SAFETY DATA SHEETS

Safety Data Sheets are an important communication component of the Globally Harmonized System (GHS). Safety Data Sheets provide the chemical toxicity information that allow us to take the necessary precautions to safely handle/ prepare chemical reagents and solutions in lab. Using personal protective equipment or utilizing engineering controls to avoid /minimize chemical exposure may be essential even while performing routine organic chemistry separations or syntheses.

Safety Data Sheets (SDS) must comply with a standard format. Each SDS includes 16 sections that detail important information about the chemical as well as the potential health effects that may arise from exposure. The 16 sections included in an SDS are as follows:

Section 1: Identification of Chemical

Section 2: Hazard Identification—This is where you will find much of the information necessary to work with a chemical safely!

- This section identifies the hazard classification of the chemical.
  Hazards are divided into three groups: **physical**, **health and environmental.**
- Each hazard group is sub-divided into different classes of hazards; each hazard class is further subdivided into categories.
  Category 1 is ALWAYS the highest level within a hazard class.
  HAZARD GROUP → HAZARD CLASS → HAZARD CATEGORY

Physical Hazard class examples: flammable, oxidizer, corrosive, explosive, self-reactive

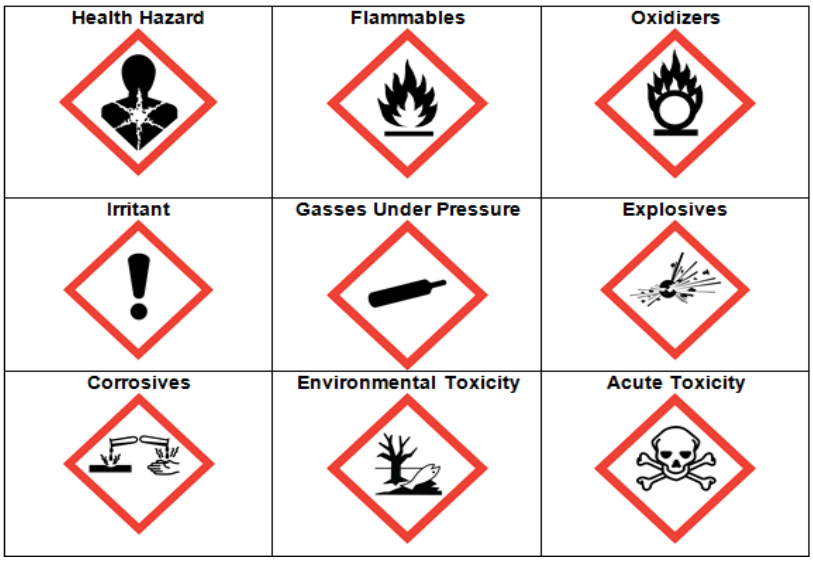
Health Hazard class examples: carcinogen, mutagen, irritant, teratogen

Environmental Hazard class examples: aquatic or ozone

- Section 2 includes standard precautionary statements that describe action(s) to be taken to minimize/eliminate the risk of the hazard.
- Section 2 also identifies hazards not otherwise classified(ex. Lachrymator)
- Hazard identification symbols (pictograms) are found in this section.

GHS PHYSICAL, ENVIRONMENTAL and HEALTH HAZARD PICTOGRAMS-

Found in Section 2 of SDS



What is an oxidizer or oxidizing agent?

An oxidizer or oxidizing agent is any substance that releases oxygen (or other oxidizing substances) to a reaction, such as fire. Fire requires three components to sustain itself; a heat source, a source of oxygen (oxidizer), and a fuel (reducing agent). Oxidizing agents are incompatible with organic materials and reducing agents. The presence of an oxidizing agent will intensify a fire; make normally non - combustible materials in air combustible. Common oxidizing materials include bromine, nitric acid, peroxides, and permanganates.

What is the difference between flammable and combustible?

To understand the difference between the terms flammable and combustible one must understand what is meant by the term **flashpoint**. The flashpoint of a liquid is the minimum temperature at which there is sufficient vapor above the liquid that, when mixed with air and a spark, a fire results**. A flammable liquid has a flashpoint below 38 ° C while a combustible liquid has a flashpoint above 38 ° C.** Flammable substances are easier to burn. For example, propane is flammable while jet fuel is combustible. Note that all flammable materials are combustible but not all combustible materials are flammable.

What is meant by corrosive?

A corrosive substance is a highly reactive substance that has the ability to cause irreparable damage to another substance, such as living tissue, on contact. Some corrosive substances can also damage metal. Substances with a very low pH (acids) or very high pH (bases) are examples of corrosive substances. Common examples of corrosive substances include hydrochloric acid, nitric acid, sulfuric acid, and sodium hydroxide. Corrosive substances cause more damage if more concentrated and upon prolonged exposure. **If you get a corrosive substance on your skin, flush the affected area immediately with lots of running cold water**.

Section 3: Composition/ information on ingredients

Section 4: First-aid measures

Section 5: Fire-fighting measures

Section 6: Accidental release measures

Section 7: Handling and storage

The precautions necessary to safely handle and store the substance are described in this section.

Section 8: Exposure control/ personal protection

Exposure limits refer to levels of airborne concentrations below which an individual NORMALLY experiences no ill health effects. According to the Canadian Centre for Occupational Health and Safety, "exposure limits have different names and different meanings depending on who developed them and whether or not they are legal limits".

Occupational Safety and Health Administration (OSHA) in the USA publish **Permissible Exposure Limits; PELs** are airborne concentrations of a substance that should not be exceeded. PELs are normally reported in units of **ppm.**

PELs may be reported as a **Time Weighted Average (TWA**); this is the average amount of substance that an adult may be exposed over an 8 hour time span.

PELs may also be reported as a **Short Term Exposure Limit (STEL)**; this is the maximum amount of substance that adult may be exposed for a continuous 15 minute time period.

Some substances do not have PELs; the lack of a PEL does NOT mean it is NOT harmful.

The precautions necessary to safely handle the substance are outlined in Section 8 and may include wearing of PPE (Personal Protective Equipment) or utilizing engineering controls (use of a fume hood). Fume hoods are recommended when a substance has a low PEL.

Examples of some PEL values are listed below.

Substance	PEL (ppm)
Acetone	1000
Octane	300
Benzene	10
Formaldehyde	0.75

Section 9: Physical and chemical properties

Section 10: Stability and reactivity

Section 11: Toxicological information

Toxicity describes the ability of a substance to cause an unwanted effect to an organism upon exposure of sufficient concentration of the substance.

A person may have excessive chemical exposure through a large one time exposure, in the case of a spill, or through repeated exposures over a long period of time. **Acute health effects often result from a single substantial exposure**. Concentrated acids and bases can cause the skin to burn and blister upon contact. **Chronic health effects often result from repeated long term exposures**. According to the Canadian Centre for Occupational Health and Safety, nerve tissue deterioration may result from inhalation and skin absorption of some organic solvents over prolonged periods at concentrations which do not cause acute toxicity.

Carcinogens are substances that are capable of causing cancer.

Mutagens are substances that are capable of causing mutations to the DNA of an individual. Examples of mutagens include formaldehyde, ethidium bromide and nicotine. Mutagens are normally carcinogens.

Teratogens are substances that are capable of causing harm to a fetus/embryo without causing harm to the mother. Ethanol is an example of a teratogen.

Route of exposure and dosage are important when evaluating the toxicity of a substance. Chloroform is no longer used as an anaesthetic because the difference in dose required to anaesthetize an individual and the dose that will result in death is not large. The most common routes of entry of a chemical into our bodies include **inhalation, dermal (skin absorption) and ingestion.**

LD_{50} is the amount of substance that will result in the death of 50 % of the organisms after a single exposure. **LD_{50}** is normally reported as **mg of substance per kg** of organism. **LD_{50}** is a measure of a substance's acut e toxicity. Substances that have lower LD_{50}s are more toxic. LD_{50}s are dependent on the route of entry of the substance.

Examples of common LD_{50}s for rats are shown below:

Substance	**LD_{50} (mg/kg)(oral)**
Nicotine	50
Ethanol	10 600
Water	180 000

LC_{50} is the concentration of a substance in air or water that will result in the death of 50 % of the organisms after a single exposure. **LC_{50}** is normally reported as **ppm or milligrams per litre** of substance in air. **Substances that have lower LC_{50}s are more toxic**.

Levels of exposure that can cause chronic health effects are MUCH LOWER than LD_{50} and **LC_{50}** amounts.

Section 12: Ecological information

Section 13: Disposal considerations

Section 14: Transport information

Section 15: Regulatory information

Section 16: Other information