

# Chemical Classification and Labelling

## ***IAMC Toolkit***

*Innovative Approaches for the Sound Management of Chemicals and Chemical Waste*



UNITED NATIONS  
INDUSTRIAL DEVELOPMENT ORGANIZATION



# Introduction

This presentation is an introduction to the safe use of hazardous substances. It aims at providing information to understand how chemicals are classified based on their intrinsic physical, health and environmental hazards (Globally Harmonized System of Classification and Labelling of Chemicals GHS).

These information allow the reader understanding the chemical potential risk for people, environment and equipment.

# Hazard Management

1. Risk Identification and safety	2. Transport and storage	3. Fire and explosion protection	4. Emergency response
<b>1.1 Chemical classification and labelling</b>	2.1 Internal transport of chemicals	3.1 Fire protection	4.1 Emergency response plan
1.2 Risk assessment	2.2 Internal pedestrian routes	3.2 Fire protection in welding and cutting operations	
1.3 Safety rules	2.3 Storage	3.3 Explosion protection	
1.4 Personal protective equipment		3.4 Container cleaning	
1.5 Skin protection			
1.6 Emergency escape routes			
1.7 Solvents, acids, bases handling			
1.8 Safety in gas tank handling			



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1. Introduction to hazardous substances
2. UN Globally Harmonized System of Classification and Labelling of Chemicals (GHS)
3. GHS Classification
4. Hazard Communication: GHS Labelling
5. Examples

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# Introduction to Hazardous Substances



# Chemicals

## Chemicals

- Are an integral part of daily life and most production processes depend on them
- Can have intrinsic hazardous properties, in which case they are considered also hazardous substances
- Can be substances or mixtures (two or more substances that do not react)
- Can be corrosive, reactive, flammable, explosive, oxidizing and inert.
- Can contribute to serious health effects such as burns/rashes, kidney damage, lung damage, heart ailments, cancer, central nervous system damage, etc.

# Hazardous Substances



Source: ISSPPRO

**Hazardous substances** are considered those that can have adverse effects on human health and the environment, or can be involved in a chemical accident due to their reactive properties.

## Examples:

- Substances posing physical hazards (e.g. explosions, fires)
- Substances causing skin and eye irritation
- Substances presenting environmental hazards
- Poisons, etc.

# Effective Control of Chemical Risks

- The use of hazardous chemicals can pose a risk to the workplace and to the local environment.



Source: Londoño G.

- **Important!** Establish a **systematic approach to safety in the use of chemicals** at the workplace to ensure a safe and healthy work environment and reduce the risks of major accidents.



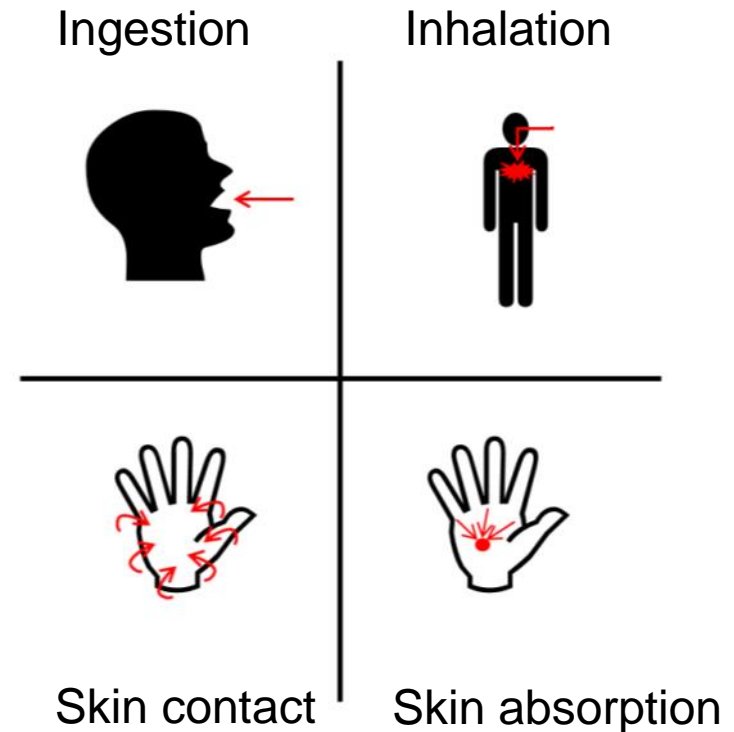
# Example of Occupational Exposure Routes

## Exposure routes include:

- Inhalation
- Skin absorption
- Ingestion/Swallowing
- Injection
- Ocular

## Important:

We need to know chemical hazards in order to protect ourselves and prevent exposure.



Source: ISSPPRO

# Classification of Chemicals

**Classification** is the process of determining the intrinsic physical, health and environmental hazards of a chemical.

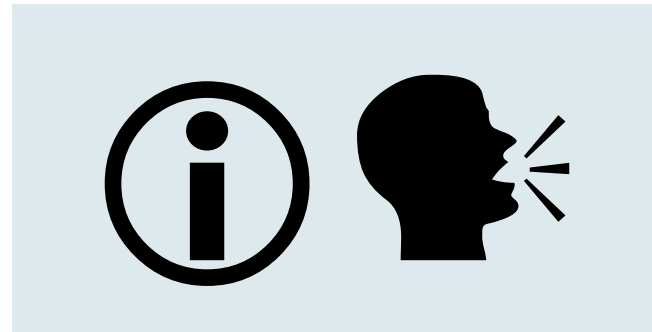
It is aimed at improving the knowledge of:

- Chemical hazards
- Chemicals use
- Risks arising from their use
- Precautions to be taken to protect people and the environment
- Means of communicating this information along the supply chain

# Classification as Basis for Chemical Safety

Therefore, it is extremely important to:

- ✓ Understand how chemicals are classified
- ✓ Communicate the hazard information of hazardous chemicals



# Optional Questions to Test Your Knowledge

- What are hazardous substances?
- Can you give some examples?
- Why is it important for chemicals to be classified?



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# UN Globally Harmonized System of Classification and Labelling of Chemicals (GHS)

# What is GHS?

- Comprehensive tool that harmonizes chemical classification and hazard communication
- Covers all hazardous substances including mixtures
- The classification and hazard communication of substances and mixtures are covered by the GHS
  
- Target audiences:
  - ✓ Consumers
  - ✓ Workers, including transport workers
  - ✓ Emergency responders

# REACH Definition of Substance and Mixture

**Substance:** A chemical element and its compounds in the natural state or obtained by any manufacturing process, including any additive necessary to preserve stability and any impurity deriving from the process used, but excluding any solvent which may be separated without affecting the stability of the substance or changing its composition.

**Mixture:** A mixture or solution composed of two or more substances

# Why was the GHS Developed?

Many different systems with differing requirements existed worldwide:

- Different hazards covered and classification criteria used
  - Information required on labels and safety data sheets (SDSs) varied
- **Result: disparity in the information provided**
- Conflicting and inconsistent information on classification and safety (labelling and safety data sheets)



# GHS Historical Background

- The GHS was developed by the United Nations as a non-binding treaty for UN member countries (2003)
  - International mandate: Agenda 21(1992), Chapter 19, Programme Area B, paragraphs 26 and 27
- Not a formal treaty, but a non-legally binding international agreement
  - Provides the basis for harmonizing regulations on chemicals at national, regional and worldwide levels
- It is continually reviewed and updated by a UN subcommittee (GHS Rev.5, 2013).

# UN Globally Harmonized System of Classification and Labelling of Chemicals (GHS)

## Purpose of the GHS:

- Ensuring that information on the hazardous properties of chemicals is available worldwide in order **to enhance the protection of human health and the environment** during the handling, transport and use of chemicals
- **Providing a structure** for countries that do not yet have a classification and labelling system
- **Reducing the need for testing and evaluation** of chemicals
- **Facilitating the international trade** in chemicals whose hazards have been properly assessed and identified on an international basis

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# GHS Classification

# GHS Classification

GHS provides a hazard-based system of classification focusing on the intrinsic properties of chemicals including:

- ✓ **Physical hazards** (e.g. explosivity, corrosivity)
- ✓ **Health hazards** (e.g. potential to cause cancer in humans, to irritate the skin or eyes)
- ✓ **Environmental hazards** (e.g. harmful to the aquatic environment)


# GHS – Hazard Classes and Categories

**Each hazard group consists of classes and categories (sub-sections of classes)**

- Example: The hazard class “Self-reactive substances and mixtures” has seven hazard categories (A-G).


**In general, the hazard categories are either in numerical or alphabetical order with “1” or “A” representing the most hazardous category.**

# GHS – Hazard Classes and Categories

Physical hazards							
	Level of hazard 						
Hazard class	Hazard category						
Explosives	Unstable explosives	Div 1.1	Div 1.2	Div 1.3	Div 1.4	Div 1.5	Div 1.6
Flammable gases	1	2					
Flammable aerosols	1	2					
Oxidising gases	1						
Gases under pressure Compressed gases, liquefied gases Refrigerated liquefied gases, dissolved gases	1						
Flammable liquids	1	2	3	4			
Flammable solids	1	2					
Self-reactive substances	Type A	Type B	Type C	Type D	Type E	Type F	Type G
Pyrophoric liquids	1						
Pyrophoric solids	1						
Self-heating substances and mixtures	1	2					
Substances and mixtures which, in contact with water, emit flammable gases	1	2	3				
Oxidizing liquids	1	2	3				
Oxidizing solids	1	2	3				
Organic peroxides	Type A	Type B	Type C	Type D	Type E	Type F	Type G
Corrosive to metals	1						

Source: based on UN GHS, 2013


# GHS – Hazard Classes and Categories

Health hazards					
	Level of hazard 				
Hazard class	Hazard category				
Acute toxicity Acute toxicity: oral Acute toxicity: dermal Acute toxicity: inhalation	1	2	3	4	5
Skin corrosion/irritation	1A	1B	1C	2	3
Serious eye damage/eye irritation	1A	2A	2B		
Respiratory or skin sensitization	1				
Germ cell mutagenicity	1A	1B	2		
Carcinogenicity	1A	1B	2		
Reproductive toxicity - fertility	1A	1B	2	Lactation	
Specific target organ toxicity - single exposure	1	2	3		
Specific target organ toxicity - repeated exposure	1	2			
Aspiration hazard	1	2			

Source: based on UN GHS, 2013



# GHS – Hazard Classes and Categories

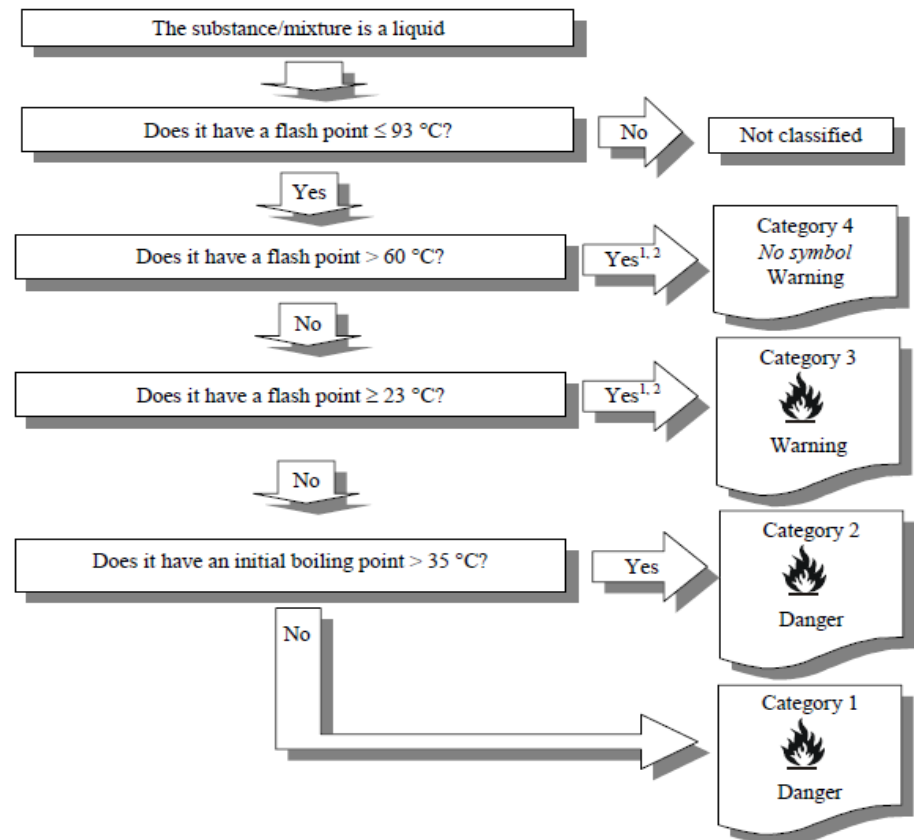
Environmental hazards				
	Level of hazard 			
Hazard class	Hazard category			
Aquatic toxicity, acute	1	2	3	
Aquatic toxicity, chronic	1	2	3	4
Hazardous to the ozone layer	1			

Source: based on UN GHS, 2013



# Example: Physical Hazard GHS Classification Decision Logic

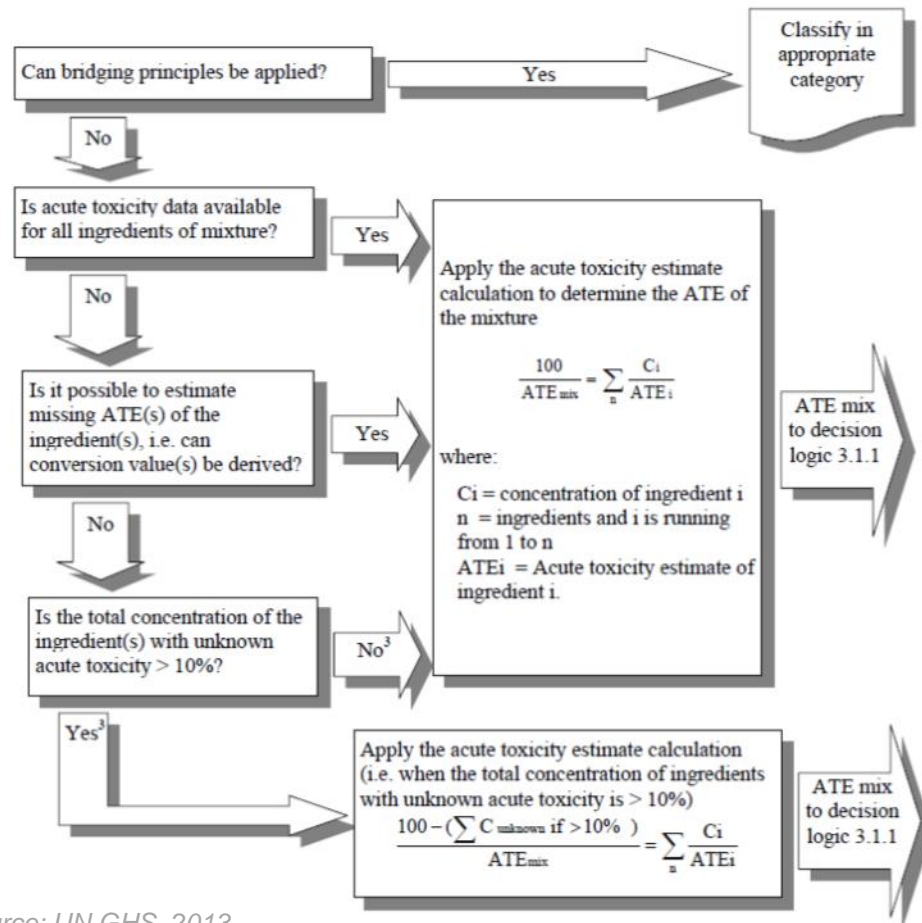
- ▶ GHS provides guidance for classification
- ▶ Example: decision logic for **flammable liquids** based on flashpoint and initial boiling point



Source: UN GHS, 2013

# Example: Health Hazard GHS Classification Decision Logic

- ▶ GHS provides guidance for classification
- ▶ Example: decision logic for **acute toxicity** based on an acute toxicity estimate calculation (ATE)



Source: UN GHS, 2013

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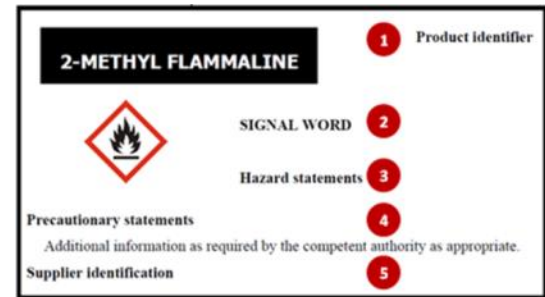
# Hazard Communication: GHS Labelling



# GHS Hazard Communication

- Based on GHS classification criteria, the GHS hazard communication system was developed, including:

- Labelling



Source: UN GHS, 2013

- Safety data sheets (SDSs)

Note:  
**MSDS=SDS**



Source: ISSPRO

# Important: Efficient Flow of Hazard Information

## **GHS labels and safety data sheets (SDSs) are important tools for**

- ✓ Communicating hazard information
- ✓ Eliminating or minimizing the risks associated with the use of hazardous chemicals in workplaces
- Incorrect information in SDSs can lead to the mishandling of chemicals, often causing injuries, economic losses or environmental damage, etc.

# Target Audience: Needs

Factors to be considered for hazard communication:

- Potential use of products
- Availability of information other than labels (e.g. SDSs, related data sheets)
- Availability of specific training

Needs of user:

- Workplace: labels, SDSs, specific training
- Consumers: labels
- Emergency responders: labels, specific training
- Transport: labels, transport documents, specific training



# GHS Labelling

- To communicate hazard information to end users through labels and SDSs, GHS uses:
  - ✓ Signal words
  - ✓ Pictograms (symbols)
  - ✓ Hazard statements
  - ✓ Precautionary statements and pictograms










# GHS – Signal Words

- Signal words are prominently displayed words on labelling to:
  - ✓ Alert the label reader to a potential hazard
  - ✓ Indicate the relative severity of the hazard
- There are two signal words used on labels in the GHS:
  - **DANGER** (higher severity)
  - **WARNING**



# GHS – Pictograms

- The GHS prescribes the following pictograms to convey the hazards of chemicals
















	<i>Exploding bomb</i> <b>Explosives</b>		<i>Flame</i> <b>Flammables</b>		<i>Flame over circle</i> <b>Oxidisers</b>
	<i>Gas cylinder</i> <b>Gases under pressure</b>		<i>Corrosion</i> <b>Corrosives</b>		<i>Skull and crossbones</i> <b>Acute toxicity</b>
	<i>Environment</i> <b>Environmental hazard</b>		<i>Exclamation mark</i> <b>Harmful/irritant</b> <b>Harmful to ozone layer</b>		<i>Health hazard</i> <b>Severe health hazards</b>

Source: UN GHS, 2013

# Harmonized Labelling: GHS and Transport Pictograms

- GHS classification criteria are based on UN recommendations on the transport of dangerous goods

*Source: UNECE GHS*

Hazard classes	Old EU hazard symbols	GHS pictograms	Transport pictograms
Explosives			
Flammables			
Oxidizers			
Corrosives			
Acute toxicity			

# GHS – Hazard Statements

- Describe the nature of the hazards covered by the GHS and the degree of severity

Hazard statement code numbers	
H <u>2</u> 00 - H <u>2</u> 99	<b>Physical</b> hazard
H <u>3</u> 00 – H <u>3</u> 99	<b>Health</b> hazard
H <u>4</u> 00 – H <u>4</u> 99	<b>Environmental</b> hazard

# Example: Flammable Liquids

## **Examples include:**




H224: Extremely flammable liquid and vapour (Cat. 1)

H225: Highly flammable liquid and vapour (Cat. 2)

H226: Flammable liquid and vapour (Cat. 3)


H227: Combustion liquid (Cat. 4)

# Exercise: Categorizing Flammable Liquids

Hazard class	Hazard category	Pictogram	Signal word	Hazard statement	
Flammable liquids	Category 1 e.g. ether		Danger	H224	Extremely flammable liquid and vapour
	Category 2 e.g. acetone		Danger	H225	Highly flammable liquid and vapour
	Category 3 e.g. xylene		Warning	H226	Flammable liquid and vapour
	Category 4 e.g. diesel	No pictogram	Warning	H227	Combustible liquid



# Exercise: Oxidizing Gases

Hazard class	Hazard category	Pictogram	Signal word	Hazard statement	
Oxidizing gases	Category 1 e.g.: oxygen, nitrous oxide		Danger	H270	May cause or intensify fire; oxidizer

# Exercise: Gases Under Pressure – What Could Happen?

E.g. oxygen, nitrogen




E.g. butane, propane, ammonia



E.g. acetylene



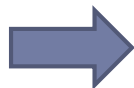
GASES UNDER PRESSURE			
Hazard category	Signal word	Hazard statement	Symbol Gas cylinder
Compressed gas	<b>Warning</b>	<b>H280</b> Contains gas under pressure; may explode if heated	
Liquefied gas	<b>Warning</b>	<b>H280</b> Contains gas under pressure; may explode if heated	
Dissolved gas	<b>Warning</b>	<b>H280</b> Contains gas under pressure; may explode if heated	
Precautionary statements			
Prevention	Response	Storage	Disposal
		<b>P140 + P403</b> Protect from sunlight. Store in a well-ventilated place.	


Source: ISSPRO



# Exercise: Gases Under Pressure – What Could Happen? (Continued)

E.g. liquid nitrogen, liquid helium






GASES UNDER PRESSURE			
Hazard category	Signal word	Hazard statement	Symbol Gas cylinder
Refrigerated liquefied gas	<b>Warning</b>	<b>H281</b> Contains refrigerated gas; may cause cryogenic burns or injury	
Precautionary statements			
Prevention	Response	Storage	Disposal
<b>P282</b> Wear cold insulating gloves/face shield/eye protection.	<b>P336</b> Thaw frosted parts with lukewarm water. Do not rub affected area.  <b>P315</b> Get immediate medical advice/attention.	<b>P403</b> Store in a well-ventilated place.	

Source: ISSPPRO



# Example: Substances and Mixtures which in Contact with Water, Emit Flammable Gases

Hazard class	Hazard category	Pictogram	Signal word	Hazard statement	
Substances and mixtures which in contact with water, emit flammable gases	Category 1 e.g. sodium hydride, carbon carbide		Danger	H260	In contact with water releases flammable gases which may ignite spontaneously
	Category 2 e.g. magnesium powder, calcium		Danger	H261	In contact with water releases flammable gases
	Category 3 e.g. aluminium powder		Warning	H261	In contact with water releases flammable gases

# GHS – Precautionary Statements

- **Describe measures recommended to prevent or minimize:**
  - The adverse effects of exposure to a hazardous chemical, or
  - Improper handling of a hazardous chemical
- **Each hazard class/category has several associated precautionary phrases**

Precautionary statement code numbers	
P <u>1</u> 00	General
P <u>2</u> 00	Prevention
P <u>3</u> 00	Response
P <u>4</u> 00	Storage
P <u>5</u> 00	Disposal

# Example: Flammable Liquids

- **Precautionary statements which may apply:**
  - P210: Keep away from sparks and open flames. No smoking. (Prevention)
  - P370+378: In case of fire: Use powder for extinction. (Response)
  - P403+235: Store in a well-ventilated place. Keep cool. (Storage)
  - P501: Dispose of contents/container in accordance with local regulations. (Disposal)

# Precautionary Pictograms

- Posting of operational procedures highlighting the necessary precautions and methods of handling chemicals for certain tasks can help reduce the risk of accidents.
- Examples of precautionary pictograms to be included on an operational procedure sign:



Source: UN GHS, 2013

# GHS – Other Information on Labels

- Product identifier (and ingredient proportions)
- Supplier/Manufacturer details
- Supplementary information, where applicable, such as:
  - Hazard classes and hazard statements not specifically covered by the GHS
  - Expiry or retest date
  - UN number











# GHS Labels

## Minimum information required on the labels:

- 1) Product identifier
- 2) Signal word
- 3) Pictogram
- 4) Hazard statement
- 5) Precautionary statement
- 6) Supplier identification

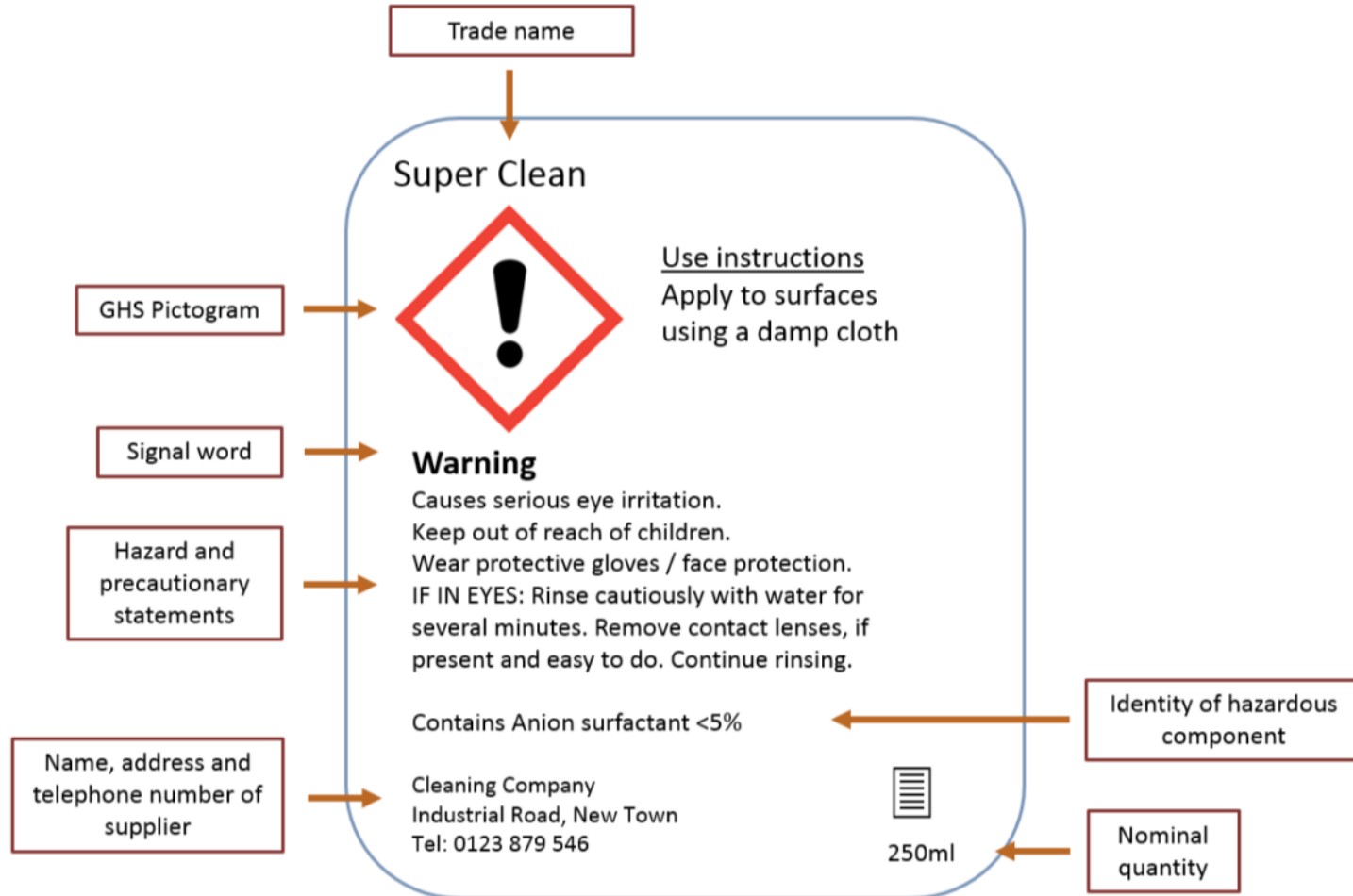
# Exercise: Label for a Hazardous Substance

Example for methanol: 1) Product identifier, 2) Signal word, 3) Pictograms  
4) Hazard statement, 5) Precautionary statement, 6) Supplier identification

   	<b>Methanol (solvent) (N° CE: 603-001-00-X)</b> 	
	<b>DANGER</b> 	
	Highly flammable liquid and vapour 	H225
	Toxic if swallowed Toxic in contact with skin Toxic if inhaled Causes damage to organs (especially on eyes) 	H301 H311 H331 H370
	Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Store in a well-ventilated place. Keep container tightly closed. Wear protective gloves/clothing, eye/face protection. If on skin: Wash with water and soap. If swallowed: Rinse mouth. Do NOT induce vomiting. Immediately call a poison centre or a doctor. Store locked up. 	P210  P403/233  P280 P302/352 P301/310 P405
	<b>Chemistry Example Sàrl</b> <b>200 litres</b> <b>St. Example 10, 1111 Town</b> <b>Telephone 032 600 60 60</b> 	

Source: based on UN GHS, 2013

# Example: Label for a Hazardous Mixture



Source: based on UN GHS, 2013



# Example: Combined GHS and TDG Label


- ▶ The GHS also allows for dangerous goods class labels to be displayed on labelling and safety data sheets.



- ▶ Example:
- ▶ Label for combining transport pictograms and GHS requirements

## Aromasol

Contains:  
Aromatic hydrocarbons 95 % v/v  
Toxicole 5 %v/v



Refer to Safety Data Sheet before use.

**2.5 L**

**Danger**

Highly flammable liquid and vapour  
Toxic if swallowed  
Cause skin irritation  
May cause cancer  
May be fatal if swallowed and enters airways

IF ON SKIN (or hair): Take off contaminated clothing and wash before re-use.  
Rinse skin using plenty of soap and water.  
IF exposed or concerned: Get medical advice/ attention.  
IF SWALLOWED: Immediately call a POISON CENTRE or doctor/ physician.  
Do NOT induce vomiting.  
Store locked up in a well-ventilated place.  
Keep cool.  
Dispose of contents/ container in accordance with local regulations.

In case of fire: Use powder for extinction.  
Keep away from sparks and open flames – No smoking.  
Keep container tightly closed.  
Ground/ bond container and receiving equipment.  
Take precautionary measures against static discharge.  
Wear protective gloves and eye and face protection.  
Wash hands thoroughly after handling.  
Do not eat, drink or smoke when using this product.

Source: UN GHS, 2013


# Exercise: Combined GHS and TDG Labels

Proper shipping name and UN number



Transport Labels

Chemical name and product identifier

XYZ Chemicals High street New town 0987 654 321		Highly inflammable liquid and vapour. Toxic if swallowed. Toxic in contact with skin. Toxic if inhaled. Causes damage to organs. Keep away from heat/ sparks/ open flames/ hot surfaces- No smoking. Do not breath mist/ vapours/ spray. Wear protective gloves/ protective clothing/ eye protection. IF SWALLOWED: Immediately call a POISON CENTRE or a doctor/ physician. IF ON SKIN (or hair): Remove/ take off immediately all contaminated clothing. Rinse skin with water/ shower. Store in a well ventilated place. Keep container tightly closed.
Methanol 603-001-00-X	<b>Danger</b>	

Pictograms and signal words

Hazard and precautionary statements

Source: UN GHS, 2013

# Exercise: Finalize a Combined GHS and TDG Label

## Example: Bulk supply of solvent

A solvent supplier provides solvents in 200-litre drums. These drums are transported directly to the workplaces on pallets in a truck.


Which GHS and transport pictograms would need to be included on the label? See examples in the table on the right.

<b>GHS Classification(s)</b>	Flammable liquids: Category 2 Carcinogenicity: Category 1A Germ cell mutagenicity: Category 1B Specific target organ toxicity – repeated exposure: Category 1 Aspiration hazard: Category 1 Eye irritation: Category 2A Skin irritation: Category 2		
<b>Signal word</b>	DANGER		
<b>Pictogram(s)</b>	?	?	?
<b>Hazard statement(s) (and codes)</b>	H225 Highly flammable liquid and vapour H350 May cause cancer H340 May cause genetic defects H372 Causes damage to organs through prolonged or repeated exposure H304 May be fatal if swallowed and enters airways H315 Causes skin irritation H319 Causes serious eye irritation		

GHS pictograms	Transport pictograms

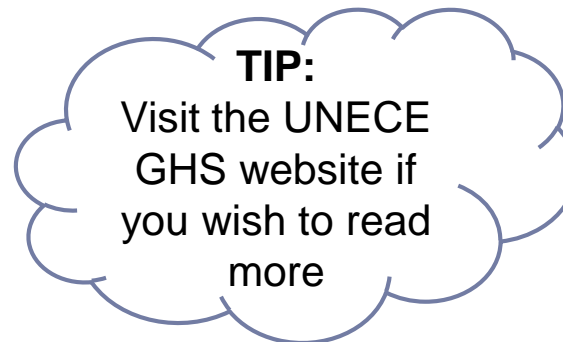
Source: ISSPPRO

# Optional Questions to Test Your Knowledge

- What is the GHS and what is its purpose?
- Who benefits from a harmonized classification and hazard communication?
- Explain the hazard-based system of the GHS classification and how it is categorized. Give a few examples.
- What potential hazard is indicated by the following pictograms?  

- What hazard statement code numbers are used to warn about physical hazards?

# Optional Questions to Test Your Knowledge

- What are the communication tools used in the GHS system to ensure the efficient flow of hazard information?
- What are the prescribed elements of GHS labels?
- Can you recognize these pictograms?  
What are the messages they are conveying?



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# Examples: GHS Fosters Safety and Resource Efficiency

# Example: Accident Prevention

- Properly classified chemicals and available hazard information (labels and safety data sheets) facilitate the evaluation of work places and planning of necessary risk prevention measures.
- Example:

Prevention measures follow the STOP logic:

S. Substitution

T. Technical measures

O. Organizational measures

P. Personal protective equipment








Source: ISSPPRO



# Example: Storage of Chemicals

Compliant storage may avoid serious chemical reactions:

POTENTIAL DANGER	CONSEQUENCES
Acids + non-precious metals	Spontaneous combustion (gaseous hydrogen) 
Oxidizer + organic materials (wood, paper, etc.)	Fire, explosion 
Acid + base	Exothermic reaction (heat emission + corrosive projections) 
Nitric acid + organic substances or metals	Toxic nitrous gas 
Chlorine bleach + acids	Toxic gaseous chlorine 



# Key messages

## GHS classification

- **Facilitates hazard identification** and helps users to **manage potential risks** of exposure
- **Provides useful information** on the hazard, the storage requirements and the expected reactions in case of an accident



# Where to Find More Information

- United Nations Commission for Europe (UNECE) about GHS:
  - General: [http://www.unece.org/trans/danger/publi/ghs/ghs\\_welcome\\_e.html](http://www.unece.org/trans/danger/publi/ghs/ghs_welcome_e.html)
  - GHS pictograms:  
<http://www.unece.org/trans/danger/publi/ghs/pictograms.html>
- United Nations Institute for Training and Research (UNITAR) guidance documents on the GHS:  
<http://www2.unitar.org/cwm/publications/ghs.aspx>
- OECD's eChemPortal provides public access to existing national GHS classifications: <http://www.oecd.org/ehs/echemportal/>
- Swedish Chemicals Agency (KEMI) quiz to test your knowledge on GHS pictograms: <http://www.kemi.se/Global/Flash/CLP-Quiz/EN/Quiz.html>



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# Images

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