# GHS – A globally standardised approach to classify chemical hazards, and to communicate them on MSDS and labels

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- An introduction to classification criteria (physico-chemical, health and environmental)
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#### **International Transportation of Dangerous Goods**

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- ▲ Marine (IMDG)
- ▲ Air (ICAO)
- Road and Rail (ADG, ADR, DOT..)
- ▲ Water ways (ADN)
- Inited Nations Recommendations on the Transport of Dangerous Goods, Model Regulations (Orange Book)
- > UN Number (eg., UN3109)
- Shipping Name (eg Organic Peroxide Type F, Liquid)
- Hazard Class (1-9)
- Packing group (I, II, III)





#### International Transport – DG Classes

- Class 1 Explosive
- Class 2 Flammable gas, Nonflammable, non-toxic gas, Toxic gas
- Class 3 Flammable liquid
- Class 4 Flammable solid, Spontaneously combustible, Dangerous when wet
- Class 5 Oxidizing agent, Organic Peroxide
- Class 6 Toxic
- Class 7 Radioactive
- Class 8 Corrosive
- Class 9 Miscellaneous (eg Environmentally hazardous)



#### Hong Kong Fire Services Department – DG Labels



# International Labelling System - EU

**Workplaces** [European Community, Malaysia, Australia, Korea (old)]:

- Hazard classes [Flammable (F, F+), Oxidizing O, Toxic T (T+, T), Harmful (Xn), Corrosive (C+, C), Irritant (Xi), Environmentally hazardous (N)]
- Hazard symbols (pictograms)
- Risk and safety phrases
  - R11: Highly flammable
  - R21: Harmful in contact with skin
  - S13: Keep away from sources of ignition.
  - S18: Wear suitable protective clothing.











Applies in workplaces.

#### Hong Kong Labelling System - Workplace

#### **Requirements from Labour Department:**

- Very similar to EU / Malaysian format
- Hazard classes (flammable, oxidizing, toxic, harmful, corrosive, irritant)
- Hazard symbols
- Risk and safety phrases
  - Example: Harmful by inhalation
  - Avoid contact with skin.



#### **Example - comparison**

#### GHS example of a poisonous substance



# What is GHS?

- <u>'Globally Harmonised System</u>' of hazard classification ad labelling.
- Initiative of United Nations/ILO/OECD since 1992.
- > The objective: A globally standardized approach to hazard classification/MSDS/labelling (Hazard Communication).
- UN's Economic and Social Councils: The "UN Committee of Experts for the Transport of Dangerous Goods and the Globally Harmonized System of Classification and Labelling of Chemicals" formally adopted the GHS in 2002 (The Purple Book).
- The Purple Book was updated about every 2 years. Now it is up to the 4th revised edition which was adopted in 2011.
- > Not legally binding, unless adopted by a country or region.

### **GHS – Scope**

- Harmonized criteria for the classification of chemical products, according to their physical, health and environmental hazards.
- Harmonized hazard communication elements (labels and MSDS).



### **GHS – Objectives**

#### Benefits:

- Enhance the protection of human health and the environment, by providing an internationally consistent system for hazard classification and communication.
- Provide a harmonised framework for those countries without an existing system.
- > Facilitate international trade in chemicals.
- Reduce the need for testing (especially animal testing) and evaluation of chemicals.

#### **GHS Hazard Classification**

GHS classification covers 27 physicochemical, health and environmental endpoints or hazard classes.



### **GHS Physico-chemical Classification**

Explosives	Pyrophoric Liquids
Flammable Gases	Pyrophoric Solids
Flammable Aerosols	Self-Heating Substances
Gases Under Pressure	Substances, which contact with water, emit flammable gases
Flammable Liquids	Oxidising Liquids
Flammable Solids	Oxidising Solids
Self-Reactive Substances	Oxidising Gases
Organic Peroxides	Corrosive to Metals

### **GHS Health Effect Classification**

Acute Toxicity: Oral	Skin Sensitisation
Acute Toxicity: Dermal	Respiratory Sensitisation
Acute Toxicity: Inhalation (Gas)	Toxic to Reproduction
Acute Toxicity: Inhalation (Vapour)	Germ Cell Mutagenicity
Acute Toxicity: Inhalation (Dust and Mist)	Carcinogenicity
Skin Corrosiveness and Irritation	Target Organ Systematic Toxicity
Serious Eye Damage/Eye Irritation	Aspiration Hazard

# **GHS Environmental Classification**

- Acute Aquatic Toxicity
- Chronic Aquatic Toxicity
- Hazardous to the Ozone Layer

#### **GHS Hazard Symbols (Pictograms)**



#### **GHS Hazard Statements**

> Standardised phrases assigned to a hazard class and category to describe the nature of the hazards.

- Codification of H-statements:
  - ✓ H2xx: Physical hazards
  - ✓ H3xx: Health hazards
  - ✓ H4xx: Environmental hazards
- Example: Flammable liquid
  - ✓ H224 Category 1 "Extremely flammable liquid and vapour"
  - ✓ H225 Category 2 "Highly flammable liquid and vapour"
  - ✓ H226 Category 3 "Flammable liquid and vapour"
  - ✓ H227 Category 4 "Combustible liquid"

All assigned hazard statement should appear on the MSDS and labels.

### **GHS Precautionary Statements**

- Standardised phrases assigned to a hazard class and category describe control measures.
- ▲ Use of P-Statements are more flexible than H-Statements.
- ▲ Codification:
  - P1xx: General
    - P102: Keep out of reach of children
  - P2xx: Prevention
    - P262: Do not get in eyes, on skin, or on clothing.
  - P3xx: Response
    - P313: Get medical advice/attention.
    - P370+P378: In case of fire: Use ....to extinguish.
  - P4xx: Storage
    - P403: Store in a well-ventilated place.
  - P5xx: Disposal
    - P501: Dispose of contents/container to.....





# **Precautionary Pictograms**



#### Their use on labels are optional only.

### Flammable Liquids

	Category 1	Category 2	Category 3	Category 4
Criteria	Flash point < 23C; boiling point <= 35℃	Flash point < 23℃; boiling point > 35℃	Flash point >= 23 -<= $60^{\circ}$ C	Flash point >60 -<=93 ℃
Symbol	*			None
Signal word	Danger	Danger	Warning	Warning
Hazard Statement	Extremely flammable liquid and vapour	Highly Flammable liquid and vapour	Flammable liquid and vapour	Combustible liquid

#### Summary: Flammables/Gases under Pressure

Hazard Class	Category	Signal Word	Symbol	Hazard Statement	Dangerous Goods Equivalent
Flammable Gases	Category 1	Danger		Extremely flammable gas	Class 2.1
	Category 2	Warning	None	Flammable gas	
Gases under pressure	N.A.	Warning	$\langle i \rangle$	Contains gas under pressure; may explode if heated	Class 2.2
Flammable Aerosols	Category 1	Danger	*	Extremely flammable aerosol	Class 2.1
	Category 2	Warning		Flammable aerosol	Class 2.1
Flammable Liquids	Category 1	Danger		Extremely flammable liquid and vapour	Class 3 PG I
	Category 2	Danger		Highly flammable liquid and vapour	Class 3 PG II
	Category 3	Warning	*	Flammable liquid and vapour	Class 3 PG III
	Category 4	Warning	None	Combustible liquid	
Flammable Solids	Category 1	Danger		Flammable solid	Class 4.1 PG II
	Category 2	Warning		Flammable solid	Class 4.1 PG III

# Summary: Substances liable to spontaneous combustion; OR, on contact with water, emit flammable gases

Hazard Class	Category	Signal Word	Symbol	Hazard Statement	Dangerous Goods Equivalent
Self-Reactive Substances and Mixutres	Туре А	Danger	× ·	Heating may cause an explosion	Class 4.1 Type A
	Туре В	Danger		Heating may cause a fire or explosion	Class 4.1 Type B
	Type C/D	Danger		Heating may cause a fire	Class 4.1 Type C/D
	Type E/F	Warning		Heating may cause a fire	Class 4.1 Type E/F
	Type G	None	None	None	Class 4.1 Type G
Pyrophoric Liquids	Category 1	Danger	*	Catches fire spontaneoulsy if exposed to air	Class 4.2 PG I
Pyrophoric Solids	Category 1	Danger		Catches fire spontaneoulsy if exposed to air	Class 4.2 PG I
Self-Heating Substances and Mixtures	Category 1	Danger		Self-heating, may catch fire	Class 4.2 PG II
	Category 2	Warning	۲	Self-heating in large quantities; may catch fire	Class 4.2 PG III
Substances and Mixture which in contact with water, emit flammable gases	Category 1	Danger	*	In contact with water releases flammable gases which may ignite spontaneously	Class 4.3 PG I
	Category 2	Danger		In contact with water releases flammable gases	Class 4.3 PG II
	Category 3	Warning		In contact with water releases flammable gases	Class 4.3 PG III

#### **Summary: Oxidizing substances / organic peroxides**

Hazard Class	Category	Signal Word	Symbol	Hazard Statement	Dangerous Goods Equivalent
Oxidizing Liquids / Oxidizing Solids	Category 1	Danger		May cause fire or explosion; strong oxidizer	Class 5.1 PG I
	Category 2	Danger		May intensify fire; oxidizer	Class 5.1 PG II
	Category 3	Warning		May intensify fire; oxidizer	Class 5.1 PG III
Organic Peroxides	Туре А	Danger	*	Heating may cause an explosion	Class 5.2 Type A
	Туре В	Danger		Heating may cause a fire or explosion	Class 5.2 Type B
	Type C/D	Danger		Heating may cause a fire	Class 5.2 Type C/D
	Type E/F	Warning	*	Heating may cause a fire	Class 5.2 Type E/F
	Type G	None	None	None	Class 5.2 Type G
Corrosive to Metals	Category 1	Warning	II N	May be corrosive to metals	Class 8

# Classification logic for health hazards of products (mixtures)



#### **Acute Toxicity**

#### Substance:

Exposure routes	Classification category or experimentally obtained acute toxicity range estimate (see Note 1)	Converted Acute Toxicity point estimate (see Note 2)
Oral (mg/kg bodyweight)	$\begin{array}{llllllllllllllllllllllllllllllllllll$	0.5 5 100 500 2500
Dermal (mg/kg bodyweight)	$\begin{array}{llllllllllllllllllllllllllllllllllll$	5 50 300 1100 2500
Gases (ppmV)	$\begin{array}{llllllllllllllllllllllllllllllllllll$	10 100 700 3000
Vapours (mg/l)	$\begin{array}{llllllllllllllllllllllllllllllllllll$	0.05 0.5 3 11
Dust/mist (mg/l)	$\begin{array}{llllllllllllllllllllllllllllllllllll$	0.005 0.05 0.5 1.5

Note: Gases concentration are expressed in parts per million per volume (ppmV).

#### **Mixture:**

If all components are known or unknown components are <=10%,

$$\frac{100}{\text{ATEmix}} = \sum_{n} \frac{\text{Ci}}{\text{ATE}_{i}}$$

If some components are unknown (with unknown component concentrations > 10%),

$$\frac{100 - \left(\sum C_{unknown} \text{ if } > 10\%\right)}{\text{ATE}_{mix}} = \sum_{n} \frac{\text{Ci}}{\text{ATE}_{i}}$$

where:

 $C_i$  = concentration of ingredient i n ingredients and i is running from 1 to n ATE<sub>i</sub> = Acute Toxicity Estimate of ingredient i.

### Acute Toxicity (oral & dermal)

	Cat.1	Cat. 2	Cat. 3	Cat. 4	Cat. 5
Oral (mg/kg bw)	<5	5-<50	50-<300	300-<2000	2000-5000
Dermal (mg/kg bw)	<50	50-<200	200-<1000	1000-<2000	2000-5000
Symbol	R	R	<u>R</u>		None
Signal Word	Danger	Danger	Danger	Warning	Warning
Hazard Statements (oral)	Fatal if swallowed	Fatal if swallowed	Toxic if swallowed	Harmful if swallowed	May be harmful if swallowed
Hazard Statement (dermal)	Fatal in contact with skin	Fatal in contact with skin	Toxic in contact with skin	Harmful in contact with skin	May be harmful in contact with skin

#### Skin Corrosion/Irritation

- A. Product test data
- B. pH <2 or >11.5
- C. Based on component data:

Sum of ingredients	Category 1 (Corrosive)	Category 2 (Irritant)	Category 3 (Mild irritant)
Skin Cat. 1	>=5%	1-<5%	
Skin Cat.2		>=10%	1-<10%
Skin Cat.3			>=10%
(10 X Cat.1) + Cat.2		>=10%	1-<10%
(10 X Cat.1) + Cat.2 + Cat.3			>=10%

#### Carcinogenicity

Category 1A: Known Human Carcinogens

- Based on human data (causal relationship)
- Strength of evidence (potency)



- Category 1B: Presumed Human Carcinogens
  - Largely based on animal data (eg, single or multiple species, relevance to humans, toxicokinetics, structural activity relationship), and/or
  - Human data (positive association)
  - Scientific judgment
- Category 2: Suspected Human Carcinogens
  - Limited animal data (eg, in a single species only, one sex only)
  - Limited human data (studies with confounding factors).

### Carcinogenicity

	Category 1A – Know human carcinogens	Category 1B - Presumed	Category 2 – Suspected
Cat.1A ingredient	>=0.1%		
Cat.1B ingredient		>=0.1%	
Cat. 2 ingredient			>=0.1% OR >=1.0%
Symbol			
Signal word	Danger	Danger	Warning
Hazard Statements	May cause cancer	May cause cancer	Suspected of causing cancer

### **Reproductive Toxicity**

▲ <u>Two Types</u>:

- Adverse effects on sexual function and fertility
- Developmental Toxicity (Teratogenicity)

#### Four Categories



- Category 1A: Known Human Reproductive Toxicants
  - Based on human data (causal relationship)
  - Strength of evidence (potency)
- Category 1B: Presumed Human Reproductive Toxicants
  - Largely based on strong animal data (eg, OECD testing guidelines for developmental toxicity, peri- and post natal toxicity, 1- or 2- generation development), and/or
- Category 2: Suspected Human Reproductive Toxicants
  - Limited human and or animal data
- Additional Category: Effect on or via Lactation

### **Reproductive Toxicity**

	Category 1A/B	Category 2	Lactation
Cat.1 A/B Ingrd.	0.1% or 0.3%		
Cat. 2 Ingrd.		0.1% or 3%	
Lactation ingrd.			0.1% or 0.3%
Symbol			None
Signal word	Danger	Warning	None
H-Statements	May damage fertility or the unborn child	Suspected of damaging fertility or the unborn child	May cause harm to breast-fed children

#### **Aspiration Hazard**

- Aspiration = entry of a liquid through mouth or nose, or indirectly from vomiting, into the trachea and lungs. This cause chemical pneumonia, or other pulmonary injuries.
- Category 1: Chemicals known to cause human aspiration toxicity hazards
  - Liquid hydrocarbons with viscosity <20.5 mm<sup>2</sup>/s (40C)
  - Past experience: examples: hydrocarbons, turpentine, pine oil.
- Category 2: Chemicals which cause concern owing to the presumption that they cause human aspiration toxicity hazard
  - Liquid chemicals with viscosity <14 mm<sup>2</sup>/s (40C)
  - Examples: aliphatic alcohol (C3-C13), isobutanol, ketones (<14C)</li>

### **Aspiration Hazard**

	Category 1	Category 2		
Cat. 1 Ingredient	>=10% + product viscosity <20.5 mm <sup>2</sup> /s (40C)			
Cat.2 Ingredient		>=10% + product viscosity <20.5 mm <sup>2</sup> /s (40C)		
Symbol				
Signal word	Danger	Warning		
H-Statement	May be fatal if swallowed and enters airways	May be harmful if swallowed and entered airways		
P-Statement	DO NOT INDUCE VOMITING			

#### Summary: CMRs (Carcinogens, Mutagens, Reproductive Toxins)

Hazard Class	Category	Signal Word	Symbol	Hazard Statement	Mixture Rule	
Germ Cell Mutagenicity	1A	Danger		May cause genetic defects	0.1%	
	1B	Danger		May cause genetic defects	0.1%	
	2	Warning	Word Symbol Hazard Statement Mixture   ger Image: May cause genetic defects 0   ger Image: May cause genetic defects 0   ing Image: Suspected of causing genetic defects 0   ger Image: May cause cancer 0   ger Image: May damage fertility or the unborn child 0.1%   ger Image: May damage fertility or the unborn child 0.1%   ger Image: May damage fertility or the unborn child 0.1%   ger Image: May damage fertility or the unborn child 0.1%   ger Image: May damage fertility or the unborn child 0.1%   ger Image: May damage fertility or the unborn child 0.1%   ger Image: May damage fertility or the unborn child 0.1%   ger Image: May damage fertility or the unborn child 0.1%   ger Image: May damage fertility or the unborn child 0.1%		1%	
Carcinogenicity	1A	Danger		May cause cancer	0.1%	
	1B	Danger	Ś	May cause cancer	0.1%	
	2	Warning		Suspected of causing cancer	0.1% or 1%	
Reproductive Toxicity	1A	Danger		May damage fertility or the unborn child	0.1% or 0.3%	
	1B	Danger	٨	May damage fertility or the unborn child	0.1% or 0.3%	
	2	Warning	٨	Suspected of damaging fertility or the unborn child	0.1% or 3%	
	Effects on/via lactation	None	None	May cause harm to breast-fed children	0.1% or 0.3%	

# **Summary: Other Health Hazards**

Hazard Class	Category	Signal Word	Symbol	Hazard Statement	Mixture Rule
Skin Corrosion/Irritation	1	Danger		Causes severe skin burns and eye damage	>=5%
	2	Warning		Causes skin irritation	10xCat.1 + Cat.2 =>10%
	3	Warning	None	Causes mild skin irritation	10xCat.1 + Cat.2 + Cat.3 >=10%
Serious Eye Damange/Eye Irritation	1	Danger	I A	Causes serious eye damage	Eye/Skin Cat.1 >=3%
	2A	Warning		Causes serious eye irritation	10xCat.1 + Cat.2A >=10%
	2B	Warning	None	Causes eye irritation	10xCat.1 + Cat.2A + Cat.2B >=10%
Skin Sensitization	1	Danger		May cause an allergic skin reaction	0.1% or 1%
Respiratory Sensitization	1	Warning		May cause allergy or asthma symptoms or breathing difficulties if inhaled	0.1% or 1%
Specific Target Organ Toxicity Single Exposure	1	Danger		Causes damage to organs	1% or 10%
	2	Warning		May causes damage to organs	1% or 10%
	3	Warning		May cause respiratory irritation, OR May cause drownsiness or dizziness	20%
Specific Target Organ Toxicity Repeated Exposure	1	Danger		Causes damage to organs through prolonged or repeated exposure	1% or 10%
	2	Warning		May causes damage to organs through prolonged or repeated exposure	1% or 10%
Aspiration Toxicity	1	Danger		May be fatal if swallowed and enters airways	>=10%, <20.5 cst (40C)
	2	Warning		May be harmful if swallowed and enters airways	>=10%, <14 cst (40C)

## **Acute Aquatic toxicity**

#### Figure 4.1.1: Categories for substances hazardous to the aquatic environment

#### Acute toxicity

Category: Acute 1	
96 hr LC50 (for fish)	≤1 mg/l and/or
48 hr EC50 (for crustacea)	≤1 mg/l and/or
72 or 96hr ErC <sub>50</sub> (for algae or other aquatic plants)	≤1 mg/l
Category: Acute 1 may be subdivided for some regulatory system	ns to include a lower band at
$L(E)C_{50} \le 0.1 \text{ mg/l}.$	
Category: Acute 2	
96 hr LC <sub>50</sub> (for fish)	$>1$ - $\leq 10$ mg/l and/or
48 hr EC <sub>50</sub> (for crustacea)	$>1$ - $\leq 10$ mg/l and/or
72 or 96hr $ErC_{50}$ (for algae or other aquatic plants)	>1 - ≤10 mg/l
Category: Acute 3	
96 hr LC <sub>50</sub> (for fish)	>10 - ≤100 mg/l and/or
48 hr EC <sub>50</sub> (for crustacea)	>10 - ≤100 mg/l and/or
72 or 96hr ErC <sub>50</sub> (for algae or other aquatic plants)	>10 - ≤100 mg/l
Some regulatory systems may extend this range beyond an L(E) of another category.	$C_{50}$ of 100 mg/l through the introduction

#### Table 4.1.2: Classification of a mixture for acute hazards, based on summation of classified components

Sum of components classified as:	Mixture is classified as:	
Acute $1 \times M^a > 25\%$		Acute 1
$(M \times 10 \times Acute \ 1) + Acute \ 2$	> 25%	Acute 2
$(M \times 100 \times Acute 1)$ + $(10 \times Acute 2)$ + Acute 3	> 25%	Acute 3

For explanation of the M factor, see 4.1.3.5.5.5.

### **Chronic Aquatic toxicity**

Figure 4.1.1: Categories for substances hazardous to the aquatic environment (cont'd)

#### Chronic toxicity

Category: Chronic 1	
96 hr LC <sub>50</sub> (for fish)	$\leq 1 \text{ mg/l and/or}$
48 hr EC50 (for crustacea)	$\leq 1 \text{ mg/l and/or}$
72 or 96hr ErC50 (for algae or other aquatic plants)	$\leq 1 \text{ mg/l}$
and the substance is not rapidly degradable and/or the log $K_{ow} \ge 4$ BCF <500).	4 (unless the experimentally determined
Category: Chronic 2	
96 hr LC <sub>50</sub> (for fish)	$> 1$ to $\leq 10$ mg/l and/or
48 hr EC <sub>50</sub> (for crustacea)	$> 1$ to $\leq 10$ mg/l and/or
72 or 96hr $ErC_{50}$ (for algae or other aquatic plants)	$> 1 \text{ to} \le 10 \text{ mg/l}$
and the substance is not rapidly degradable and/or the log $K_{\rm ow}$ determined BCF <500), unless the chronic toxicity NOECs are	$\geq$ 4 (unless the experimentally $>$ 1 mg/l.
Category: Chronic 3	
96 hr LC <sub>50</sub> (for fish)	$> 10$ to $\le 100$ mg/l and/or
48 hr EC <sub>50</sub> (for crustacea)	$> 10$ to $\le 100$ mg/l and/or
72 or 96hr $ErC_{50}$ (for algae or other aquatic plants)	$> 10 \text{ to} \le 100 \text{ mg/l}$
and the substance is not rapidly degradable and/or the log $K_{ow}$ determined BCF <500) unless the chronic toxicity NOECs are	$\geq$ 4 (unless the experimentally $>$ 1 mg/l.
Category: Chronic 4	
Poorly soluble substances for which no acute toxicity is recorded	l at levels up to the water solubility,
and which are not rapidly degradable and have a log $K_{ow} \ge 4$ , ind	licating a potential to bioaccumulate, will
be classified in this category unless other scientific evidence exis	sts showing classification to be $f_{\text{classification}} = f_{\text{classification}} + f_{classification$
NOECs > 1 mg/l, or evidence of rapid degradation in the environ	ment.

#### Table 4.1.3: Classification of a mixture for chronic hazards based on summation of classified ingredients

Sum of ingredients classified as:		Mixture is classified as:
Chronic $1 \times M^a$	≥25%	Chronic 1
$(M \times 10 \times Chronic 1) + Chronic 2$	≥25%	Chronic 2
$(M \times 100 \times Chronic 1) + (10 \times Chronic 2) + Chronic 3$	≥25%	Chronic 3
Chronic 1 + Chronic 2 + Chronic 3 + Chronic 4	≥25%	Chronic 4

### **Aquatic Toxicities**

	Acute 1		Αςι	ute 2	Acute 3		
Symbol	¥_2		No	one	None		
Signal Word	Warning		No	one	None		
H-Statement	Very toxic to aq life	y toxic to aquatic		c Toxic to aquatic life		ful to aquatic	
	Chronic 1	Chron	ic 2	Chronic 3		Chronic 4	
Symbol	¥2			None	)	None	
Signal Word	Warning	Ν	lone	None		None	
H-Statement	Very toxic to aquatic life with long lasting effects	Toxic to aquatic life with long lasting effects		Harmful to aquatic life long lasting effects	e with g	May cause long lasting harmful effects to aquatic life 38	

#### Summary: Environmental Hazards

Hazard Class	Category	Signal Word	Symbol	Hazard Statement	Mixture Rule
Hazardous to the Aquatic Environemnt - Acute	1	Warning		Very toxic to aquatic life	Cat.1 X M >=25%
	2	None	None	Toxic to aquatic life	10 X Cat.1 X M + Cat.2 >=25%
	3	None	None	Harmful to aquatic life	100 X Cat.1 X M + 10 X Cat.2 + Cat.3 >=25%
Hazardous to the Aquatic Environemnt - Chronic	1	Warning	¥1	Very toxic to aquatic life with long lasting effects	Cat.1 X M >=25%
	2	None		Toxic to aquatic life with long lasting effects	10 X Cat.1 X M + Cat.2 >=25%
	3	None	None	Harmful to aquatic life with long lasting effects	100 X Cat.1 X M + 10 X Cat.2 + Cat.3 >=25%
	4	None	None	May cause long lasting harmful effects to aquatic life	Cat.1 + Cat.2 + Cat.3 + Cat.4 >=25%
Hazardous to the Ozone Layer	1	Warning		Harms public health and the enviroment by destroying ozone in the upper atmosphere	>=0.1%

M = Multiplying factor (usually set at 1).

#### **GHS MSDS Format**

Information should be presented as a 16-heading format as follows:

- 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.

#### **GHS Label Format**

> Symbols



- Signal word (Danger or Warning)
- Hazardous Components
- Hazard Phrases
- Precautionary Phrases and Pictograms
- > Supplier Information

#### **International Implementation of GHS**

- Countries/regions already adopted full GHS (pure substances and mixtures):
  - China, Taiwan, Japan, New Zealand, Vietnam
- Already adopted GHS for pure substances and have a timeline for mixtures:
  - European Union, Korea, Singapore, Indonesia
- ▲ Will implement GHS within the next few years:
  - USA, Canada, Brazil, Australia, Malaysia, Philippines, Thailand, Malaysia....

### **US-OSHA GHS Final Rule**

Became effective May 2012



- New GHS rule is added to OSHA's existing hazard communication standard, or worker right-to-know law.
- GHS rule will affect over 5 million workplaces and 40 million workers.
- Implementation schedule:

Deadline	Who to do what
Dec 2013	Employers to train workers on GHS MSDS/labels
Dec 2015	Manufacturers/importers to comply with GHS
June 2016	Employers comply with all hazard communication requirements.

#### **EU: CLP Regulation**

▲ CLP = Classification, Labelling and Packaging.

- ▲ The CLP Regulation entered into force in January 2009.
- The Regulation replaces over time two previous pieces of legislation, the Dangerous Substances Directive and the Dangerous Preparations Directive.
- ▲ Transition period until 2015.
- ▲ Requirements: GHS.
- Annex VI to CLP Regulation: A list of harmonised classifications that are legally binding for all member states.
- ▲ Have established an C&L Inventory.

#### Present moves towards dissemination of GHS



#### GHS Tools developed for GHS Dissemination & GHS Pamphlets by FDA



	Implemer	ntation date 46
Country	Pure substances	Mixtures
Japan	1/12/2006	1/12/2008
Taiwan	31/12/2009	31/12/2009
Vietnam	30/03/2014	30/03/2016
Indonesia	24/03/2010	2013 (expected)
New Zealand	31/12/2010	31/12/2010
China	1/12/2011	1/12/2011
South Korea	30/06/2011	30/06/2013
EU	1/12/2010	1/6/2015
Singapore	1/2/2012	1/6/2015
Brazil	27/02/2011	1/6/2015
USA	2015-16	2015-16
Malaysia	2012 (expected)	2013 (expected)
Thailand	13/03/2013	13/03/2017
Philippines	2012 (expected)	2012 (expected)
South Africa	2012 (expected)	2016 (expected)
Canada	2014/2015 (expected)	2014/2015 (expected)
Australia	1/1/2017	1/1/2017
Hong Kong	TBA	TBA
India	TBA	TBA

#### GHS Building Block Approach



	GI	HS Red	comme	ndatio	n	Toxic	: Chemi	icals C	ontrol La
Acute toxicity	Cat. 1	Cat. 2	Cat. 3	Cat. 4	Cat.5	Cat. 1	Cat. 2	Cat. 3	Cat. 4
Skin Corrosive / Irritant	Cat. 1	Cat. 2	Cat.3			Cat.1	Cat.2		
Serious Eye Damage / Irritant	Cat. 1	Cat.2A	Cat.2B			Cat.1	Ca	nt.2	]
Respiratory Sensitizer	Cat.1			•		Cat.1			•
Skin Sensitizer	Cat.1			_		Cat.1			
Germ Cell Mutagen	Cat.1A	Cat.1B	Cat.2			Ca	t.1	Cat.2	]
Carcinogen	Cat.1A	Cat.1B	Cat.2			Ca	t.1	Cat.2	]
Reproductive Toxicant	Cat.1A	Cat.1B	Cat.2	Adit. Ca	t.	Ca	t.1	Cat.2	Adit. Cat.
TOST (Single exposure)	Cat.1	Cat.2	Cat.3		_	Cat.1	Cat.2		
TOST (Repeated exposure)	Cat.1	Cat.2		-		Cat.1	Cat.2		-
Aspiration Hazard	Cat.1	Cat.2				Cat.1			
Environmental Hazard (Acute)	Cat.1	Cat.2	Cat.3			Cat.1			
Environmental Hazard (Chronic)	Cat.1	Cat.2	Cat.3	Cat. 4		Cat.1	Cat.2	Cat.3	Cat. 4
					-				

#### "Building block approach" in Korea MOE

#### Building Blocks not adopted by Singapore



	-	-	_	_		_			-
Purple Book - UN -	Hazard Category	Korea	Japan	Taiwan	China	NZ	Singapore	Vietnam	EU
Classification									(1272/2008)
ACUTE TOXICITY: SKIN	Category 1	~	~	~	~	~	~	√	~
	Category 2	√	~	~	~	$\checkmark$	~	~	$\checkmark$
	Category 3	~	~	$\checkmark$	$\checkmark$	$\checkmark$	~	~	$\checkmark$
	Category 4	~	~	~	~	~	~	~	~
	Category 5	X	x	~	~	~	X	~	X
ACUTE TOXICITY:	Category 1	2	~	~	~	~	2	~	2
INHALATION (GASES)									
	Category 2	~	~	~	~	~	~	~	$\checkmark$
	Category 3	~	~	~	~	~	~	~	$\checkmark$
	Category 4	~	~	~	~	~	~	~	$\checkmark$
	Category 5	X	X	~	~	~	X	~	X
ACUTE TOXICITY:	Category 1	~	$\checkmark$	~	~	~	2	~	~
INHALATION (VAPORS)									
	Category 2	√	~	$\checkmark$	~	~	~	√	$\checkmark$
	Category 3	√	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	1	√	$\checkmark$
	Category 4	~	~	~	$\checkmark$	~	~	~	~
	Category 5	X	X	$\checkmark$	$\checkmark$		X	$\checkmark$	X
ACUTE TOXICITY: INHALATION (DUSTS AND MISTS)	Category 1	~	~	~	~	<b>₩</b>	~	~	~
	Category 2	~	~	~	~	$\checkmark$	1	√	~
	Category 3	√	~	~	$\checkmark$	$\checkmark$	1	~	$\checkmark$
	Category 4	√	~	~	~	$\checkmark$	~	~	$\checkmark$
	Category 5	X	x	~	~	~	X	~	X
SKIN CORRISIVENESS AND IRRITATION	Category 1A	$\sqrt{(1 \text{ only})}$	2	~	V	~	$\sqrt{(1 \text{ only})}$	~	Ŷ
	Category 1B	√ (1 only)	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	√ (1 only)	$\checkmark$	$\checkmark$
	Category 1C	√ (1 only)	$\checkmark$	$\checkmark$	~	$\checkmark$	√ (1 only)	~	$\checkmark$
	Category 2	√	$\checkmark$	$\checkmark$	~	$\checkmark$	~	~	$\checkmark$
	Category 3	X	X	~	~	$\checkmark$	X	$\checkmark$	X
SERIOUS EYE DAMAGE /EYE IRRITATION	Category 1	~	~	$\checkmark$	~	$\checkmark$	$\checkmark$	$\checkmark$	~
	Category 2A	√	~	~	$\checkmark$	~	$\checkmark$	√	$\checkmark$
	Category 2B	X	X	$\checkmark$	$\checkmark$	X	(Merged)	$\checkmark$	χ
RESPIRATORY SENSITIZATION	Category 1	~	~	$\checkmark$	V	~	~	~	$\checkmark$
SKIN SENSITIZATION	Category 1	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
GERM CELL MUTAGENICITY	Category 1A	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
	Category 1B	1	~	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$

Hazard Class/Category 危害类别分类			UN GHS (2011) 联合国GHS (2011)	CLP (2011) 欧盟CLP (2011)	China GHS (2006) 中国GHS (2006)	US HCS (2012) 美国GHS (2012)	Notes: 备注
Acute toxicity急性毒性	Acute Tox. 4	Inhalation- Vapors	V	V	V	V	
		Inhalation- Dusts and Mists	~	√	√	V	
	Acute Tox. 5	Oral	V	N/A 未采用	V	N/A 未采用	
		Dermal	V	N/A 未采用	V	N/A 未采用	
		Inhalation- Gases	√	N/A 未采用	√	N/A 未采用	
		Inhalation- Vapors	√	N/A 未采用	V	N/A 未采用	
		Inhalation- Dusts and Mists	√	N/A 未采用	V	N/A 未采用	
Skin corrosion/irritation 皮肤腐蚀/刺激	Catego ry 1: skin corrosi ve	1A	√	V	√	V	
		1B	√	√	√	√	
		1C	√	√	V	√	
	Category 2: skin Irritation		V	V	√	√	
	Category 3: Mild Irritant		V	N/A 未采用	√	N/A 未采用	
Serious eye damage/eye irritation 严重眼睛损伤/眼睛刺激性	Eye Irrit.2	2A	V	√ , Not specified for A or B, in practice aligned	V	V	
		2B	√	with 2A. √ , A/B但未细分 AB , 实际对应2A	V	V	

Hazard Class/Category 危害类别分类		UN GHS (2011) 联合国GHS (2011)	CLP (2011) 欧盟CLP (2011)	China GHS (2006) 中国GHS (2006)	US HCS (2012) 美国GHS (2012)	Notes: 备注
Hazardous to the aquatic environment 对水生环境的危害	Aquatic Acute 1	V	V	V	N/A 未采用	
	Aquatic Acute 2	V	N/A 未采用	V	N/A 未采用	
	Aquatic Acute 3	V	N/A 未采用	V	N/A 未采用	
	Aquatic Chronic 1	V	V	V	N/A 未采用	
	Aquatic Chronic 2	V	V	V	N/A 未采用	
	Aquatic Chronic 3	V	V	V	N/A 未采用	
	Aquatic Chronic 4	V	V	V	N/A 未采用	
Hazardous to the ozone layer 对臭氧层的危害	ardous to the ozone r Ozone 氧层的危害		V	N/A 未采用	N/A 未采用	

# **GHS in China**

- > Released National (GB) Standards on GHS:
  - ✓ GHS classification criteria (GB20576~GB20599 and GB20561~GB20562), similar to the Purple Book.
  - ✓ MSDS requirements (GB/T16483-2008) 《化学品安全 技术说明书 内容和项目顺序》
  - ✓ Chemical classification and hazard communication (GB13690-2009) 《化学品分类和危险公示 通则》
  - ✓ GHS Labelling Standard (GB15258-2009) 《化学品安 全标签编写规定》
- Regulation:
  - ✓ State Administration of Work Safety (SAWS) issued Decree 591, "Regulation on the Safe Management of Dangerous Chemicals". It is regarded as the legal basis for China's official implementation of GHS.
  - ✓ Effective from 1 December 2011.

	CQR CQR	A CONTRACTOR OF A CONTRACTOR A CONTRA
Flammable 易燃	Oxidiser 氧化	Explosive 爆炸
Corrosive 腐蚀	Gases under pressure 含压力下气体	Toxic to human health 对人类健康有毒
		No. of the second secon
Harmful, irritating, or causes allergic skin reactions 有害,刺激或导致皮肤 过敏反应	May cause allergic respiratory reactions, cancer, genetic defects, toxic to reproduction, or aspiration hazards 可能导致呼吸过敏反应,癌 症,遗传缺陷,对生殖有毒 或吸入危害	Toxic to aquatic life (both acute and chronic) 对水生生物有毒(急性和慢 性)

#### **Chemical Management in Taiwan**

主管機關	法源與主管領域
環保署	「毒性化學物質管理法」
環保署	環境用藥
農業委員會	植物保護用藥「農藥管理法」
消防署	公共危险物品
交通部	危險物品運輸「交通安全規則第84條」
衛生署	化妝品、食品、食品添加劑、健康食
	品、及藥品與管制藥品管理等
勞工委員會	工作場所「勞工安全衛生法」

### GHS Regulatory Framework (1)

- ▲行政院勞工委員會 (Executive Yuan, Council of Labor Affairs):
  - Leads GHS implementation in Taiwan
  - Is responsible for occupational health and safety
  - In 2006, published National Standard CNS 15030 Chemical Classification and Labelling (in Traditional Chinese), based on GHS.
  - Amended "Regulation of Labelling and Hazard Communication of Dangerous and Harmful Substances 2007" (危險物與有害物標示及通 識規則):
    - Attachment 1.1: Five Classes of Dangerous Goods [爆炸性物質, 著火性物質, 氧化性物質, 易燃液體, 可燃性氣體]. Definitions are provided, but specific chemicals are not listed.
    - Attachment 1.2: A list of 413 harmful chemicals.

#### Scope of CLA Regulation (危險物與有害物標 示及通識規則)

- Applies to all hazardous chemicals (pure substances, mixtures, raw materials and products) that are manufactured, used, stored, and sold:
  - 危險物與有害物標示及通識規則 附表一危險物及有害物. (Phase 1 Implementation)
  - 符合CNS 15030 化學品分類及標示系列(具物理性危害與健康危害者) (*Phase 2, 3.. Implementation*.....)
  - 其他經中央主管機關指定者
- Applies to manufacturers, employers, importers and distributors.
- Exempt: Industrial wastes, tobacco, food and beverages, medicines, cosmetics, consumer products.

#### ▲ 27 GHS Hazard Classifications

9 Hazard Symbols



#### Hazard labels are required.



#### **GHS Implementation Status**

#### CHEMCON ASIA 2011

#### Implementation Schedule 2006~2015



### Is it really globally harmonised?

- "Building Block Approach"
- Selection of "Cut-off Limit value / Concentration limits"
  - Skin sensitization (0.1% vs. 1%)
  - Respiratory sensitization: solid/liquid (0.1% vs. 1%)
  - Carcinogenicity : Cat. 2 (0.1% vs. 1%)
  - Reproductive toxicity : Cat. 1 (0.1% vs. 0.3%), Cat. 2 (0.1% vs. 3%),
  - Additional category for lactation (0.1% vs. 0.3%)
  - Specific target organ toxicity (Single exposure) : Cat. 1 (1% vs. 10%), Cat. 2 (1% vs. 10%)
  - Specific target organ toxicity (Repeated exposure) : Cat. 1 (1% vs. 10%), Cat. 2 (1% vs. 10%)
- National GHS hazardous registers:
  - EU, NZ, KR, JP, TW have established their own substance lists of classification
  - China, Malaysia are developing their own lists.

#### Toluene – a common industrial chemical

Classification results by different jurisdictions:

	EU	Japan	Korea	Taiwan
Flammable liquid	2	2	2	2
Aspiration toxicity	1	1	1	1
Skin irritation	2	2	2	2
Acute tox – oral	-	5	-	4
Acute tox – inhalation	-	4	4	-
Eye irritation	-	2B	2A	2A
Reproductive toxicity	2	1A	1A	-
Systemic toxicity (single exposure)	3	1,3	1,3	-
Systemic toxicity (repeat exposure)	2	1	1	2

#### **Any Question ??**

