Chemical Segregation (cont'd)

http://www.ehso.com/ChemicalStorageGuidelines.htm

Hazard Class of Chemical	Recommended Storage Method	Examples	Incompatibilities
General Chemicals - Non-reactive	Store on general laboratory benches or shelving preferably behind glass doors and below eye level.	Agar Sodium chloride Sodium bicarbonate Most non-reactive salts	See specific SDS
Oxidizers	Store in a spill tray inside a chemical storage cabinet. Separate from flammable and combustible materials.	Ammonium persulfate Ferric chloride Iodine Sodium hypochlorite Benzoyl peroxide Potassium permanganate Potassium dichromate The following are generally considered oxidizing substances: Peroxides, perchlorates, chlorates, nitrates, bromates, super-oxides.	Separate from reducing agents, flammables, and combustibles.
Poisons/Toxic Compounds	Store separately in vented, cool, dry area, in unbreakable chemically-resistant secondary containers and in accordance with the hazardous nature of the chemical.	Aniline Carbon tetrachloride Chloroform Cyanides Heavy metals compounds, i.e., cadmium, mercury, osmium Oxalic acid Phenol Formic acid	Flammable liquids, acids, bases, and oxidizers. See specific SDS

Table 2. Basic Chemical Segregation (cont'd)

http://www.ehso.com/ChemicalStorageGuidelines.htm

Hazard Class of Chemical	Recommended Storage Method	Examples	Incompatibilities
Water-Reactive Chemicals	Store in dry, cool location, protect from water fire sprinkler.	Sodium metal Potassium metal Lithium metal Lithium aluminum hydride	Separate from all aqueous solutions and oxidizers.
Carcinogens	Label all containers as "Cancer Suspect Agents". Store according to the hazardous nature of the chemical, using appropriate security when necessary.	Benzidine Beta-naphthylamine Benzene Methylene chloride Beta-propiolactone	See specific SDS.
Teratogens Teratogens	Label all containers as "Suspect Reproductive Hazard". Store according to the hazardous nature of the chemical, using appropriate security when necessary	Lead and mercury compounds Benzene Aniline	See specific SDS.
Peroxide-Forming Chemicals	Store in air-tight containers in a dark, cool, dry area. See Table 3 for recommended storage time limits.	Store in air-tight containers in a dark, cool, dry area. See Table 3 for recommended storage time limits.	See specific SDS
Strong Reducing Agents	Store in cool, dry, well-ventilated location. Water reactive. Segregate from all other chemicals.	Acetyl chloride Thionyl chloride Maleic anhydride Ferrous sulfide	See specific SDS

Table 3. Suggested Storage Time Limits for Common Peroxidizable Compounds

http://www.ehso.com/ChemicalStorageGuidelines.htm[5/1/2014 1:34:33 PM]
Chemical Storage Guidelines from The CDC

Under proper conditions, these chemicals will form explosive peroxides which can be detonated by shock or heat.

MOST DANGEROUS: Discard after 3 months.

Peroxide formation hazard during storage.

Diisopropyl ether Divinyl acetylene Isopropyl ether	Potassium metal Sodium amide Vinylidene chloride

DANGEROUS: Discard after one year.

Peroxide formation hazard during storage and on concentration (i.e., distillation) of compound.

Acetal Acetaldehyde Cumene Cyclohexene Diacetylene	Dicyclopentadiene Diethyl ether 1,4-Dioxane Ethylene glycol dimethyl ether Methyl acetylene	Methyl cyclopentane Methyl isobutyl ketone Tetrahydrofuran Tetrahydronaphthalene Vinyl ethers

DANGEROUS: Discard after one year.

Peroxide formation causes initiation of hazardous polymerization.

Acrylic acid Acrylonitrile 1,3-Butadiene 2-Butanol	Chloroprene Chlorotrifluoroethylene Methyl methacrylate 2-Propanol Styrene	Tetrafluoroethylene Vinyl acetate Vinyl acetylene Vinyl chloride Vinyl pyridine

You have completed the Right to Know/ Hazard Communication course. For documentation please e-mail umces-safety@umces.edu for a short test you must complete. Once completed hit the "Submit" button on the top right corner of the test.