



GHS

A guide to Globally Harmonized System (GHS) chemical labeling standards

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What is GHS? Why now?

The Globally Harmonized System of Classification and Labeling of Chemicals (GHS) is a method developed by the United Nations (UN) for communicating chemical hazards. Under this system, chemical containers must all display a specific label. This label helps facilitate the safe shipping and use of hazardous substances.

Before GHS, inconsistencies in labeling made exporting and importing chemicals a challenge. Countries were each using their own labeling system. The lack of international standards increased the risk of accidents because recipients of chemical shipments could not quickly recognize the hazards presented by their packages. As a result of differing labeling from country to country, shipping costs also rose for many companies as the global trade of chemicals grew.

The GHS aims to eliminate this confusion by providing clear guidelines for chemical labeling that can be used across borders.

The UN published the first edition of the GHS in 2003, but these changes to chemical



hazard communication are just beginning to go into effect in the United States. The Occupational Safety and Health Administration (OSHA) integrated GHS into its Hazard Communication Standard (HazCom) in 2012, and the new regulations are currently being implemented by manufacturers, importers, distributors, and employers.

The GHS unifies several important aspects of communicating about hazardous chemicals. In addition to standardizing the format and contents of labels on chemical containers, the system requires the use of a Safety Data Sheet, which includes specific, detailed information about a chemical, its hazards, and relevant first aid measures.

The GHS also creates standardized hazard classifications that make it easier for those handling these chemicals to understand what physical and health risks are associated with them.



Participating Countries

The GHS is not a legal requirement, but many countries are choosing to adopt this new standard because it simplifies the transport and storage of chemicals. Those involved in the chemical trade will no longer need to create multiple labels and information sheets to sell their products to more than one country.

The chemical business worldwide amounts to more than \$1.7 trillion annually, and in the U.S. it is a \$450 billion industry. Consider the fact that OSHA estimates the GHS will save the country \$585 million annually in productivity improvements and \$266 million related to reduced safety risks, and the changes seem more than worthwhile.

Additionally, the changes will prevent 43 deaths and 585 work-related injuries and illnesses in the U.S. each year, according to OSHA.

Not all countries will adopt the GHS standards in the exact same way, but the UN does mandate that countries use the same basic components of the standard if they choose to adopt it: hazard classifications, safety data sheets, and labels.





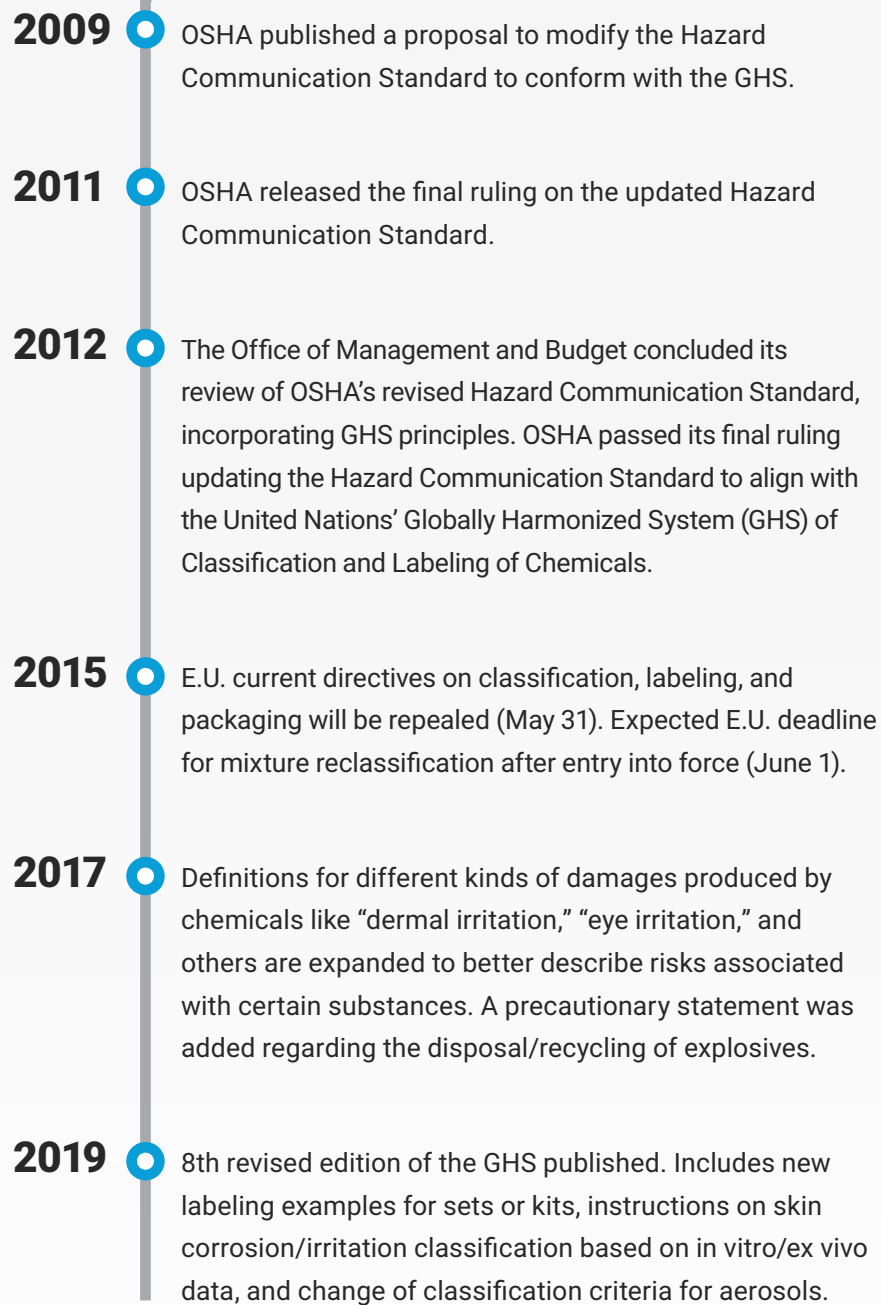
72 participating countries (2019)

Argentina	Guatemala	Paraguay
Australia	Hungary	Peru
Austria	Iceland	Philippines
Belgium	Indonesia	Poland
Bolivia	Ireland	Portugal
Brazil	Israel	Republic of Korea
Brunei Darussalam	Italy	Romania
Bulgaria	Japan	Russian Federation
Cambodia	Kyrgyzstan	Senegal
Canada	Lao People's Democratic Republic	Serbia
Chile	Latvia	Singapore
China	Liechtenstein	Slovakia
Colombia	Lithuania	Slovenia
Cyprus	Luxembourg	South Africa
Czech Republic	Madagascar	Spain
Democratic Republic of Congo	Malaysia	Sweden
Denmark	Malta	Switzerland
Ecuador	Mauritius	Thailand
Estonia	Mexico	Turkey
Finland	Myanmar	United Kingdom
France	Netherlands	United States of America
Gambia	New Zealand	Uruguay
Germany	Nigeria	Vietnam
Greece	Norway	Zambia

GHS Timeline

- 1992** ○ The Globally Harmonized System (GHS) was mandated at the United Nations Conference on Environment and Development (UNCED) to internationally standardize classification and labeling of chemicals.
- 2002** ○ Countries were encouraged to implement the new GHS as soon as possible, with a goal of having a fully operational system by 2008. In December 2002, the UN approved the 1st edition of the GHS standards.
- 2003** ○ The 1st edition of the GHS was published and made available for implementation.
- 2004** ○ In December 2004, amendments to the GHS were adopted at the 2nd session of the Subcommittee of Experts. Amendments included revisions on classification and labeling, new rules for aspiration hazards and precautionary statements, pictograms, and preparation of safety data sheets.
- 2005** ○ OSHA Published an Advanced Notice of Proposed Rulemaking and opened it to public comments. Later that year the 1st revised edition of the GHS was adopted by the Committee of Experts.
- 2007** ○ The 2nd revised edition of the GHS was published (included standardized precautionary measures).



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- A vertical timeline on a light gray background, starting with a series of five small gray dots at the top. A vertical gray line descends from these dots, with blue circular markers at each year. To the right of each marker is a text block describing a regulatory update.
- 2009** OSHA published a proposal to modify the Hazard Communication Standard to conform with the GHS.
 - 2011** OSHA released the final ruling on the updated Hazard Communication Standard.
 - 2012** The Office of Management and Budget concluded its review of OSHA's revised Hazard Communication Standard, incorporating GHS principles. OSHA passed its final ruling updating the Hazard Communication Standard to align with the United Nations' Globally Harmonized System (GHS) of Classification and Labeling of Chemicals.
 - 2015** E.U. current directives on classification, labeling, and packaging will be repealed (May 31). Expected E.U. deadline for mixture reclassification after entry into force (June 1).
 - 2017** Definitions for different kinds of damages produced by chemicals like "dermal irritation," "eye irritation," and others are expanded to better describe risks associated with certain substances. A precautionary statement was added regarding the disposal/recycling of explosives.
 - 2019** 8th revised edition of the GHS published. Includes new labeling examples for sets or kits, instructions on skin corrosion/irritation classification based on in vitro/ex vivo data, and change of classification criteria for aerosols.

Important Dates

The GHS has been implemented globally since 1992, but made its biggest impact on businesses in the United States in 2012, when it was officially incorporated by OSHA. That year, OSHA's Hazard Communication Standard was changed to align with GHS.

Since then, several relevant GHS implementation dates have been enforced by OSHA. These dates have affected employers, distributors, chemical manufacturers, and importers.

Employers:

- Had to incorporate new label requirements and safety data sheet (SDS) format starting December 1, 2013. They were also required to provide training for employees on these new standards.
- By June 1, 2016, employers were required to update workplace labeling and HazCom programs, and train employees on newly identified physical or health hazards.

Distributors:

- On December 1, 2015, distributors were no longer allowed to ship products which used labels from chemical manufacturers/importers that did not comply with GHS.

Employers, distributors, chemical manufacturers, and importers:

- Were required to comply with all final rule provisions starting on June 1, 2015.
- Were only able to ship products under the old classification system until December 1, 2015.

Hazard Classifications & Categories

A main purpose of the new GHS is to standardize the types of chemical hazards that exist and the way entities in the chemical industry classify chemicals that have those hazards. To that end, the GHS names three main hazard groups: physical, health, and environmental.

- **Physical hazards pose a threat that could injure people or damage property. For example, a gas might explode, causing physical damage.**
- **Health hazards impact human health by causing irritating symptoms or even deadly diseases.**
- **Environmental hazards negatively impact aquatic environments.**

Each general group is divided up into more specific classes, and each class into even more specific categories. (Details about the classes and categories can be found in the GHS Purple Book.)

The following classes are used by the GHS:

Environmental Hazards	
Acute Aquatic Toxicity	Chronic Aquatic Toxicity

Health Hazards	
Acute Toxicity	Carcinogenicity
Skin Corrosion/Irritation	Reproductive Toxicity
Serious Eye Damage/Eye Irritation	Target Organ Systemic Toxicity- Single Exposure
Respiratory or Skin Sensitization	Target Organ Systemic Toxicity- Repeat Exposure
Germ Cell Mutagenicity	Aspiration Toxicity

Physical Hazards

Chemicals Under Pressure	Pressurized liquids or solids
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

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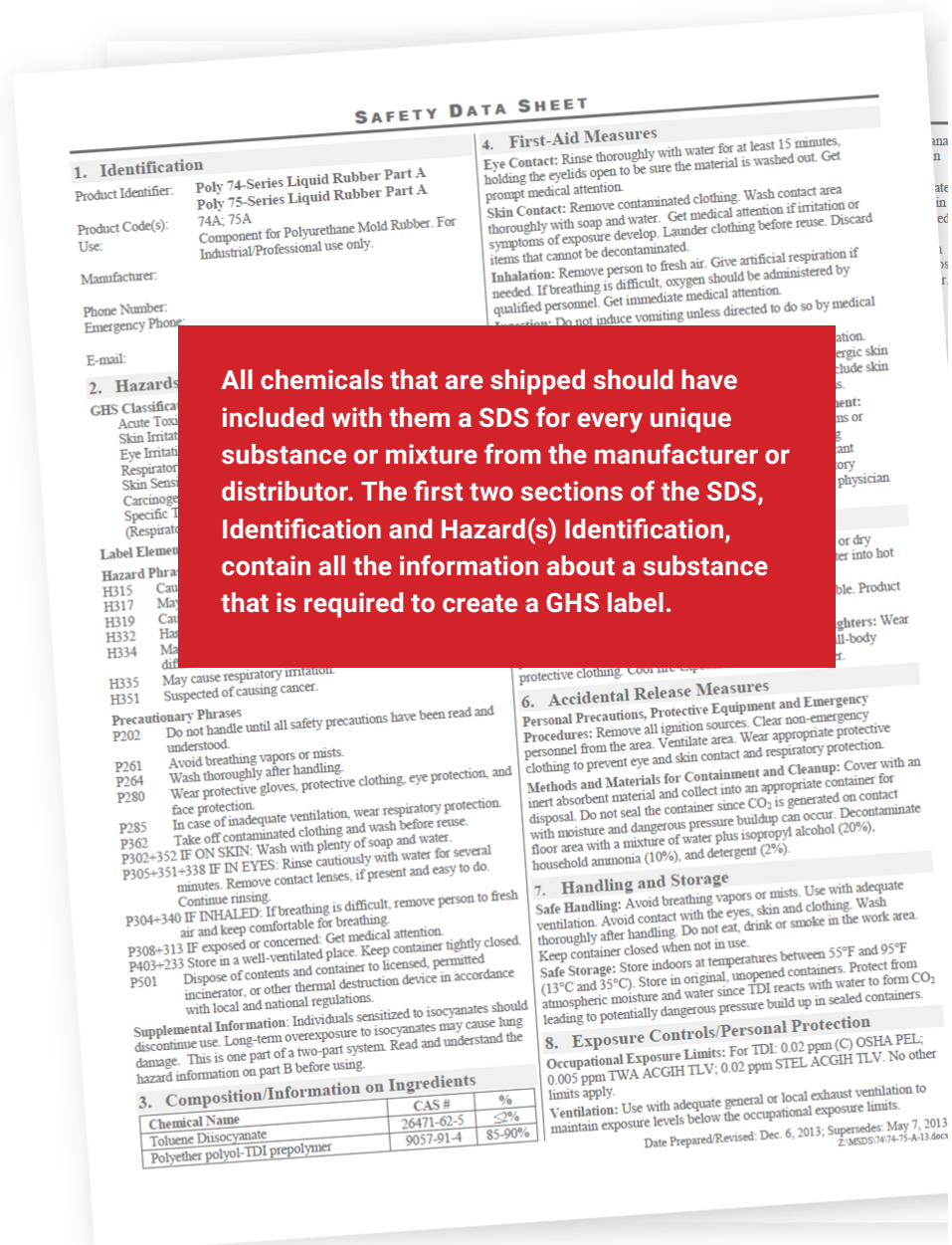


GHS Safety Data Sheets (SDS)

Previously called MSDS (Material Safety Data Sheets) under the old OSHA HazCom standards, Safety Data Sheets are a critical part of GHS and are designed to communicate complete information about a chemical or mixture and how to mitigate any issues with handling or storage. Additionally, first aid procedures are listed in case of accidental exposure.

Information on the SDS should include these categories/headers, and in this order:

1. Identification
2. Hazard(s) identification
3. Composition/information on ingredients
4. First-aid measures
5. Fire-fighting 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



All chemicals that are shipped should have included with them a SDS for every unique substance or mixture from the manufacturer or distributor. The first two sections of the SDS, Identification and Hazard(s) Identification, contain all the information about a substance that is required to create a GHS label.

GHS Label Elements

1 PENTANE
CAS 109-66-0

2 DANGER

3 Extremely flammable gas. Contains gas under pressure. May explode if heated. Gas may reduce oxygen in confined spaces.

4 Keep away from heat/spark/open flames/hot surfaces. No smoking. Protect from sunlight. Store in a well-ventilated place.
Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so.
Eye contact: For liquified gas, flush eyes with lukewarm water, Seek immediate attention.
Skin contact: Liquified gases may cause cryogenic burns. Treat burned or frostbitten skin by flushing or immersing the affected area(s) in lukewarm water. Do not rub affected area.
Inhalation: If respiratory systems develop, move victim away from source of exposure and into fresh air. Seek medical attention.

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1 Product Identifier

Name or number used for a hazardous product on a label or in the SDS

2 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

3 Hazard Statements

Standard phrases assigned to a hazard class and category that describe the nature of the hazard

4 Precautionary Statements

Measures to minimize or prevent adverse effects

5 GHS Pictograms

Standardized set of symbols which convey health, physical, and environmental hazard information

6 Supplier Identification

Company name, address, and phone number should be listed on the label

The prescribed symbols, signal words, and hazard statements can be readily selected from Annex 1 of the GHS Purple Book. These standardized elements are not subject to variation, and should appear on the GHS label as indicated in the GHS for each hazard category or 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.

GHS Packaging Pictograms

Pictograms graphically represent a chemical's hazards. The pictograms used for GHS packaging labels are built out of two elements: a red diamond and a black image. The space between these two elements should be white.

When chemicals are shipped in boxes or other larger containers, these 9 pictograms should be placed on the inner packaging inside the boxes. Transport pictograms (see page 15) should be placed on outer packaging such as boxes or shipping containers.



Flammables

This symbol is used for:

- Flammable gases (cat. 1)
- Flammable aerosols (cat. 1, 2)
- Flammable liquids (cat. 1, 2, 3)
- Flammable solids (cat. 1, 2)
- Self-reactive substances and mixtures (types B, C, D, E, F)
- Pyrophoric liquids (cat. 1)
- Pyrophoric solids (cat. 1)
- Self-heating substances and mixtures (cat. 1, 2)
- Substances and mixtures, which in contact with water, emit flammable gases (cat. 1, 2, 3)
- Organic peroxides (types B, C, D, E, F)



Corrosive

This symbol is used for:

- Corrosive to metals (cat. 1)
- Skin corrosion (cat. 1A, 1B, 1C)
- Serious eye damage (cat. 1)



Irritant

This symbol is used for:

- Acute toxicity (oral, dermal, inhalation) (cat. 4)
- Skin irritation (cat. 2, 3)
- Eye irritation (cat. 2A)
- Skin sensitization (cat. 1)
- Specific target organ toxicity following single exposure (cat. 3)
- Respiratory tract irritation
- Narcotic effects

NOTE: The Irritant pictogram should not be used in conjunction with the Toxic pictogram; -OR- for skin or eye irritation if either the Corrosive pictogram also appears, or if the Health Hazard pictogram is used to indicate respiratory sensitization.



Toxic

This symbol is used for:

- Acute toxicity (oral, dermal, inhalation) (cat. 1, 2, 3)



Oxidizing

This symbol is used for:

- Oxidizing gases (cat. 1)
- Oxidizing liquids (cat. 1, 2, 3)
- Oxidizing solids (cat. 1, 2, 3)



Explosive

This symbol is used for:

- Unstable explosives
- Explosives (divs. 1.1, 1.2, 1.3, 1.4)
- Self-reactive substances and mixtures (types A, B)
- Organic peroxides (types A, B)



Compressed Gas

This symbol is used for:

- Compressed gases
- Liquefied gases
- Refrigerated liquefied gases
- Dissolved gases



Environmentally Damaging

This symbol is used for:

- Acute hazards to the aquatic environment (cat. 1)
- Chronic hazards to the aquatic environment (cat. 1, 2)



Health Hazard



This symbol is used for:

- Respiratory sensitization (cat. 1)
- Germ cell mutagenicity (cat. 1A, 1B, 2)
- Carcinogenicity (cat. 1A, 1B, 2)
- Reproductive toxicity (cat. 1A, 1B, 2)
- Specific target organ toxicity following single exposure (cat. 1, 2)
- Specific target organ toxicity following repeated exposure (cat. 1A, 1B, 2)
- Aspiration hazard (cat. 1, 2)

Transport Pictograms

Transport pictograms use a wider variety of colors than packaging pictograms and are designed to communicate what chemicals are carried by a vehicle. Additional information such as subcategory numbers may be required.

These pictograms should be placed on outer packaging. On large containers that do not contain inner packaging, place both a transport pictogram and a GHS label.

Class 1: Explosives		
Explosives		
 <p>Layout for divisions 1.1-1.3</p>	Division 1.1	Substances and articles which have a mass explosion hazard
	Division 1.2	Substances and articles which have a projection hazard but not a mass explosion hazard
	Division 1.3	Substances and articles which have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard
 <p>Layout for divisions 1.4-1.6</p>	Division 1.4	Substances and articles which are classified as explosives but which present no significant hazard
	Division 1.5	Very insensitive substances which have a mass explosion hazard
	Division 1.6	No hazard statement

Class 2: Gases

Flammable Gases



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

The symbol, number and border line may be shown in white instead of black.

Non-Flammable, Non-Toxic Gases



Gases which are asphyxiant, oxidizing, or do not come under any other divisions.

The symbol, number and border line may be shown in white instead of black.

Toxic Gases



Gases which are known to be so toxic or corrosive to humans as to pose a hazard to health; or are presumed to be toxic or corrosive to humans because they have an LC50 value equal to or less than 5000 (ppm).

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Class 3 and 4: Flammable Liquids and Solids

Flammable Liquids



Liquids which have a flash point of less than 60 °C and which are capable of sustaining combustion.

The symbol, number and border line may be shown in white instead of black.

Flammable solids, self-reactive substances and solid desensitized explosives



Solids which, under conditions encountered in transport, are readily combustible or may cause or contribute to fire through friction; self-reactive substances which are liable to undergo a strongly exothermic reaction; solid desensitized explosives which may explode if not diluted sufficiently.

Substances liable to spontaneous combustion



Substances liable to spontaneous heating under normal conditions encountered in transport, or to heating up in contact with air and then being liable to catch fire.

Substances which in contact with water emit flammable gases



Substances which, by interaction with water, can become spontaneously flammable or give off flammable gases in dangerous quantities.

The symbol, number and border line may be shown in white instead of black.



Class 3 and 4: Flammable Liquids and Solids

Flammable Liquids



Liquids which have a flash point of less than 60 °C and which are capable of sustaining combustion.

The symbol, number and border line may be shown in white instead of black.

Flammable solids, self-reactive substances and solid desensitized explosives



Solids which, under conditions encountered in transport, are readily combustible or may cause or contribute to fire through friction; self-reactive substances which are liable to undergo a strongly exothermic reaction; solid desensitized explosives which may explode if not diluted sufficiently.

Substances liable to spontaneous combustion



Substances liable to spontaneous heating under normal conditions encountered in transport, or to heating up in contact with air and then being liable to catch fire.

Substances which in contact with water emit flammable gases



Substances which, by interaction with water, can become spontaneously flammable or give off flammable gases in dangerous quantities.

The symbol, number and border line may be shown in white instead of black.

Other GHS Transport Classes

Oxidizing Substances



Substances which, although not necessarily combustible, can, through yielding oxygen, cause or contribute to the combustion of other material.

The symbol, number and border line may be shown in white instead of black.

Organic Peroxides



Organic substances which contain the bivalent $-O-O-$ structure and may be considered derivatives of hydrogen peroxide, where one or both of the hydrogen atoms have been replaced by organic radicals.

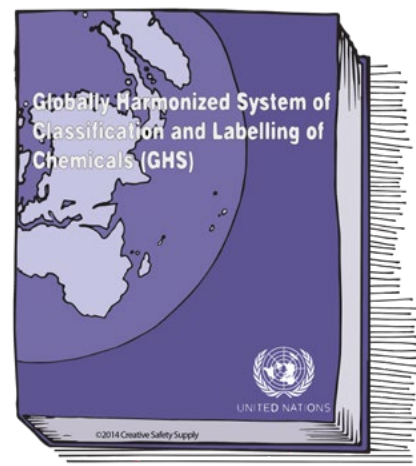
Corrosive Substances



Substances which cause full thickness destruction of intact skin tissue on exposure time of less than 4 hours; or exhibit a corrosion rate of more than 6.25 mm per year on either steel or aluminium surfaces at 55° C.

The symbol, number and border line may be shown in white instead of black.

Additional information about hazard categories, pictograms, transport pictograms, and other components of GHS can be found in the "GHS Purple Book" or online through OSHA's website at <https://www.osha.gov/dsg/hazcom/ghs.html>





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Creating GHS Labels

There are several options to create or acquire GHS labels for marking your chemicals.

NOTE: When creating GHS labels, the only given regulation is that the hazard pictograms, signal word, and hazard statements should be located together on the label. Aside from this, the label format or layout is not actually specified by GHS.

The three most common GHS labeling options are:

- Order labels from a safety company
- Print your own paper labels from an inkjet or laser printer
- Print your own labels using a thermal transfer printer (recommended)



Ordering GHS Labels

For companies with a limited need for GHS labels, ordering GHS labels from a catalog or website can be a viable option.

Typically you can fill out a printed or online order form per chemical with the required chemical information found in the chemical's SDS sheet, submit it, and the company will print the label for you and ship to your facility.

PROS:

No equipment needed

CONS:

High cost per label, wait time for delivery, impractical for high volume and/or repeat need

Printing Paper GHS Labels

Another option for creating GHS labels is to utilize an existing inkjet or laserjet printer to print labels onto standard paper.

The obvious major downside to this is the durability of paper labels. Because of the nature of GHS, GHS labels are around chemicals- and a small amount of certain chemicals or even water

PROS:

Inexpensive, utilizes existing equipment, print on demand, can save files for later quick recall

CONS:

Not durable, requires extra protection from water, wear and chemical damage, not practical for smaller containers/labels



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could obscure or destroy the label. Additionally, ink on paper exposed to UV will often fade and lose visibility, and depending on the print method, these labels can wear very easily with contact.

Some of these downfalls can be mitigated by protecting the labels with heavy duty plastic sleeves or another protective means, but this often can be difficult to do with smaller label sizes.

Printing GHS Labels with a Thermal Transfer Printer

By far, the most ideal option for creating GHS labels is through the use of a thermal transfer printer.

Because of their superior lifespan and low cost per label, for most companies dealing with a lot of GHS labels, having a thermal transfer printer in-house ends up being the easiest and most cost-effective way to create these labels.

Thermal transfer printers connect to any PC but are different than inkjet or laserjet printers in that instead of laying ink on top of a paper surface, thermal transfer printers work by heating a print ribbon resin and thermally bonding it to a material, usually an industrial vinyl. Through this method, you create weatherproof labels capable of lasting many years- even outdoors- without fading, smearing or wearing away.

Although most thermal transfer printers are monocolored systems (1 color at a time), many companies that offer thermal transfer printers can provide a dedicated GHS label stock with the red pictogram borders pre-printed.

Using your SDS, simply copy and paste, or manually enter the required information into the correct fields and print your label(s). Any thermal transfer printer capable of printing GHS labels should have the functionality to save labels so you can print them again later on.

PROS:

Highly durable, weatherproof, chemical/UV/water/wear resistant, can save files for later quick recall, low cost per label vs ordering, print on demand

CONS:

Requires a thermal transfer printer



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