DSPS-SCC
Safety
Competence
Center

Series « What should I know ? »

Generally Harmonized System of classification and labelling of chemicals

Volume 3 *– Classification examples*

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Introduction

This booklet serves as help for the classification and categorization of chemicals according to the CLP regulation. The CLP being a European version, Switzerland included, of the **Globally Harmonized System of Classification and Labelling of Chemicals** (GHS). This document is only an interpretation of the original CLP regulation (rule CE n° 1272/2008) and its annex VI according to the Technical Progress Adaptation (ATP) version 10. This guide is not exhaustive and does not replace the CLP rules.

Abbreviations as well as hazard statements (R phrases) and precautionary statements (P phrases) are grouped in the *Additional information* section at the end of the document.

This booklet presents examples of classification of mixtures according to the GHS hazards and begins with physical hazards, then health hazards and finishes on environmental hazards.

Classification principles

Classification of pure substances and mixtures (mixture or solution consisting of at least two substances which do not react together) according to their hazardousness is done according to the available data and the knowledge of critical effects. Also, if one or more of these individual substances possess intrinsic hazards, every mixture containing one or more of these substances will have to be assessed and classified.

This booklet focuses solely on the methods allowing hazards' classification using deductive methods; it is only in the absence of information that *in vitro* or even *in vivo* methods (these experimental trials are mentioned only in this Volume) will be used.

To classify and categorize pure substances and mixtures, one should consider what has already been officialized and proceed as follows[1]:

1. If they exist, **use the data on substances or mixtures as such**. Otherwise, the substance or substances of a mixture should be assessed individually.
2. If relevant, use extrapolation principles first (see Vol. 2, p. 36; if ingredients affect the mixture's properties, it must be taken into account).
3. Read the **Safety Data Sheet** (**SDS**) of the substance or of each component of the mixture (use the supplier's sheets).
4. At **section n°2.2 of the SDS** (*Hazards identification*), record the hazard classes and categories.
5. At **section n°3 of the SDS** (*Composition/information on ingredients*), record the **Cut-off Values** (also named **Specific Concentration Limit (SCL)** in the CLP document). For the hazards for the aquatic environment, record the **Multiplication factor (M factor).**
6. Verify in the **CLP annex VI** (ATP-10 or ATP-13 from May 2020) if a **Specific Concentration Limit (SCL) and/or a M factor** are given (SCL and M values found in the CLP annex VI should always take the priority over the values found in the SDS).

[1] Unless stated, the indicated concentrations are weight concentration (% wt).

7. Consult the **C&L inventory on the ECHA website** because the REACH notifications and data recorded in the C&L inventory provide additional information (e.g. Ethanol and its classification as an eye irritant. Whereas annex VI of the CLP does not give any threshold, there is a specific concentration (C ≥ 50%) validated in the C&L inventory of ECHA).
8. More specifically for mixtures: extrapolation principles (see Vol. 2, p. 36) should be used first, when relevant (if ingredients affect the mixture's properties, it must be taken into account).
9. Apply the **GHS tables and calculations** as explained in Volume 2.
10. If a substance/mixture must be characterized through tests, one must follow the *Manual for Tests and Criteria* (for all physical hazards) and the *OECD guidelines* (for health and environmental hazards).

Note: All references to tables correspond to the tables in Volume 2.

This information has been grouped in the form of the table below:

<table>
<tr><td rowspan="2">Step</td><td colspan="7">Chemical name of the ingredient XYZ (n° CAS xx-yy-zz)</td></tr>
<tr><td>Hazards</td><td>Specific concentrations, M-factor (CLP annex VI) or other available data</td><td>As per authorities</td><td>Hazard categories and classes</td><td>Pictogra m-mes</td><td>Signal word</td><td>Hazard statement</td></tr>
<tr><td>1</td><td>Physical</td><td></td><td rowspan="3"></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2</td><td>Health</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>3</td><td>Environmental</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>4</td><td colspan="7">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td>5</td><td colspan="7">0.2 M correspond to 12 g of XYZ in 1 L of water, that is an 1.2% aqueous solution.</td></tr>
<tr><td>6</td><td>Physical</td><td></td><td colspan="2"></td><td></td><td></td><td></td></tr>
<tr><td>7</td><td>Health</td><td></td><td colspan="2"></td><td></td><td></td><td></td></tr>
<tr><td>8</td><td>Environmental</td><td></td><td colspan="2"></td><td></td><td></td><td></td></tr>
<tr><td rowspan="3">9</td><td colspan="7">Labelling of the aqueous solution at 0.2 M of XYZ :</td></tr>
<tr><td colspan="5">Pictogram-s</td><td colspan="2">Signal word</td></tr>
<tr><td colspan="5">  and/ or </td><td colspan="2">DANGER/ Warning or /</td></tr>
</table>

- The 3rd column of the table groups the specific concentrations, the M-factors from the Annex VI of the CLP or any other relevant and trustworthy information. The fourth column indicates under which authority/notification the hazards classes and categories have been attributed. In the 5th and 6th columns are reported the pictograms and the corresponding signal word, respectively. The last column indicates the code linked to the hazard statements.
- The first rows of the table regroup all information on hazards (physical, health and environmental, respectively) for the mentioned component (stated on the first row)
- Grayed rows: *reasoning for the categorization and classification of the* mixture, explain concentration calculations. They also show how to apply the tables and calculations of the GHS to determine the classification of the mixture.

- The last rows propose the hazards pictograms and the signal word that should appear on the label of the mixture.
- If a mixture mentioned in this booklet possess more than one hazard, it will be classified only in function of the hazards presented in the previous paragraphs. For example, if a mixture contains flammable components and acute toxicity is used as example in the determination of the fire hazard, only the classification of this mixture in function of its flammability will be considered.

Documents and official institutions

GHS (ver. 8, 2019) : https://www.unece.org/trans/danger/publi/ghs/ghs_rev08/08files_e.html

CLP (2008) : https://eur-lex.europa.eu/legal-content/FR/TXT/?uri=LEGISSUM:ev0013

ECHA : https://echa.europa.eu/fr/home

CLP Annex VI : https://echa.europa.eu/fr/information-on-chemicals/annex-vi-to-clp

C&L inventory : https://echa.europa.eu/fr/information-on-chemicals/cl-inventory-database

REACH : https://echa.europa.eu/fr/regulations/reach/understanding-reach

ADR-RTMD : https://www.unece.org/trans/danger/publi/adr/adr_e.html and http://www.unece.org/index.php?id=41869

OCDE:https://www.oecd.org/fr/env/ess/essais/lignesdirectricesdelocdepourlesessaisdeproduitschimiques.htm

OChim : https://www.admin.ch/opc/fr/classified-compilation/20141117/index.html

SUVA : https://www.suva.ch

For more information, please contact the SCC: go.epfl.ch/Support-SCC

1. Physical Hazards

1.1. Explosives and deactivated explosives

Tests according to RTMD must be performed to determine the classification.

1.2. Desensitized explosives

Tests according to RTMD must be performed to determine the classification.

1.3. Self-reactive chemicals and organic peroxides

A solution made of inert diluent(s) and containing benzoyl peroxide (molar mass of 242 g/mol) will be categorized as *peroxide* as soon as its concentration allow to give off 1% of oxygen. It brings to solve the following equation:

$$1(\%\text{ available oxygen}) = \frac{16 \text{ x } C(\%\text{peroxyde concentration})}{242\ (g/mol)} \rightarrow C = 242/16 = 15.125\%$$

So, as soon as the solution contains 15.125% of this peroxide, it will be categorized as *peroxide*.

Tests according to RTMD must be performed to determine the flammability or explosivity of the mixture. These will determine the final label of the substance.

1.4. Self-heating substances

Tests according to RTMD must be performed to determine the classification.

1.5. Pyrophoric liquids and solids

Tests according to RTMD must be performed to determine the classification.

1.6. Flammable, pyrophoric and/or chemically unstable gas

Let's consider the following gas mixture: 2% (H_2) + 6% (CH_4) + 27% (Ar) + 65% (He).
Only the hazard *flammable* will be considered here.

Steps	Reasoning:	
1	According to the norm :	K_i (Ar) = 0.55 and K_i (He) = 0.9.
2	Calculation :	The equivalent mixture, with nitrogen as compensating gas, becomes: 2% (H_2) + 6% (CH_4) + [27% x 0.55 + 65% x 0.9](N_2) = 2% (H_2) + 6% (CH_4) + 73.35% (N_2) = 81.35%
3	Adjustment to the sum of content to 100%:	(100/81.35) × [2% (H_2) + 6% (CH_4) + 73.35% (N_2)] = 2.46% (H_2) + 7.37% (CH_4) + 90.17% (N_2)
4	The Tc_i are :	Tc_i (H_2) = 5.5% et Tc_i (CH_4) = 8.7%
5	Calculation on the flammability of the equivalent mixture:	$\sum_i^n \frac{V_i\,\%}{T_{ci}}$ = $\frac{2.46}{5.5} + \frac{7.37}{8.7} = 1.29$
6	Conclusion :	The result being superior to 1 → **the mixture is flammable to the air** 
	Remark :	Tests according to the RTMD will have to be realized to determine which flammable category 1A or 1B the mixture belongs.

Classification based on flammable limits:

To obtain approximate values of flammable limits, the principle of mass conservation from Lavoisier can be useful: Given a mixture of *i* **gaseous substances or flammable vapors**, present in a n_i percentage concentration in air. If for each substance a lower (or superior) flammable limit N_i exist, then according to Lavoisier law, we have:

$$\frac{n1}{N1} + \frac{n2}{N2} + \frac{n3}{N3} = 1$$

And

$$L = \frac{100}{\frac{P1}{N1} + \frac{P2}{N2} + \frac{P3}{N3}}$$

With ***L*** being the lower or superior flammability limit of the final mixture in percentage.

Then for a mixture of the 4-following gas, such as:

Component	P_i	N_i (LEL_i)
Methane	80%	5.3%
Ethane	15%	3.22%
Propane	4%	2.37%
Butane	1%	1.86%

We have :

$$L = \frac{100}{\frac{80}{5.3} + \frac{15}{3.22} + \frac{4}{2.37} + \frac{1}{1.86}} = 4.55\%$$

These approximations hold for these mixtures:

- Of Hydrogen, carbon monoxide, and methane (two together or all together)
- Of gas in water (gaseous mixture obtained by the reaction of steam on coal), lighting gas (gaseous mixture produced by coal distillation)
- Of simple paraffinic hydrocarbons of chemical formula C_nH_{2n+2}, including natural gas; ***however, all differences between calculated and observed values are sometimes significant***. Biggest differences are observed when one of the ingredient is a steam such as diethyl oxide, acetone and carbon disulfide [http://www.inrs.fr/inrs-pub/inrs01.nsf/IntranetObject-accesParReference/Page%20Editoriale%20Aide%20Caratex/$File/Visu.html].

N.B.: Regarding explosion prevention, one had better to refer to the Chemical thermodynamic and energy hazard evaluation (CHETAH). By taking account of the weight-based combustion enthalpies, it allows to approximate for 214 hydrocarbons. Otherwise, one must measure to have reliable values rather than approximations.

To help characterizing the hazards of a mixture, the INRS has created the CarAtex database (http://staubex.ifa.dguv.de/explosuche.aspx?lang=f). It is a collection of publications on the flammability of gases, liquids, and vaporizable solids. It reports the flash point, the self-ignition temperature, the lower and superior flammability limits, the boiling temperature, the steam pressure at 20°C, the evaporation index and the steam density in regards to the air. Are also indicated the characteristics presenting a high flammability or explosion risk such as the incompatibility with water or halogenated substances, the peroxide formation, the shock sensitivity, etc. These data are in no way exhaustive: the information, specific to each substance have each been reported through literature research.

1.7. Substances which, in contact with water, emit flammable gases

Tests according to RTMD must be performed to determine the classification.

1.8. Aerosols (dispensers)

Tests according to RTMD must be performed to determine the classification.

1.9. Flammable liquids

Literature suggest several calculation methods for the flash point (FP) and the boiling point (BP), but the experimental measurement remains the most reliable and convenient way.

International norms to determine the FP:	ISO 1516	ISO 1523	ISO 2719
	ISO 13736	ISO 3679	ISO 3680
International norms to determine the BP:	ISO 3924	ISO 4626	ISO 3405

The flash point (FP) of liquids mixture is reached when its vapor pressure is equal to the lower explosivity limit. The total vapor pressure (P) of the mixture is equal to the sum of all partial pressures (P_i) of all the mixture ingredients *i*: $\mathbf{P = \Sigma_i P_i}$

The partial pressure of an ingredient *i* of the mixture is equal to the vapor pressure of the pure ingredient at the temperature of the mixture multiplied by its molar fraction in said mixture. Partial vapor pressures P_i are calculated according to Raoult's law: $\mathbf{P_i = x_i \gamma_i P_i^{sat}}$ with:

Also see http://www.chemguide.co.uk/physical/phaseeqia/idealpd.html for more details on Raoult's law.

P_i	Partial pressure of ingredient *i* in vapor phase above the liquid mixture at T = BP
x_i	Molar fraction of the ingredient *i* in liquid phase ($\Sigma_i x_i = 1$)
γ_i	Activity coefficient of the ingredient *i* in liquid phase at the temperature T of the mixture.
P_i^{sat}	Saturating vapor pressure of the ingredient *i* at the temperature T of the mixture.

P_i^{sat} can be obtained using Antoine's law $\mathbf{\log P_i^{sat} = A_i - B_i/(T+C_i)}$ with T in Kelvin, and P_i^{sat} in bar. A, B and C are empirical parameters (see Dortmund Data Bank http://www.ddbst.com and the database of the National Institute of Standards and Technologies – NIST https://www.nist.gov).

For example, a mixture made of ethanol / benzylic alcohol 50:50 % in volume (for example 2 and 2 mL). Only the hazard *flammable* will be considered here.

	Ethanol	**Benzylic alcohol**
CAS number	64-17-5	100-51-6
Molar mass (M)	46.07 g/mol	108.14 g/mol
Density (d)	0.79 g/mL	1.05 g/mL
Boiling point	64°C	205°C
Flash point	14°C	96°C
Vapor pressure	P^v_E= 5.95 kPa (20°C)	P^v_A= 0.013 kPa (25°C)
Lower explosive limit (LEL) (noble gas law: concentration is directly proportional to the pressure)	3.3 %vol = 3.3 kPa= 0.033 bar	1.3%vol = 1.3 kPa = 0.013 bar
Parameters for Antoine's law (for 273<T<351 K) http://webbook.nist.gov/chemistry	A_E = 5.37229; B_E=1670.409; C_E=-40.191	A_A = 4.47713; B_A=1738.9; C_A=-89.559
Molar fraction $x_i = \%_i xd_i/M_i$ / $(\%_i xd_i/M_i+\%_j xd_j/M_j)$	$x_E = 0.5xd_E/M_E$ / $(0.5xd_E/M_E+0.5xd_A/M_A)$= 0.64	$x_A = 0.5xd_A/M_A$ / $(0.5xd_E/M_E+0.5xd_A/M_A)$= 0.36

Assumptions:	- solutions and their corresponding vapors are deemed ideal then γ_i =1. - the contribution of benzylic alcohol is negligible because $P^v_E >> P^v_A$. Then $P_E = 0.033= 0.64 \times 10^{(A_E - B_E/(T+C_E))}$
Conclusion:	The flash point of the mixture ethanol/benzylic alcohol 50:50 % vol. can be estimated to 291 K that is 18°C. The mixture must be categorized either in the category 1 or 2 according to its boiling point that should be measured experimentally.

Given a mixture methanol/water 75:25 % in volume (for example 3 and 1 mL).
Only the hazard *flammable* will be considered here.

	Methanol	Water
CAS number	67-56-1	7732-18-5
Molar mass (M)	32 g/mol	18 g/mol
Density (d)	0.791 g/mL	1 g/mL
Boiling point	41°C	100°C
Flash point	9.7°C	/
Vapor pressure	12.3 kPa (20°C)	3.2 kPa (25°C)
Lower explosive limit (LEL)	6 % vol = 6 kPa= 0.06 bar	/
Parameters for Antoine's law (pour 288<T<357 K) http://webbook.nist.gov/chemistry	A_M = 5.2049; B_M= 1581.341; C_M=-33.50	A_W = 5.20389; B_W= 1733.926; C_W=- -39.485
Molar fraction $x_i = \%_i xd_i/M_i / (\%_i xd_i/M_i+\%_j xd_j/M_j)$	$x_M = 0.75xd_M/M_M / (0.75xd_M/M_M+0.25xd_W/M_W)$= 0.56	$X_W = 0.25xd_W/M_W / (0.75xd_M/M_M+0.25xd_W/M_W)$= 0.44
Assumptions:	- solutions and their corresponding vapors are deemed ideal then γ_i =1. - The water contribution is negligible because $P^v_M >> P^v_W$. Then $P_M = 0.06= 0.56 \times 10^{(A_M - B_M/(T+C_M))}$	
Conclusion:	The flash point of the mixture methanol/water 75 :25 % vol. can be estimated to T = 289.6 K, that is 16.6 °C*. The mixture must be categorized either in the category 1 or 2 according to its boiling point that should be measured experimentally.	

* The experimental value we have is T_{exp}= 16.5°C [P.J. Martinez *et al.*; Flash point determination of binary mixtures of alcohols, ketones and water; 7th World Congress of Chemical Engineering (2005), 1-8].

Characterization of an aqueous solution of glacial acetic acid ($M(CH_3CO_2H)$ = 60.05 g/mol; density = 1.05 g/cm^3).
Only the hazard *flammable* will be considered here.

<table>
<tr><th colspan="7">Acetic acid (n° CAS 64-19-7)</th></tr>
<tr><td>Hazards</td><td>Specific concentrations, M-factor (CLP annex VI) or other available data</td><td>As per authorities</td><td>Hazard categories and classes</td><td>Pictogram</td><td>Signal word</td><td>Hazard statement</td></tr>
<tr><td>Physical</td><td>C=100%:
PE= 39°C</td><td>CLP (GHS)</td><td>Flam. liq. cat.3</td><td>  </td><td>Warning</td><td>H226</td></tr>
<tr><td colspan="7">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="7">0.2 M corresponding to 12 g acetic acid in 1 L water, that is a 1.2% aqueous solution.</td></tr>
<tr><td>Physical</td><td>Flammability:
No threshold in the Annex VI, it must be determined by a measure or extrapolation.</td><td colspan="2">We dilute a flammable liquid of category 3 by a non-flammable liquid with 100% miscibility. The 0.2 M aqueous solution will be at best a flammable liquid of category 4.</td><td>/</td><td>Warning</td><td>/</td></tr>
<tr><td colspan="7">Labelling of the 0.2 M acetic acid aqueous solution:</td></tr>
<tr><td colspan="4">Pictogram</td><td colspan="3">Signal word</td></tr>
<tr><td colspan="4">/</td><td colspan="3">WARNING</td></tr>
</table>

Characterization of an alcoholic solution of red methyl (M = 269.3 g/mol).
Only the hazard *flammable* will be considered here.

Red methyl (n° CAS 493-52-7)						
Hazards	Specific concentrations, M-factor (CLP annex VI) or other available data	As per authorities	Hazard categories and classes	Pictogram	Signal word	Hazard statement
Physical	/	/	/			
EtOH (n° CAS 64-17-5)						
Physical	/	CLP (GHS)	Flam. Liq. Cat. 2		Danger	H225
Reasoning for the categorization and classification of the mixture:						
1 g of red methyl in 1L of a 60% alcohol aqueous solution, that makes a 0.1% solution.						
Physical	Flammability: No threshold in the Annex VI, it must be determined by a measure or extrapolation.	As per literature, FP(60% EtOH) = 19.5°C and BP = 80.9°C → Flam. Liq. cat. 2			Danger	H225
Labelling of the 60% alcohol solution with 0.1% methyl red:						
Pictogram					Signal word	
					DANGER	

1.10. Flammable solids

Tests according to RTMD must be performed to determine the classification.

1.11. Oxidizing gases

The determination of the oxidizing property of a mixture is calculated according to the formula giving the oxidizing power (PC).

$PC = \frac{\sum_{i=1}^{n} x_i C_i}{\sum_{i=1}^{n} x_i + \sum_{k=1}^{p} K_k B_k}$	x_i	Molar fraction of the i^{th} oxidizing gas in the mixture
	C_i	Oxygen equivalence coefficient of the i^{th} oxidizing gas in the mixture
	K_k	Nitrogen equivalence coefficient of the inert gas k
	B_k	Molar fraction of the k^{th} inert gas in the mixture
	N	Total number of oxidizing gas in the mixture
	P	Total number of inert gas in the mixture
Criteria:	If PC is above 0.235, the mixture is considered as more oxidizing than the air, and thus will wear the pictogram  .	

Only the hazard *oxidizing* will be considered here.

Example 1: given the following gas mixture: 9% (O_2) + 16% (N_2O) + 75% (He).

Steps	Reasoning	
1	Oxygen equivalence coefficient (C_i):	C_i (N_2O) = 0.6 et C_i (O_2) = 1
2	Nitrogen equivalence coefficient of the non-flammable and non-oxidizing gas:	K_k (He)= 0.9
3	Calculation of the oxidizing power:	$PC = \frac{0.09 * 1 + 0.16 * 0.6}{0.09 + 0.16 + 0.9 * 0.75} = 0.201$ → 20.1% < 23.5%
4	Conclusion:	The result being below 23.5% → the mixture is not an oxidant.

Example 2: given the following gas mixture: 0.6% fluoride (F_2) in nitrogen.

Steps	Reasoning	
1	Oxygen equivalence coefficient (C_i):	C_i (F_2) = 40
2	Calculation of the oxidizing power:	$PC = \frac{0.006 * 40}{0.006 + 1 * 0.994} = 0.24$ → 24% > 23.5%
3	Conclusion:	The result being above 23.5% → the mixture is oxidant  , category 1.

1.12 Oxidizing liquids and solids

Tests according to RTMD must be performed to determine the classification.

Characterization of an aqueous solution of potassium dichromate ($M(K_2Cr_2O_7)$ = 294.18 g/mol).
Only the hazard *oxidizing* will be considered here.

Potassium dichromate (n° CAS 7778-50-9)						
Hazards	Specific concentrations, M-factor (CLP annex VI) or other available data	As per authorities	Hazard categories and classes	Pictogram	Signal word	Hazard statement
Physical	/	CLP (GHS)	Oxidizing solid cat. 2		Danger	H272
Reasoning for the categorization and classification of the mixture:						
5.88 g $K_2Cr_2O_7$ in 1 L H_2O, that is a 0.59% aqueous solution.						
Physical	Oxidizing ?	If no other comparable and categorized substance exists, one cannot make an extrapolation and testing is the only way.				
Labelling of the 0.02 M aqueous solution of potassium dichromate:						
Pictogram				Signal word		
 (if positive result)				DANGER (if positive result)		

Characterization of an aqueous solution of nitric acid 65% ($M(HNO_3)$ = 63.01 g/mol; density = 1.40 g/cm^3).
Only the hazard *oxidizing* will be considered here.

Nitric acid (n° CAS 7697-37-2)						
Hazards	Specific concentrations, M-factor (CLP annex VI) or other available data	As per authorities	Hazard categories and classes	Pictogram	Signal word	Hazard statement
Physical	C ≥ 99%	CLP (GHS)	Oxidizing liq. cat. 2		Danger	H272
	65% ≤ C < 99%		Oxidizing liq. cat. 3		Warning	
Reasoning for the categorization and classification of the mixture:						
2M → 2x63.01= 126 g in 1L H_2O, that is a 12.6% aqueous solution of nitric acid.						
Physical	Oxidizing liq.	C < 65% → out of cat.		/	/	/
Labelling of the 2M aqueous solution of nitric acid:						
Pictogram				Signal word		
/				/		

1.13 Gases under pressure

Tests according to RTMD must be performed to determine the classification.

1.14 Corrosive to metals

Characterization of an iron chloride solution ($M(FeCl_3.6H2O) = 270.4$ g/mol). Only the hazard *corrosive to metals* will be considered here.

Preparation of the mixture to 0.5 M: 135.2g in 100 mL distilled H_2O, add 130 mL HCl 25%. Complete to 1 L with distilled H_2O. 130 mL 25% HCl corresponds to 130x1.12= 145.6g → 145.6/36.46g.mol^{-1}= 4 mol. But the used acid solution is at 25%; so, it corresponds to 1 mol. The final solution contains then also 1 mol of HCl; that is 36.46g HCl per liter so C_{HCl}=3.646%.

<table>
<tr><th colspan="7">Iron chloride (III) (n° CAS 7705-08-0)</th></tr>
<tr><td>Hazards</td><td>Specific concentrations, M-factor (CLP annex VI) or other available data</td><td>As per authorities</td><td>Hazard categories and classes</td><td>Pictogram</td><td>Signal word</td><td>Hazard statement</td></tr>
<tr><td>Physical</td><td>/</td><td>CLP (GHS)</td><td>Corr. to metals cat. 1</td><td>  </td><td>Warning</td><td>H290</td></tr>
<tr><td colspan="7">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="7">135.2 g of $FeCl_3.6H_2O$ in 1L water, that is an aqueous solution of C_{FeCl3} = 13.5% (or 0.5 M) and C_{HCl}.=3.65%.</td></tr>
<tr><td rowspan="2">Physical</td><td rowspan="2">Corr. to metals</td><td colspan="5">No threshold defined according to C_{FeCl3}, one must extrapolate or measure.</td></tr>
<tr><td colspan="2">C_{HCl} > 0.1% → cat. 1</td><td>  </td><td>Warning</td><td>H290</td></tr>
<tr><td colspan="7">Labelling of the 0.5M aqueous solution of iron chloride (III):</td></tr>
<tr><td colspan="3">Pictogram</td><td colspan="4">Signal word</td></tr>
<tr><td colspan="3">  </td><td colspan="4">Warning</td></tr>
</table>

Characterization of an alcoholic solution of potassium hydroxide (M(KOH) = 56 g/mol).
Only the hazards *corrosive to metals* and *flammable* will be considered here.

<table>
<tr><td colspan="7">Potassium hydroxide (n° CAS 1310-58-3)</td></tr>
<tr><td>Hazards</td><td>Specific concentrations, M-factor (CLP annex VI) or other available data</td><td>As per authorities</td><td>Hazard categories and classes</td><td>Pictogram</td><td>Signal word</td><td>Hazard statement</td></tr>
<tr><td>Physical</td><td>/</td><td>CLP (GHS)</td><td>Corr. to metals cat. 1</td><td>  </td><td>Warning</td><td>H290</td></tr>
<tr><td colspan="7">EtOH (n° CAS 64-17-5)</td></tr>
<tr><td>Physical</td><td>/</td><td>CLP (GHS)</td><td>Flam. liq. cat. 2</td><td>  </td><td>Danger</td><td>H225</td></tr>
<tr><td colspan="7">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="7">1 mol = 56 g in 1L that is 5.6% KOH in ethanol.</td></tr>
<tr><td rowspan="2">Physical</td><td>Flammability</td><td colspan="2">Flammable liq. cat. 2</td><td>  </td><td>Danger</td><td>H225</td></tr>
<tr><td>Corrosive to metals</td><td colspan="5">No threshold defined, one must extrapolate or measure</td></tr>
<tr><td colspan="7">Labelling of the 1 M mixture:</td></tr>
<tr><td colspan="4">Pictogram</td><td colspan="3">Signal word</td></tr>
<tr><td colspan="4">  </td><td colspan="3">DANGER</td></tr>
</table>

2. Health hazards

Depending on the available data, the classification of mixture according to their health hazards is done:

- Either thanks to data of similar mixtures,
- Either by data on ingredients' mixture
- Either by tests

Available data on similar mixtures are enough to estimate the classification of a mixture:
The extrapolation principles (Vol. 2, p. 36) work for the determination of the acute toxicity (short term), hazards for skin/eyes (irritation/corrosion/sensitization). It can also be used to determine chronic toxicity (long term) such as CMR: carcinogenicity, mutagenicity, reproductive toxicity; and STOT: Specific Target Organ Toxicity; and aspiration hazard.

Dilution:

- If a mixture is diluted by a substance that belong to a health hazard class (e.g. corrosion/irritation or sensitization) equivalent to, or lower, than that of the ingredient the least hazardous (e.g. corrosive/irritating or sensitizing), and do not alter the hazardousness (in this case it doesn't modify the corrosive/irritating, or sensitizing power) of other ingredients, then the mixture can be categorized similarly to the original substance. Otherwise, the method explained in section 2.0 (classification of mixture from its ingredients) may be employed.

- If diluted by water or another non-toxic solvent, its toxicity may be determined using measurements from the original mixture.

Classification examples of a mixture M according to the properties of the substances A and B:

Ingredients		**Mixture M**
Substance A	**Substance B**	
Known hazard	Hazardousness equivalent or lower than that of A	Same classification as A
Known hazard	Water or other non-toxic adjuvants	Classification based on dilution
100 mL of a solution with LD_{50}= 1'000 mg/kg (oral, cat. 4)	Dilution with 100 mL water	Mixture with LD_{50}= 2'000 mg/kg (oral, cat. 4)

Interpolation within same category:

Let's consider A, B and C three mixtures made of identical ingredients. A and B are in the same health hazard category (e.g. fatal). If the concentrations of the toxicologically-active ingredients in C are in between the ones in A and B, it is assumed that the mixture C is in the same category than the one attributed to A and B.

Now let's consider 3 mixtures with identical ingredients, i.e., S_1 and S_2 but at different concentrations. The mixtures M_1 and M_2 are, for example, both classified as STOT category 1. If M_3 is also composed of S_1 and S_2 in intermediate concentrations, then the same toxicity can be applied to M_3.

Ingredients		**Mixtures**	
Substances	**Toxicity**	**Composition**	**Toxicity mixture M_1**
S_1	Tested	80%	Established, e.g. STOT cat. 1
S_2	Tested	20%	
			Toxicity mixture M_2
S_1	Tested	30%	Established, e.g. STOT cat. 1
S_2	Tested	70%	
			Toxicity mixture M_3
S_1	Tested	from 30% to 80%	M_3 is considered as being part of the same STOT classification cat. 1 than M_1 et M_2.
S_2	Tested	from 20% to 70%	

Highly similar mixtures:

Let's consider two mixtures M_1 and M_2 globally similar containing two ingredients, A and B. The concentration of B is relatively similar in M_1 and M_2:

Mixture M_1			
Substances	**Toxicity**	**Composition**	**Toxicity**
A	Tested	$C_{M1}(A)$	Established category
B	Tested	$C_{M1}(B)$	
Mixture M_2			
Substances	**Toxicity**	**Composition**	**Toxicity**
C	Non-tested	$C_{M2}(C)$	If the hazard category of A & C is the same and that $C_{M1}(A) \approx C_{M2}(C)$, then the hazard category of M_1 can also be applied to M_2.
B	Tested	$C_{M2}(B) \approx C_{M1}(B)$	

2.0 Classification of mixtures from its ingredients

2.1 Acute toxicity (AT)

Example 1: let's consider the following mixture:

- 10% of substance 1 known as an acute toxic cat. 3 (oral)
- 5% of substance 2 known as an acute toxic cat. 2 (oral)

Ingredients	Toxicity	Pictogram	Mixture's composition
Substance 1	Cat.3 (oral) acute toxic		10%
Substance 2	Cat. 2 (oral) acute toxic		5%
Other substances	Not hazardous		85%

The determination of the classification of the mixture is done as follows:

Equivalent ATE[2] of substances in the last column of the 2.1.2 table (Vol. 2):

ATE_{oral} for substance 1: $ATE_1 = 100$ et ATE_{oral} for substance 2: $ATE_2 = 5$.

Equivalent ATE are given through the following formula:

$$\frac{100}{ATE_{mix,\ oral}} = \frac{10}{100} + \frac{5}{5} \rightarrow ETA_{mix,\ oral} = 91$$

Conclusion: From table 2.1.2, the ATE_{mix} for a 91 oral exposure gives a classification as acute toxic, category 3. Thus, the mixture X is classified as having an **acute oral toxicity, category 3**.

The pictogram  will have to be present on tis label. Label will indicate the signal word *Danger* and the hazard statement *Toxic if swallowed* (H301).

2.1.1 No data for more than 10% of its ingredients

Given a mixture Y made up of the ingredients listed underneath:

Ingredients	Toxicity	Pictogram	Composition of the mixture X
1	$LD_{50,\ oral}$ = 125 mg/kg		4%
2	No data		92%
3	$LD_{50,\ oral}$ = 1500 mg/kg		3%
4	$LD_{50,\ oral}$ = 10 mg/kg		1%

[2] ATE = Acute Toxicity Estimate (see Chapter 2.1, Vol. 2).

$$\frac{100-\left(\sum C_{inconnu}\ \text{si} > 10\%\right)}{ETA_{mél}} = \sum_n \frac{C_i}{ETA_i}$$

$$\frac{100-92}{ATE_{mix,\ oral}} = \frac{4}{125} + \frac{3}{1500} + \frac{1}{10} \rightarrow ATE_{mix,\ oral} = 59.7\ \text{mg/kg}.$$

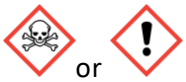
Conclusion: The mixture Y is an acute toxic of category 3, where 92% "of this mixture is made of an ingredient whose toxicity is unknown".

In addition to this mention, the label will include the pictogram  , the signal word *Danger* and the hazard statement *Toxic if swallowed* (H301).

2.1.2 <u>If a component, for which no data is available, is present in a mixture with a concentration of at least 1%</u>

The mixture is classified only on its known ingredients and with the mention that X % of the mixture consist in a component of unknown toxicity.

Let's consider a mixture Z made up of the following ingredients:

Ingredients	Toxicity	Pictogram	Composition of the mixture X
Ingredient 1	$LD_{50,\ skin}$ = 40 mg/kg		2%
Ingredient 2	$LD_{50,\ skin}$= 300 mg/kg		17.6%
Mixture M_1	$ATE_{mix,\ skin}$= 190 mg/kg		19.2%
Ingredient 3	Unknown		1.2%
Mixture M_2	$LD_{50,\ skin}$ = 500 mg/kg	 or	36%
Ingredient 4	$LD_{50,\ skin}$ = 1.21 mg/kg		24%

$$ETA_{mél} = \frac{100}{\frac{2}{40} + \frac{17.6}{300} + \frac{19.2}{190} + \frac{36}{500} + \frac{24}{1{,}210}}$$

$ATE_{mix,\ skin}$= 332 mg/kg.

Conclusion: « The mixture Z has a cat. 3 acute toxicity and 1.2% of the mixture has an unknown toxicity ». In addition to this mention the label will wear the pictogram  , the signal word *Danger* and the hazard statement *Toxic if swallowed* (H301).

Characterization of an aqueous solution of ammonium chloride ($M(NH_4Cl) = 53.49$ g/mol).
Only the hazard *acute toxicity* will be considered here.

Ammonium chloride (n° CAS 12125-02-9)						
Hazards	Specific concentrations, M-factor (CLP annex VI) or other available data	As per authorities	Hazard categories and classes	Pictogram	Signal word	Hazard statement
Health	/	CLP (GHS)	AT oral cat. 4		Warning	H332
Reasoning for the categorization and classification of the mixture:						
26.75 g NH_4Cl in 1L water, that is a 2.67% aqueous solution.						
Health	AT oral	100/ATE = 2.67/500 → ATE= 18.10^3 → out cat.		/	/	/
Labelling of the 0.5 M NH_4Cl mixture:						
Pictogram				Signal word		
/				/		

Characterization of an aqueous solution of potassium dichromate ($M(K_2Cr_2O_7)$ = 294.18 g/mol).
Only the hazards *acute toxicity* and *oxidizer* will be considered here.

<table>
<tr><th colspan="7">Potassium dichromate (n° CAS 7778-50-9)</th></tr>
<tr><td>Hazards</td><td>Specific concentrations, M-factor (CLP annex VI) or other available data</td><td>As per authorities</td><td>Hazard categories and classes</td><td>Pictogram</td><td>Signal word</td><td>Hazard statement</td></tr>
<tr><td>Physical</td><td>/</td><td rowspan="4">CLP (GHS)</td><td>Solid oxidizer cat. 2</td><td>  </td><td rowspan="3">Danger</td><td>H272</td></tr>
<tr><td rowspan="3">Health</td><td>/</td><td>AT oral cat. 3</td><td rowspan="2">  </td><td>H301</td></tr>
<tr><td>/</td><td>AT inhal. cat. 2</td><td>H330</td></tr>
<tr><td>/</td><td>AT skin cat. 4</td><td>  </td><td>Warning</td><td>H312</td></tr>
<tr><td colspan="7">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="7">74 g $K_2Cr_2O_7$ in 700 mL distilled H_2O, add 150 mL H_2SO_4 96%. Complete to 1 L with distilled H_2O
That makes a 74g solution so, 7.4% $K_2Cr_2O_7$ solution.
And 150 mL H_2SO_4 ≡ 150x1.83= 274.5 g so, 27.4% H_2SO_4.</td></tr>
<tr><td>Physical</td><td>Oxidizer ?</td><td colspan="5">If no other comparable and categorized substance exists, one cannot make an extrapolation and testing is the only way.</td></tr>
<tr><td rowspan="3">Health</td><td>AT oral</td><td>100/ATE = 7.4/100
→ ATE= 1351 → cat. 4</td><td>  </td><td>Warning</td><td>H302</td></tr>
<tr><td>AT inhal. (vapors)</td><td>100/ATE = 7.4/0.5
→ ATE= 6.7 → cat. 3</td><td rowspan="2">  </td><td rowspan="2">Danger</td><td rowspan="2">H331</td></tr>
<tr><td>AT inhal. (aerosols)</td><td>100/ATE = 7.4/0.05
→ ATE= 0.67 → cat. 3</td></tr>
<tr><td>AT skin</td><td>100/ATE = 7.4/1100
→ ATE = $14{,}8.10^3$ → hors cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td colspan="7">Labelling of the 0.25 M solution:</td></tr>
<tr><td colspan="4">Pictograms</td><td colspan="3">Signal word</td></tr>
<tr><td colspan="4">  (if positive result)  </td><td colspan="3">DANGER</td></tr>
</table>

Characterization of an aqueous solution of cysteine (M(cystein) = 121.16 g/mol).
Only the hazards *acute toxicity* and *corrosive to metals* will be considered here.

Cystein (n° CAS 52-90-4)						
Hazards	Specific concentrations, M-factor (CLP annex VI) or other available data	As per authorities	Hazard categories and classes	Pictogram	Signal word	Hazard statement
Health	/	ECHA (reported)	AT oral cat. 4		Warning	H302
Reasoning for the categorization and classification of the mixture:						
0.1 M HCl corresponds to an aqueous solution of 0.1x36.46= 3.6 g put in 1 L water that is 0.36% HCl. 12.12 g cystein in 1 L HCl 0.1 M, that is an acidic solution of 0.36% HCl and 1.21% cystein.						
Physical	Corr. to metals.	CLP (annex VI): C_{HCl} > 0.1% → cat. 1			Warning	H290
Health	AT oral	100/ATE= 1.21/500 → ATE= 41.10^3 → out cat.		/	/	/
Labelling of the 0.36% HCl and 1.21% cystein acidic solution:						
Pictogram				Signal word		
				WARNING		

2.2 Skin irritation and corrosion

2.2.1 Skin irritation:

Characterization of an aqueous solutions of sodium acetate ($M(CH_3CO_2Na*3H_2O) = 136.04$ g/mol).
Only the hazards *skin irritation* and *eye irritation* will be considered here.

<table>
<tr><td colspan="7">Sodium acetate trihydrate (n° CAS 6131-90-4)</td></tr>
<tr><td>Hazards</td><td>Specific concentrations, M-factor (CLP annex VI) or other available data</td><td>As per authorities</td><td>Hazard categories and classes</td><td>Pictogram</td><td>Signal word</td><td>Hazard statement</td></tr>
<tr><td rowspan="2">Health</td><td>/</td><td rowspan="2">ECHA (reported)</td><td>Skin irrit. cat. 2</td><td rowspan="2">  </td><td rowspan="2">warning</td><td>H315</td></tr>
<tr><td>/</td><td>Eye irrit. cat. 2</td><td>H319</td></tr>
<tr><td colspan="7">H_2O (n° CAS 7732-18-5)</td></tr>
<tr><td>Health</td><td>/</td><td></td><td>No hazard</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td colspan="7">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="7">27.2 g sodium acetate trihydrate in 1 L water, that is a 2.7% aqueous solution.</td></tr>
<tr><td rowspan="2">Health</td><td>Skin irrit.</td><td>Vol. 2, tab. 2.2.1:
1% < C < 10% → cat. 3</td><td>/</td><td>Warning</td><td>H316</td></tr>
<tr><td>Eye irrit.</td><td>Vol. 2, tab. 2.3.2:
C < 10% → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td colspan="7">Labelling of the 8.7% sodium acetate solution:</td></tr>
<tr><td colspan="3">Pictogram</td><td colspan="4">Signal word</td></tr>
<tr><td colspan="3">/</td><td colspan="4">Warning</td></tr>
</table>

Characterization of an alcoholic solution of bromothymol blue.
Only the hazards *flammable, acute toxicity*, *skin irritation* and *eye irritation* will be considered here.

<table>
<tr><td colspan="7">Bromothymol blue (n° CAS 76-59-5)</td></tr>
<tr><td>Hazards</td><td>Specific concentrations, M-factor (CLP annex VI) or other available data</td><td>As per authorities</td><td>Hazard categories and classes</td><td>Pictogram</td><td>Signal word</td><td>Hazard statement</td></tr>
<tr><td>Physical</td><td>/</td><td rowspan="4">ECHA (notif.)</td><td>No hazards</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td rowspan="3">Health</td><td>/</td><td>AT oral cat. 4</td><td rowspan="3">  </td><td>Warning</td><td>H302</td></tr>
<tr><td>/</td><td>Skin irrit. cat. 2</td><td>Danger</td><td>H315</td></tr>
<tr><td>/</td><td>Eye irrit. cat. 2</td><td>Warning</td><td>H319</td></tr>
<tr><td colspan="7">EtOH (n° CAS 64-17-5)</td></tr>
<tr><td>Physical</td><td>/</td><td rowspan="2">CLP (GHS)</td><td>Flam. liq. cat. 2</td><td>  </td><td>Danger</td><td>H225</td></tr>
<tr><td>Health</td><td>/</td><td>Eye irrit. cat. 2</td><td>  </td><td>Warning</td><td>H319</td></tr>
<tr><td colspan="7">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="7">1 g bromothymol blue in 1L, that is a 0.1% bromothymol blue and 20% ethanol aqueous solution.</td></tr>
<tr><td>Physical</td><td>Flammability: No threshold in the Annex VI, it must be determined by a measure or extrapolation.</td><td>As per literature, FP (EtOH at 20%) ≈ 26°C → Flam. liq. cat.3</td><td>  </td><td>Warning</td><td>H226</td></tr>
<tr><td rowspan="2">Health</td><td>AT oral</td><td>100/ATE = 0.1/500
→ ATE= 10^5 → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td>Skin & eye irrit.</td><td>Vol. 2, tab. 2.2.1 & 2.3.2:
$C_{ethanol}$ > 10% → cat. 2</td><td>  </td><td>Warning</td><td>H315
H319</td></tr>
<tr><td colspan="7">Labelling for the 0.1% bromothymol blue and 20% ethanol aqueous solution:</td></tr>
<tr><td colspan="4">Pictograms</td><td colspan="3">Signal word</td></tr>
<tr><td colspan="4">  </td><td colspan="3">WARNING</td></tr>
</table>

Characterization of an alcoholic solution of green bromocresol.
Only the hazards *flammable* and *skin irritation and eye irritation* will be considered here.

<table>
<tr><td colspan="7">Green bromocresol (n° CAS 76-60-8)</td></tr>
<tr><td>Hazards</td><td>Specific concentrations, M-factor (CLP annex VI) or other available data</td><td>As per authorities</td><td>Hazard categories and classes</td><td>Pictogram</td><td>Signal word</td><td>Hazard statement</td></tr>
<tr><td rowspan="2">Health</td><td>/</td><td rowspan="2">ECHA (notif.)</td><td>Skin irrit. cat. 2</td><td rowspan="2">  </td><td rowspan="2">Warning</td><td>H315</td></tr>
<tr><td>/</td><td>Eye irrit. cat. 2</td><td>H319</td></tr>
<tr><td colspan="7">EtOH (n° CAS 64-17-5)</td></tr>
<tr><td>Physical</td><td>/</td><td rowspan="2">CLP (GHS)</td><td>Flam. liq. cat. 2</td><td>  </td><td>Danger</td><td>H225</td></tr>
<tr><td>Health</td><td>/</td><td>Eye irrit. cat. 2</td><td>  </td><td>Warning</td><td>H319</td></tr>
<tr><td colspan="7">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="7">1g green bromocresol in 1L, that is a 0.1% green bromocresol and 20% ethanol aqueous solution.</td></tr>
<tr><td>Physical</td><td>Flammability: No threshold in the Annex VI, it must be determined by a measure or extrapolation.</td><td colspan="2">As per literature, FP (EtOH at 20%) ≈ 26°C → Flam. liq. cat.3</td><td>  </td><td>Warning</td><td>H226</td></tr>
<tr><td>Health</td><td>Skin & eye irrit.</td><td colspan="2">Vol. 2, tab. 2.2.1:
$C_{éthanol}$ > 10% → cat. 2</td><td>  </td><td>Warning</td><td>H315
H319</td></tr>
<tr><td colspan="7">Labelling for the 0.1% green bromocresol and 20% ethanol aqueous solution:</td></tr>
<tr><td colspan="4">Pictograms</td><td colspan="3">Signal word</td></tr>
<tr><td colspan="4">  </td><td colspan="3">WARNING</td></tr>
<tr><td colspan="7">0.03 g green bromocresol in 1L water, that is a 3.10^{-3} % green bromocresol solution.</td></tr>
<tr><td>Health</td><td>Skin & eye irrit.</td><td colspan="2">Vol. 2, tab. 2.2.1 & 2.3.2:
C < 1% → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td colspan="7">Labelling for the 3.10^{-3} % green bromocresol aqueous solution</td></tr>
<tr><td colspan="4">Pictogram</td><td colspan="3">Signal word</td></tr>
<tr><td colspan="4">/</td><td colspan="3">/</td></tr>
</table>

2.2.2 Skin corrosion

Example 1: Determine the classification of the mixture using the following information:

Ingredient	Concentration (%)	Skin hazard	Data on	
			The ingredient	The mixture
1	4	Category 1	pH= 1.8	pH= 4
2	5	Category 2	/	
3	5	Category 3	/	
4	86	/	Not available	

Answer:
The mixture is classified as skin corrosive category 1 because ingredient 1 is present in a concentration superior to 1%. Although, according to table 2.2.1 (Vol. 2, p.41) it corresponds to a classification in cat. 2., the pH of this ingredient indicates 1.8, so the "additivity" calculation is not the most appropriate given remark 1 (see next page). Given the little available information, the mixture will be classified by a more conservative approach. Without information on the action mechanism of the ingredient 1, the mixture could be a corrosive without taking account of the pH of the mixture. Thus, the criterion of the remark 1 *"a mixture containing corrosive or irritant ingredients who cannot be classified using the additivity approach explained in table 2.2.1 due to its chemical characteristics must be classified in cat. 1 if the concentration of one of its corrosive ingredients exceed 1%, and is classified in category 2/3 if the concentration of one of its irritant ingredients exceed 3%"* applies.

→ The mixture is classified as **skin corrosive category 1**.

The label will include the pictogram  , the signal word *Danger* and the hazard statement *Causes severe skin burns and eye damages* (H314).

Example 2: Classification of mixtures containing corrosives/irritants ingredients for the skin:

Ingredient 1	Ingredient 2	Ingredient 3	Mixture classified as
Skin hazard category 1A	Skin hazard category 1B	Skin hazard category 1C	Skin corrosion category 1B because 4+1=5%
4%	1%	1%	
3%	1%	1%	Skin corrosion category 1C because 3+1 ≤ 5 but 3+1+1=5%
Skin hazard category 1A	Skin hazard category 2	/	Skin irritation category 2 because (10x0.5)+6 ≥ 10
0.5%	6%		

Example 3: Classification of mixtures containing corrosives/irritants ingredients for the skin:

Mixture M	Concentration (%)	Skin irritation
Ingredient 1	95	/
Ingredient 2	0.5	Category 1
Ingredient 3	0.4	Category 1
Ingredient 4	4.1	Category 2

The sum of the Cat. 1 ingredients = 0.5 + 0.4 = 0.9% (< 1%) and the sum of the Cat. 2 ingredients = 4.1% (< 10%), but the total sum = (10 x 0.9) + 4.1= 13.1% (> 10%).

Conclusion: This mixture is classified as **skin irritant category 2**.

The label will wear the pictogram  , the Signal word *Warning* and the hazard statement *Cause skin irritation* (H315).

***Remark 1*:** One must be particularly careful for the classification of certain categories of chemicals such as acids, bases, inorganic salts, aldehydes, phenols and surfactants (see remarks in Chapters 2.2 and 2.3, Vol. 2, p.45).

Characterization of an aqueous solution of hydrochloric acid (M(HCl) = 36.46 g/mol).
Only the hazards *corrosive to metals, skin corrosion* and *skin and eye irritation* will be considered here.

<table>
<tr><th colspan="7">Hydrochloric acid (n° CAS 7647-01-0)</th></tr>
<tr><td>Hazards</td><td>Specific concentrations, M-factor (CLP annex VI) or other available data</td><td>As per authorities</td><td>Hazard categories and classes</td><td>Pictogram</td><td>Signal word</td><td>Hazard statement</td></tr>
<tr><td>Physical</td><td>/</td><td rowspan="4">CLP (GHS)</td><td>C > 0.1% →Corrosive to metals cat. 1</td><td>  </td><td>Warning</td><td>H290</td></tr>
<tr><td rowspan="3">Health</td><td>C ≥ 25%</td><td>Skin corr. cat. 1B</td><td>  </td><td>Danger</td><td>H314</td></tr>
<tr><td rowspan="2">10% ≤ C < 25%</td><td>Skin irrit. cat. 2</td><td rowspan="2"></td><td rowspan="2"></td><td>H315</td></tr>
<tr><td>Eye irrit. cat. 2</td><td>H319</td></tr>
<tr><td colspan="7">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="7">0.1 M (14.6g ≡ 1.46/4=0.36%) in 1L H_2O or
0.1 M HCl corresponds to 0.1x36.46= 3.6 g in 1L water, that is 0.36% HCl.</td></tr>
<tr><td>Physical</td><td>Corrosive to metals</td><td colspan="2">C > 0.1% → cat. 1</td><td>  </td><td>Warning</td><td>H290</td></tr>
<tr><td rowspan="2">Health</td><td>Skin & eye corrosion</td><td colspan="2">C < 10% → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td>Skin and eye irritation</td><td colspan="2">C < 10% → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td colspan="7">Labelling of the 0.1 M hydrochloric acid solution:</td></tr>
<tr><td colspan="4">Pictogram</td><td colspan="3">Signal word</td></tr>
<tr><td colspan="4">  </td><td colspan="3">WARNING</td></tr>
</table>

Characterization of an aqueous solution of phosphoric acid ($M(H_3PO_4)$ = 98 g/mol; density = 1.71 g/cm^3). Only the hazards *corrosive to metals, skin corrosion* and *irritation* will be considered here.

<table>
<tr><th colspan="7">Phosphoric acid (n° CAS 7664-38-2)</th></tr>
<tr><td>Hazards</td><td>Specific concentrations, M-factor (CLP annex VI) or other available data</td><td>As per authorities</td><td>Hazard categories and classes</td><td>Pictogram</td><td>Signal word</td><td>Hazard statement</td></tr>
<tr><td rowspan="2">Physical</td><td rowspan="2">/</td><td rowspan="4">CLP (GHS)</td><td>No hazards</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td>Corr. to met. cat. 1</td><td rowspan="2">  </td><td>Warning</td><td>H290</td></tr>
<tr><td rowspan="2">Health</td><td>C ≥ 25%</td><td>Skin corr. cat. 1B</td><td>Danger</td><td>H314</td></tr>
<tr><td>10% ≤ C < 25%</td><td>Skin irrit. cat. 2</td><td rowspan="2">  </td><td rowspan="2">Warning</td><td>H315</td></tr>
<tr><td>Eye irrit. cat. 2</td><td>H319</td></tr>
<tr><td colspan="7">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="7">0.5 M → 0.5x98= 49 g in1 L H_2O, that is a 4.9% phosphoric acid aqueous solution.</td></tr>
<tr><td>Physical</td><td>Corr. to metals</td><td colspan="2">No threshold, but similar solution with no reported corrosion to metals</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td>Health</td><td>Skin Corr./Irrit.</td><td colspan="2">C < 10% → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td colspan="7">Labelling of the 0.5 M phosphoric acid aqueous solution:</td></tr>
<tr><td colspan="4">Pictogram</td><td colspan="3">Signal word</td></tr>
<tr><td colspan="4">/</td><td colspan="3">/</td></tr>
</table>

HEALTH HAZARDS

Characterization of an aqueous solution of sulfuric acid ($M(H_2SO_4)$ = 98.08 g/mol; density = 1.83 g/cm^3). Only the hazards *corrosive to metals, skin corrosion* and *skin and eye irritation* will be considered here.

<table>
<tr><th colspan="7">Sulfuric acid (n° CAS 7664-93-9)</th></tr>
<tr><td>Hazards</td><td>Specific concentrations, M-factor (CLP annex VI) or other available data</td><td>As per authorities</td><td>Hazard categories and classes</td><td>Pictogram</td><td>Signal word</td><td>Hazard statement</td></tr>
<tr><td rowspan="2">Physical</td><td rowspan="2">/</td><td rowspan="5">CLP (SGH)</td><td>Pas de danger</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td>Corr. to met. cat. 1</td><td rowspan="2">  </td><td>Warning</td><td>H290</td></tr>
<tr><td rowspan="3">Health</td><td>C ≥ 15%</td><td>Skin corr. cat. 1A</td><td>Danger</td><td>H314</td></tr>
<tr><td rowspan="2">5% ≤ C < 15%</td><td>Skin Irrit. cat. 2</td><td rowspan="2">  </td><td rowspan="2">Warning</td><td>H315</td></tr>
<tr><td>Eye Irrit. cat. 2</td><td>H319</td></tr>
<tr><td colspan="7">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="7">2 M → 2x98.08= 196.16g in 1 L H_2O, that is a 19.6% sulfuric acid aqueous solution.</td></tr>
<tr><td>Physical</td><td>Corr. to metals</td><td colspan="2">No threshold, but similar solution with no reported corrosion to metals</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td>Health</td><td>Skin Corr./Irrit.</td><td colspan="2">C > 15% → corr. cat. 1A</td><td>  </td><td>Danger</td><td>H314</td></tr>
<tr><td colspan="7">Labelling of the 2 M sulfuric acid solution</td></tr>
<tr><td colspan="4">Pictogram</td><td colspan="3">Signal word</td></tr>
<tr><td colspan="4">  </td><td colspan="3">DANGER</td></tr>
</table>

Characterization of aqueous solutions of sodium hydroxide (M(NaOH) = 40.01 g/mol).
Only the hazards *corrosive to metals, skin corrosion* and *skin and eye irritation* will be considered here.

<table>
<tr><th colspan="7">Sodium hydroxide (n° CAS 1310-73-2)</th></tr>
<tr><td>Hazards</td><td>Specific concentrations, M-factor (CLP annex VI) or other available data</td><td>As per authorities</td><td>Hazard categories and classes</td><td>Pictogram</td><td>Signal word</td><td>Hazard statement</td></tr>
<tr><td>Physical</td><td>/</td><td rowspan="5">CLP (GHS)</td><td>C > 1% → corr. to met. cat. 1</td><td rowspan="3">  </td><td>Warning</td><td>H290</td></tr>
<tr><td rowspan="3">Health</td><td>C ≥ 5%</td><td>Skin corr. cat. 1A</td><td rowspan="2">Danger</td><td rowspan="2">H314</td></tr>
<tr><td>2% ≤ C < 5%</td><td>Skin corr. cat. 1B</td></tr>
<tr><td>0.5% ≤ C < 2%</td><td>Skin irrit. cat. 2</td><td rowspan="2">  </td><td rowspan="2">Warning</td><td>H315</td></tr>
<tr><td>Eye irrit. cat. 2</td><td>H319</td></tr>
<tr><td colspan="7">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="7">0.1 M → 0.1x40= 4 g in 1 L H_2O, that is a 0.4% sodium hydroxide aqueous solution.</td></tr>
<tr><td>Physical</td><td>Corr. to metals</td><td colspan="2">C < 1% → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td>Health</td><td>Corr./Irrit.</td><td colspan="2">C < 0.5% → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td colspan="7">Labelling of the 0.4% sodium hydroxide solution:</td></tr>
<tr><td colspan="3">Pictogram</td><td colspan="4">Signal word</td></tr>
<tr><td colspan="3">/</td><td colspan="4">/</td></tr>
<tr><td colspan="7">2 M → 2x40= 80 g in 1 L H_2O, that is an 8% sodium hydroxide aqueous solution.</td></tr>
<tr><td>Physical</td><td>Corr. to metals</td><td colspan="2">C > 1% → cat. 1</td><td rowspan="2">  </td><td>Warning</td><td>H290</td></tr>
<tr><td>Health</td><td>Corr./Irrit.</td><td colspan="2">C > 5% → cat. 1A</td><td>Danger</td><td>H314</td></tr>
<tr><td colspan="7">Labelling of the 8% sodium hydroxide solution:</td></tr>
<tr><td colspan="3">Pictogram</td><td colspan="4">Signal word</td></tr>
<tr><td colspan="3">  </td><td colspan="4">DANGER</td></tr>
</table>

Characterization of an aqueous solution of glutamic acid (M(glutamic acid.HCl) = 183.6 g/mol).
Only the hazards *skin irritation* and *eye irritation* will be considered here.

<table>
<tr><th colspan="7">Glutamic acid.HCl (n° CAS 138-15-8)</th></tr>
<tr><td>Hazards</td><td>Specific concentrations, M-factor (CLP annex VI) or other available data</td><td>As per authorities</td><td>Hazard categories and classes</td><td>Pictogram</td><td>Signal word</td><td>Hazard statement</td></tr>
<tr><td>Health</td><td>/</td><td>CLP (GHS)</td><td>Skin corr. cat. 1A</td><td>  </td><td>Danger</td><td>H314</td></tr>
<tr><td colspan="7">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="7">0.1M, or 18.36 g glutamic acid in 1 L H_2O, that is a 1.84% aqueous solution.</td></tr>
<tr><td rowspan="2">Health</td><td>Skin Irrit.</td><td rowspan="2">CLP (GHS)</td><td>Vol. 2, tab. 2.2.1: 5% > C ≥ 1% → cat. 2</td><td rowspan="2">  </td><td rowspan="2">Warning</td><td>H315</td></tr>
<tr><td>Eye Irrit.</td><td>Vol. 2, tab. 2.3.2: 3% > C ≥ 1% → cat. 2</td><td>H319</td></tr>
<tr><td colspan="7">Labelling of the 0.1M glutamic acid aqueous solution:</td></tr>
<tr><td colspan="4">Pictogram</td><td colspan="3">Signal word</td></tr>
<tr><td colspan="4">  </td><td colspan="3">WARNING</td></tr>
</table>

2.3 Serious eye damage / eye irritation

2.3.1 Eye irritation

Characterization of an aqueous solution of ethylenediaminetetraacetic acid (M(EDTA) = 372.24 g/mol). Only the hazard *eye irritation* will be considered here.

Ethylenediaminetetraacetic acid (n° CAS 60-00-4)						
Hazards	Specific concentrations, M-factor (CLP annex VI) or other available data	As per authorities	Hazard categories and classes	Pictogram	Signal word	Hazard statement
Health	/	CLP (GHS)	Eye irrit. cat. 2		Warning	H319
Reasoning for the categorization and classification of the mixture:						
0.02 M means 7.45g EDTA in 1 L H_2O, that is a 0.7% aqueous solution.						
Health	Eye irrit.	CLP (SGH)	Vol. 2, tab. 2.3.2: C < 10% → out cat.	/	/	/
Labeling of the 0.02 M EDTA aqueous solution:						
Pictogram				Signal word		
/				/		

See also examples in the *Skin irritation* section (section 2.2.1).

2.3.2 Serious eye damage

Example of classification of a hazardous mixture M for the eyes when the additivity approach does not apply:

Mixture M	Concentration (%)	Eye corrosion/ irritation	Information on ingredient
Ingredient 1	0.5	Category 1	/
Ingredient 2	3.5	Category 2	Surfactant
Ingredient 3	15	/	/
Ingredient 4	15	/	/
Ingredient 5	66	/	No data

According to table 2.3.2 (Vol. 2, p.44), the category 1 ingredient is present at 0.5%, thus < 1% → mixture M is not corrosive to the eye:

- Sum of cat. 2 ingredients = 3.5% (< 10%),
- Sum of all ingredients (corrosives and irritants) = 10 x 0.5 + 3.5 = 8.5% (< 10%).

But the ingredient of category 2 is a surfactant present a concentration of 3.5%, thus > 3% which influence the classification according to table 2.3.3 (Vol. 2, p.45) → this mixture with 5 ingredients is thus an **eye irritant of category 2.**

The label will contain the pictogram  , the signal word *Warning* and the hazard statement *Causes serious eye irritation* (H319).

Characterization of an aqueous solution of sodium bicarbonate (saturated solution = 87g/L; M= 84g/mol).
Only the hazards *acute toxicity, skin irritation* and *eye damage* will be considered here.

<table>
<tr><td colspan="7">Sodium bicarbonate (n° CAS 144-55-8)</td></tr>
<tr><td>Hazards</td><td>Specific concentrations, M-factor (CLP annex VI) or other available data</td><td>As per authorities</td><td>Hazard categories and classes</td><td>Pictogram</td><td>Signal word</td><td>Hazard statement</td></tr>
<tr><td rowspan="3">Health</td><td>/</td><td rowspan="3">ECHA (reported)</td><td>AT oral cat. 4</td><td rowspan="2">  </td><td rowspan="2">Warning</td><td>H332</td></tr>
<tr><td>/</td><td>Skin irrit. cat. 2</td><td>H315</td></tr>
<tr><td>/</td><td>Eye dam. cat. 1</td><td>  </td><td>Danger</td><td>H318</td></tr>
<tr><td colspan="7">H_2O (n° CAS 7732-18-5)</td></tr>
<tr><td>Physical</td><td>/</td><td rowspan="2">CLP (GHS)</td><td>No hazards</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td>Health</td><td>/</td><td>No hazards</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td colspan="7">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="7">Saturated aqueous solution thus 87 g/L (1,03M), that is an 8.7% sodium bicarbonate aqueous solution.</td></tr>
<tr><td>Physical</td><td>/</td><td colspan="2">CLP (GHS)</td><td>No hazards</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td rowspan="3">Health</td><td>AT oral</td><td colspan="2">100/ATE = 8.7/500
→ ATE= 5747 → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td>Skin irrit.</td><td colspan="2">Vol. 2, tab. 2.2.1:
1% < C < 10% → cat. 3</td><td>/</td><td>Warning</td><td>H316</td></tr>
<tr><td>Eye corr. & irrit.</td><td colspan="2">Vol. 2, tab. 2.3.2:
C > 3% → cat. 1</td><td>  </td><td>Danger</td><td>H318</td></tr>
<tr><td colspan="7">Labelling of the 8.7% sodium bicarbonate solution:</td></tr>
<tr><td colspan="4">Pictogram</td><td colspan="3">Signal word</td></tr>
<tr><td colspan="4">  </td><td colspan="3">DANGER</td></tr>
</table>

Characterization of arginin solutions (M(arginin) = 174.2 g/mol).
Only the hazards *corrosive to metals, skin irritation, eye irritation* and *eye damage* will be considered here.

<table>
<tr><td colspan="7">Arginin (n° CAS 74-79-3)</td></tr>
<tr><td>Hazards</td><td>Specific concentrations, M-factor (CLP annex VI) or other available data</td><td>As per authorities</td><td>Hazard categories and classes</td><td>Pictogram</td><td>Signal word</td><td>Hazard statement</td></tr>
<tr><td rowspan="2">Health</td><td>/</td><td rowspan="2">ECHA (reported)</td><td>Skin irrit. cat. 2</td><td rowspan="2">  </td><td rowspan="2">Warning</td><td>H315</td></tr>
<tr><td>/</td><td>Eye irrit. cat. 2</td><td>H319</td></tr>
<tr><td colspan="7">HCl (n° CAS 7647-01-0)</td></tr>
<tr><td>Physical</td><td>/</td><td rowspan="4">CLP (GHS)</td><td>C > 0.1% → Corr. to metals cat. 1</td><td rowspan="4">  </td><td>Warning</td><td>H290</td></tr>
<tr><td rowspan="3">Health</td><td>C ≥ 25%</td><td>Skin corr. cat. 1B</td><td>Danger</td><td>H314</td></tr>
<tr><td rowspan="2">25% > C ≥ 10%</td><td>Skin irrit. cat. 2</td><td rowspan="2"></td><td>H315</td></tr>
<tr><td>Eye irrit. cat. 2</td><td>H319</td></tr>
<tr><td colspan="7">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="7">0.04 M = 6.97 g arginin in 1 L H_2O, that is a 0.7% aqueous solution.</td></tr>
<tr><td>Health</td><td>Eye irrit.</td><td colspan="2">Vol. 2, tab. 2.3.2:
$C_{arginine}$ < 10% → hors cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td colspan="7">Labelling of the 0.7% arginin solution:</td></tr>
<tr><td colspan="3">Pictogram</td><td colspan="4">Signal word</td></tr>
<tr><td colspan="3">/</td><td colspan="4">/</td></tr>
<tr><td colspan="7">0.05 M = 8.72 g arginin in 1 L H_2O, that is a 0.87% aqueous solution.
0.1 M HCl corresponds to 0.1x36.46= 3.6 g in 1L water that is a 0.36% HCl solution.</td></tr>
<tr><td>Physical</td><td>Corr. to metals</td><td colspan="2">C_{HCl} ≥ 0.1% → cat. 1</td><td>  </td><td>Warning</td><td>H290</td></tr>
<tr><td rowspan="3">Health</td><td>Eye irrit.</td><td colspan="2">Vol. 2, tab. 2.3.2:
$C_{a.a.}$ < 10% → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td>Skin corr.</td><td colspan="2">C_{HCl} < 10% → out cat.</td><td rowspan="2">/</td><td rowspan="2">/</td><td rowspan="2">/</td></tr>
<tr><td>Eye Corr. & Irrit.</td><td colspan="2">C_{HCl} < 10% → out cat.</td></tr>
<tr><td colspan="7">Labelling of the 0.87% arginin and 0.36% HCl solution:</td></tr>
<tr><td colspan="3">Pictogram</td><td colspan="4">Signal word</td></tr>
<tr><td colspan="3">  </td><td colspan="4">WARNING</td></tr>
</table>

Characterization of an aqueous solution of potassium thiocyanate (M(KSCN) = 97.18 g/mol).
Only the hazards *acute toxicity* and *eye damages* will be considered here.

<table>
<tr><td colspan="7">Potassium thiocyanate (n° CAS 333-20-0)</td></tr>
<tr><td>Hazards</td><td>Specific concentrations, M-factor (CLP annex VI) or other available data</td><td>As per authorities</td><td>Hazard categories and classes</td><td>Pictogram</td><td>Signal word</td><td>Hazard statement</td></tr>
<tr><td rowspan="4">Health</td><td>/</td><td rowspan="3">CLP (GHS)</td><td>AT oral cat. 4</td><td rowspan="3">  </td><td rowspan="3">Warning</td><td>H302</td></tr>
<tr><td>/</td><td>AT inhal. cat. 4</td><td>H330</td></tr>
<tr><td>/</td><td>AT skin cat. 4</td><td>H312</td></tr>
<tr><td>/</td><td>REACH</td><td>Eye dam. cat. 1</td><td>  </td><td>Danger</td><td>H318</td></tr>
<tr><td colspan="7">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="7">0.002 M solution of KSCN, that is a 0.02% solution:</td></tr>
<tr><td rowspan="5">Health</td><td>AT oral</td><td>100/ATE= 0.02/500 →ATE= 25.10^5 → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td>AT inhal. (vapors)</td><td>100/ATE= 0.02/11 → ATE= 55000 → cat. 5</td><td colspan="3" rowspan="2">The category 5 contains chemicals that are relatively low toxics, but which can become dangerous for vulnerable populations under specific conditions.</td></tr>
<tr><td>AT inhal. (aerosols)</td><td>100/ATE= 0.02/1.5 → ATE= 7500 → cat. 5</td></tr>
<tr><td>AT skin</td><td>100/ATE= 0.02/1100 → ATE= 55.10^5 → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td>Eye corr. & irrit.</td><td>Vol. 2, tab. 2.3.2: 10xC < 10% → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td colspan="7">Labelling of the 0.002 M potassium thiocyanate solution:</td></tr>
<tr><td colspan="3">Pictogram</td><td colspan="4">Signal word</td></tr>
<tr><td colspan="3">/</td><td colspan="4">/</td></tr>
</table>

Characterization of an aqueous solution of pentahydrate sodium thiosulfate.
Only the hazards *acute toxicity, skin irritation* and *eye damages* will be considered here.

<table>
<tr><td colspan="7">Sodium bicarbonate (n° CAS 144-55-8)</td></tr>
<tr><td>Hazards</td><td>Specific concentrations, M-factor (CLP annex VI) or other available data</td><td>As per authorities</td><td>Hazard categories and classes</td><td>Pictogram</td><td>Signal word</td><td>Hazard statement</td></tr>
<tr><td rowspan="3">Health</td><td rowspan="3">/</td><td rowspan="3">ECHA (reported)</td><td>AT oral cat. 4</td><td rowspan="2">  </td><td rowspan="2">Warning</td><td>H332</td></tr>
<tr><td>Skin irrit. cat. 2</td><td>H315</td></tr>
<tr><td>Eye corr. cat. 1</td><td>  </td><td>Danger</td><td>H318</td></tr>
<tr><td colspan="7">Pentahydrate sodium thiosulfate (n° CAS 10102-17-7)</td></tr>
<tr><td>Physical</td><td>/</td><td rowspan="3">CLP (GHS) & ECHA</td><td>/</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td>Health</td><td>/</td><td>/</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td>Environmental</td><td>/</td><td>/</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td colspan="7">H_2O (n° CAS 7732-18-5)</td></tr>
<tr><td>Physical</td><td>/</td><td rowspan="3">CLP (GHS)</td><td>/</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td>Health</td><td>/</td><td>/</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td>Environmental</td><td>/</td><td>/</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td colspan="7">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="7">1g $NaHCO_3$ in 1L H_2O, that is a 0.1% aqueous solution.</td></tr>
<tr><td rowspan="3">Health</td><td>AT</td><td colspan="2">100/ATE= 0.1/500 → ATE= 5.10^5 → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td>Skin irrit.</td><td colspan="2">Vol. 2, tab. 2.2.1:
10xC = 1% → cat. 3</td><td>/</td><td>Warning</td><td>H316</td></tr>
<tr><td>Eye corr. & irrit.</td><td colspan="2">Vol. 2, tab. 2.3.2:
10xC < 10% → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td colspan="7">Labelling of the 2.5% sodium thiosulfate and 0.1% sodium bicarbonate solution:</td></tr>
<tr><td colspan="4">Pictogram</td><td colspan="3">Signal word</td></tr>
<tr><td colspan="4">/</td><td colspan="3">WARNING</td></tr>
</table>

Characterization of amino acids solution.

Only the hazards *corrosive to metals*, *skin corrosion, skin and eye irritation* and *eye damage* will be considered here.

<table>
<tr><th colspan="7">L form amino acids</th></tr>
<tr><td colspan="4">Alanin (n° CAS 302-72-7): no hazards</td><td colspan="3">Glycin (n° CAS 56-40-6): no hazards</td></tr>
<tr><td colspan="4">Histidin (n° CAS 4998-57-6): no hazards</td><td colspan="3">Lysin (n° CAS 70-54-2): no hazards</td></tr>
<tr><td colspan="4">Phénylalanin (n° CAS 150-30-1): no hazards</td><td colspan="3">Prolin (n° CAS 609-36-9): no hazards</td></tr>
<tr><td colspan="4">Valin (n° CAS 515-06-3): no hazards</td><td colspan="3"></td></tr>
<tr><td colspan="7">The water and amino acids (a.a.) mentioned in this table are not classified as hazardous according to the CLP. These a.a. are absent from the annex VI. They do not alter the corrosive or irritating properties of the mixtures described here. Thus, these a.a. won't be accounted for when classifying the mixtures.</td></tr>
<tr><th colspan="7">HCl (n° CAS 7647-01-0)</th></tr>
<tr><td>Hazards</td><td>Specific concentrations, M-factor (CLP annex VI) or other available data</td><td>As per authorities</td><td>Hazard categories and classes</td><td>Pictogram</td><td>Signal word</td><td>Hazard statement</td></tr>
<tr><td>Physical</td><td>/</td><td rowspan="4">CLP (GHS)</td><td>C > 0.1%
→ corr. to metals cat. 1</td><td rowspan="4">  </td><td>Warning</td><td>H290</td></tr>
<tr><td rowspan="3">Health</td><td>C ≥ 25%</td><td>Skin corr. cat. 1B</td><td>Danger</td><td>H314</td></tr>
<tr><td rowspan="2">10% ≤ C < 25%</td><td>Skin irrit. cat. 2</td><td></td><td>H315</td></tr>
<tr><td>Eye irrit. cat. 2</td><td></td><td>H319</td></tr>
<tr><td colspan="7">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="7">0.1 M hydrochloric acid corresponds to 0.1 x 36.46 g/mol, that is 3.65 g/L, that is 0.36% aqueous solution.</td></tr>
<tr><td>Physical</td><td>Corr. to metals</td><td colspan="2">C ≥ 0.1% → cat. 1</td><td>  </td><td>Warning</td><td>H290</td></tr>
<tr><td rowspan="2">Health</td><td>Skin corr.</td><td colspan="2">C < 10% → out cat.</td><td rowspan="2">/</td><td rowspan="2">/</td><td rowspan="2">/</td></tr>
<tr><td>Eye corr.</td><td colspan="2">C < 10% → out cat.</td></tr>
<tr><td colspan="7">Labelling of the aqueous acidic solutions of a.a.:</td></tr>
<tr><td colspan="4">Pictogram</td><td colspan="3">Signal word</td></tr>
<tr><td colspan="4">  </td><td colspan="3">WARNING</td></tr>
</table>

2.4 Respiratory or skin sensitization

Characterization of a potassium dichromate solution ($M(K_2Cr_2O_7)$ = 294.18 g/mol).
Only the hazards *oxidizer*, *acute toxicity, skin corrosion, respiratory and skin sensitization* will be considered here.

Potassium dichromate (n° CAS 7778-50-9)						
Hazards	Specific concentrations, M-factor (CLP annex VI) or other available data	As per authorities	Hazard categories and classes	Pictogram	Signal word	Hazard statement
Physical	/	CLP (GHS)	Solid oxidizer cat. 2		Danger	H272
Health	/		AT oral cat. 3			H301
	/		AT inhal. cat. 2			H330
	/		Skin AT cat. 4		Warning	H312
	/		Skin corr. 1B		Danger	H314
	/		Resp. sens. 1			H334
			Skin sens. 1		Warning	H317

(reasoning and results on the next page).

Characterization of a potassium dichromate solution (results).

<table>
<tr><td colspan="6">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="6">74 g $K_2Cr_2O_7$ in 700 mL distilled H_2O, add 150 mL H_2SO_4 96%. Complete to 1 L with distilled H_2O
It comes back to a solution of 74 g so to 7.4% $K_2Cr_2O_7$
and 150mL H_2SO_4 ≡ 150 x 1.83= 274.5 g so 27.4% H_2SO_4.</td></tr>
<tr><td>Physical</td><td>Oxidizer ?</td><td colspan="4">If no other comparable and categorized substance exists, one cannot make an extrapolation and testing is the only way.</td></tr>
<tr><td rowspan="7">Health</td><td>AT oral</td><td>100/ATE = 7.4/100
→ ATE= 1351 → cat. 4</td><td>  </td><td>Warning</td><td>H302</td></tr>
<tr><td>AT inhal. (vapors)</td><td>100/ATE = 7.4/0.5
→ ATE= 6.7 → cat. 3</td><td rowspan="2">  </td><td rowspan="2">Danger</td><td rowspan="2">H331</td></tr>
<tr><td>AT inhal. (aerosols)</td><td>100/ATE = 7.4/0.05
→ ATE= 0.67 → cat. 3</td></tr>
<tr><td>Skin AT</td><td>100/ATE = 7.4/1100
→ ATE = $14{,}8.10^3$ → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td rowspan="2">Skin corr.</td><td>Vol. 2, tab. 2.2.1:
C > 5% → cat. 1A</td><td rowspan="2">  </td><td rowspan="2">Danger</td><td rowspan="2">H314</td></tr>
<tr><td>C_{H2SO4} ≥ 15 %, → cat. 1A</td></tr>
<tr><td>Resp. sens.</td><td>Vol. 2, tab. 2.4.1:
C ≥ 0.1% → cat. 1</td><td>  </td><td>Danger</td><td>H334</td></tr>
<tr><td>Skin sens.</td><td>Vol. 2, tab. 2.4.1:
C ≥ 0.1% → cat. 1</td><td>  </td><td>Warning</td><td>H317</td></tr>
<tr><td colspan="6">Labelling of the 0.25 M mixture:</td></tr>
<tr><td colspan="4">Pictograms</td><td colspan="2">Signal word</td></tr>
<tr><td colspan="4">  (if positive result)  </td><td colspan="2">DANGER</td></tr>
</table>

2.5. Carcinogenicity/ Mutagenicity/ Reproductive toxicity

2.5.1 Carcinogenicity

Characterization of an alcoholic solution of red methyl.
Only the hazards *carcinogenicity*, *flammable,* and *eye irritation* will be considered here.

<table>
<tr><th colspan="7">Red methyl (n° CAS 493-52-7)</th></tr>
<tr><td>Hazards</td><td>Specific concentrations, M-factor (CLP annex VI) or other available data</td><td>As per authorities</td><td>Hazard categories and classes</td><td>Pictogram</td><td>Signal word</td><td>Hazard statement</td></tr>
<tr><td>Health</td><td>/</td><td>ECHA (notif.)</td><td>C2</td><td>  </td><td>Warning</td><td>H351</td></tr>
<tr><th colspan="7">EtOH (n° CAS 64-17-5)</th></tr>
<tr><td>Physical</td><td>/</td><td rowspan="2">CLP (GHS)</td><td>Flam. liq. cat. 2</td><td>  </td><td>Danger</td><td>H225</td></tr>
<tr><td>Health</td><td>/</td><td>Eye irrit. cat. 2</td><td>  </td><td>Warning</td><td>H319</td></tr>
<tr><td colspan="7">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="7">1 g red methyl in 1L of a 60% ethanol aqueous solution, that is a 0.1% solution.</td></tr>
<tr><td>Physical</td><td>Flammability: No threshold in the Annex VI, it must be determined by a measure or extrapolation.</td><td colspan="2">As per literature, FP (EtOH at 60%) = 19.5°C and BP = 80.9°C → Flammable liq. cat. 2</td><td>  </td><td>Danger</td><td>H225</td></tr>
<tr><td rowspan="2">Health</td><td>Carcinogenicity</td><td colspan="2">Vol. 2, tab. 2.5.2:
C > 0.1% → C2</td><td>  </td><td>Warning</td><td>H351</td></tr>
<tr><td>Eye irrit.</td><td colspan="2">Vol. 2, tab. 2.3.2:
$C_{ethanol}$ > 10% → cat. 2</td><td>  </td><td>Warning</td><td>H319</td></tr>
<tr><td colspan="7">Labelling of the 60% ethanol and 0.1% red methyl aqueous solution:</td></tr>
<tr><td colspan="4">Pictograms</td><td colspan="3">Signal word</td></tr>
<tr><td colspan="4">  </td><td colspan="3">DANGER</td></tr>
</table>

2.5.2 Mutagenicity on germ cells

Characterization of a solution ammonium metavanadate.
Only the hazards *oxidizer*, *acute toxicity, eye irritation, skin sensitization* and *mutagenicity* will be considered here.

Ammonium metavanadate (n° CAS 7803-55-6)						
Hazards	Specific concentrations, M-factor (CLP annex VI) or other available data	As per authorities	Hazard categories and classes	Pictogram	Signal word	Hazard statement
Physical	/	CLP (GHS)	No hazard	/	/	/
Health	/		AT oral cat. 3		Danger	H301
	/		AT inhal. cat. 4		Warning	H332
	/		Eye irrit. cat. 2		Warning	H319
	/		Skin sens. cut. 1		Warning	H317
	/	ECHA (reported)	M2		Warning	H341
Nitric acid (n° CAS 7697-37-2)						
Physical	C ≥ 99%	CLP (GHS)	Oxid. liq. cat. 2		Danger	H272
	65% ≤ C < 99%		Oxid. liq. cat. 3		Warning	
Health	Skin corrosion		C ≥ 20 %→ cat. 1A		Danger	H314
			5% ≤ C < 20% → cat. 1B			

(reasoning and results on the next page).

Characterization of a solution ammonium metavanadate (results).

<table>
<tr><td colspan="6">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="6">2.5 g in 700 mL distilled lukewarm H_2O, add 20 mL HNO_3 65%. Complete to 1 L with distilled H_2O:
That gives a 0.25% NH_4VO_3 aqueous solution.
And 20 ml HNO_3 ≡ 20 x1.40 = 28 g so 2.8% HNO_3.</td></tr>
<tr><td>Physical</td><td>Oxidizing liquid</td><td>C_{HNO3} < 65% → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td rowspan="7">Health</td><td>AT oral</td><td>100/ATE= 0.25/100
→ ATE = 4.10^4 → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td>AT inhal.
(vapors)</td><td>100/ATE= 0.25/11
→ ATE= 4400 → cat. 5</td><td colspan="3" rowspan="2">The category 5 contains chemicals that are relatively low toxics but can become dangerous for vulnerable populations under specific conditions.</td></tr>
<tr><td>AT inhal.
(aerosols)</td><td>100/ATE= 0.25/1.5
→ ATE= 600 → cat. 5</td></tr>
<tr><td>Skin corrosion</td><td>Vol. 2, tab. 2.2.1:
10xC_{HNO3} + C_{Metav} > 10% → cat. 2</td><td rowspan="3">  </td><td rowspan="3">Warning</td><td>H315</td></tr>
<tr><td>Eye irritation</td><td>Vol. 2, tab. 2.3.2:
10xC_{HNO3} + C_{Metav} > 10% → cat. 2</td><td>H320</td></tr>
<tr><td>Skin sens.</td><td>Vol. 2, tab. 2.4.1:
C > 0.1% → cat. 1</td><td>H317</td></tr>
<tr><td>Mutagenicity</td><td>Vol. 2, tab. 2.5.2:
C_{Metav} < 1% → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td colspan="6">Labelling of the 0.25% ammonium metavanadate mixture:</td></tr>
<tr><td colspan="3">Pictograms</td><td colspan="3">Signal word</td></tr>
<tr><td colspan="3">  </td><td colspan="3">WARNING</td></tr>
</table>

2.5.3 Reproductive toxicity and/ or having a nefarious effect on the fetus or breastfeeding

Characterization of a solution of potassium tetraborate.
Only the hazard *reproductive toxicity* will be considered here.

Tetrahydrate potassium tetraborate (n° CAS 12045-78-2)						
Hazards	Specific concentrations, M-factor (CLP annex VI) or other available data	As per authorities	Hazard categories and classes	Pictogram	Signal word	Hazard statement
Health	/	CLP (SGH)	R2		Danger	H361
Reasoning for the categorization and classification of the mixture:						
122.2 g in 1L H_2O, that is a 12.2% potassium tetraborate aqueous solution.						
Health	Reproductive toxicity	Vol. 2, tab. 2.5.3: C > 0.1% → R2			Warning	H361
Labelling of the 0.4 M potassium tetraborate aqueous solution:						
Pictogram					Signal word	
					ATTENTION	

HEALTH HAZARDS

Characterization of an alcoholic solution of phenolphthalein.

Only the hazards *flammability*, *eye irritation, carcinogenicity, mutagenicity* and *reproductive toxicity* will be considered here.

<table>
<tr><td colspan="7">Phenolphtalein (n° CAS 77-09-8)</td></tr>
<tr><td>Hazards</td><td>Specific concentrations, M-factor (CLP annex VI) or other available data</td><td>As per authorities</td><td>Hazard categories and classes</td><td>Pictogram</td><td>Signal word</td><td>Hazard statement</td></tr>
<tr><td>Physical</td><td>/</td><td>ECHA</td><td>No hazard</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td rowspan="3">Health</td><td>C ≥ 1% : C1B</td><td rowspan="3">CLP (GHS)</td><td>C1B</td><td rowspan="3">  </td><td>Danger</td><td>H350</td></tr>
<tr><td>C ≥ 0.1% : M2</td><td>M2</td><td>Warning</td><td>H341</td></tr>
<tr><td>C ≥ 0.1% : R2</td><td>R2</td><td>Warning</td><td>H361
H362</td></tr>
<tr><td colspan="7">EtOH (n° CAS 64-17-5)</td></tr>
<tr><td>Physical</td><td>/</td><td rowspan="2">CLP (GHS)</td><td>Flam. liq. cat. 2</td><td>  </td><td>Danger</td><td>H225</td></tr>
<tr><td>Health</td><td>/</td><td>Eye irrit. cat. 2</td><td>  </td><td>Warning</td><td>H319</td></tr>
<tr><td colspan="7">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="7">1g in 1L so 0.1% phenolphtalein in a 50% ethanol aqueous solution.</td></tr>
<tr><td>Physical</td><td>Flammability: No threshold in the Annex VI, it must be determined by a measure or extrapolation.</td><td colspan="2">As per literature, FP (EtOH at 50%) = 19.5°C and BP = 88°C → Flam. liq. cat. 2</td><td>  </td><td>Danger</td><td>H225</td></tr>
<tr><td rowspan="4">Health</td><td>Carcinogenicity</td><td colspan="2">Vol. 2, tab. 2.5.2:
C < 1% → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td>Mutagenicity</td><td colspan="2">Vol. 2, tab. 2.5.2:
C ≥ 0.1% → cat. M2</td><td>  </td><td>Warning</td><td>H341</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="2">Vol. 2, tab. 2.5.3:
C ≥ 0.1% → cat. R2</td><td>  </td><td>Warning</td><td>H361
H362</td></tr>
<tr><td>Eye irritation</td><td colspan="2">Vol. 2, tab. 2.3.2:
C_{ETOH} > 10% → cat. 2</td><td>  </td><td>Warning</td><td>H319</td></tr>
<tr><td colspan="7">Labelling of the 0.1% phenolphtalein alcoholic solution:</td></tr>
<tr><td colspan="4">Pictograms</td><td colspan="3">Signal word</td></tr>
<tr><td colspan="4">  </td><td colspan="3">DANGER</td></tr>
</table>

HEALTH HAZARDS

Characterization of an alcoholic solution of thymolphtalein.

Only the hazards *flammability*, *acute toxicity, eye irritation, carcinogenicity, mutagenicity* and *reproductive toxicity* will be considered here.

Thymolphtalein (n° CAS 125-20-2)						
Hazards	Specific concentrations, M-factor (CLP annex VI) or other available data	As per authorities	Hazard categories and classes	Pictogram	Signal word	Hazard statement
Physical	/	ECHA (notif.)	Flam. liq. cat. 2		Danger	H225
Health	/		AT oral cat. 4		Warning	H302
	C ≥ 0.1%: C1B		C1B		Danger	H350
	C ≥ 0.1%: M2		M2		Warning	H341
	C ≥ 0.1%: R2		R2		Warning	H361 H362
EtOH (n° CAS 64-17-5)						
Physical	/	CLP (GHS)	Flam. liq. cat. 2		Danger	H225
Health	/		Eye irrit. cat. 2		Warning	H319
Reasoning for the categorization and classification of the mixture:						
1 g thymolphtalein in 1L ethanol, that is a 0.1% alcoholic solution.						
Physical	Flammability: No threshold in the Annex VI, it must be determined by a measure or extrapolation.	As per literature, FP (EtOH at 96%) <15°C and BP = 78°C → Flam. liq. cat. 2			Danger	H225
Health	AT oral	100/ATE = 0.1/500 → ATE= 5.10^5 → out cat.		/	/	/
	Carcinogenicity	Vol. 2, tab. 2.5.2: C ≥ 0.1% → cat. C1B			Danger	H350
	Mutagenicity	Vol. 2, tab. 2.5.2: C ≥ 0.1% → cat. M2			Warning	H341
	Reproductive toxicity	Vol. 2, tab. 2.5.3: C ≥ 0.1% →cat. R2			Warning	H361 H362
	Eye irritation	Vol. 2, tab. 2.3.2: $C_{ethanol}$ > 10% → cat. 2			Warning	H319
Labelling of the 0.1% thymolphtalein alcoholic solution:						
Pictograms				Signal word		
				DANGER		

2.6 Specific Target Organ Toxicity (STOT)

2.6.1 STOT – Single Exposure (STOT-SE)

Characterization of an alcoholic bromide solution (Kaufmann).

Only the hazards *flammability*, *acute toxicity, skin corrosion, eye irritation* and *STOT-SE* will be considered here.

<table>
<tr><th colspan="7">Sodium bromide (n° CAS 7647-15-6)</th></tr>
<tr><td>Hazards</td><td>Specific concentrations, M-factor (CLP annex VI) or other available data</td><td>As per authorities</td><td>Hazard categories and classes</td><td>Pictogram</td><td>Signal word</td><td>Hazard statement</td></tr>
<tr><td>Physical
Health</td><td>/</td><td>CLP & REACH</td><td>No hazard</td><td>/</td><td>/</td><td>/</td></tr>
<tr><th colspan="7">Bromide (n° CAS 7726-95-6)</th></tr>
<tr><td>Physical</td><td>/</td><td rowspan="3">CLP (GHS)</td><td>No hazard</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td rowspan="3">Health</td><td>/</td><td>AT inhal. cat. 2</td><td>  </td><td rowspan="3">Danger</td><td>H330</td></tr>
<tr><td>/</td><td>Skin corr. 1A</td><td rowspan="2">  </td><td>H314</td></tr>
<tr><td>/</td><td>ECHA</td><td>Eye corr. cat. 1</td><td>H318</td></tr>
<tr><th colspan="7">Methanol (n° CAS 67-56-1)</th></tr>
<tr><td>Physical</td><td>/</td><td rowspan="6">CLP (GHS)</td><td>Flam. liq. cat. 2</td><td>  </td><td rowspan="6">Danger</td><td>H225</td></tr>
<tr><td rowspan="5">Health</td><td>/</td><td>AT oral cat. 3</td><td rowspan="3">  </td><td>H301</td></tr>
<tr><td>/</td><td>AT inhal. cat. 3</td><td>H331</td></tr>
<tr><td>/</td><td>AT skin cat. 3</td><td>H311</td></tr>
<tr><td>C ≥ 10%</td><td>STOT-SE (optical nerv) cat. 1</td><td rowspan="2">  </td><td>H370</td></tr>
<tr><td>3% ≤ C < 10%</td><td>STOT-SE cat. 2</td><td>H371</td></tr>
</table>

(reasoning and results on the next page).

Characterization of an alcoholic bromide solution (Kaufmann) (results).

<table>
<tr><td colspan="6">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="6">13 g NaBr in 700 mL MeOH; add 5.1 mL x 3.12= 15.91 g bromide and complete to 1 L methanol → that is a 1.59% methanolic solution.</td></tr>
<tr><td rowspan="5">Health</td><td>AT inhal. (vapors)</td><td>100/ATE= 1.59/0.5
→ ATE= 31.4 → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td>AT inhal. (aerosols)</td><td>100/ATE= 1.59/0.05
→ ATE= 3.14 → cat. 4</td><td>  </td><td>Warning</td><td>H332</td></tr>
<tr><td>Skin corrosion</td><td>Vol. 2, tab. 2.2.1:
1% ≤ C < 5% → skin irrit. cat. 2</td><td rowspan="2">  </td><td rowspan="2">Warning</td><td>H315</td></tr>
<tr><td>Eye corrosion</td><td>Vol. 2, tab. 2.3.2:
1% ≤ C < 3% → eye irrit. cat. 2</td><td>H319</td></tr>
<tr><td>STOT-SE (optical nerv)</td><td>C_{MeOH} > 10% → cat. 1</td><td>  </td><td>Danger</td><td>H370</td></tr>
<tr><td colspan="6">Labelling of the methanolic mixture of Kaufmann:</td></tr>
<tr><td colspan="6">Although methanol is not pure, it is slightly modified and should then keep its flammability. To have the exact category, one should re-calculate or measure its new flash and boiling point (FP, BP, respectively). Since it is likely they both increase, we can choose a conservative approach and apply the flam. liq. cat. 2 of the pure liquid classification. This approach can also be used to health and environmental hazards. Indeed, the bromide addition does not allow reconsidering the hazard classificaiton of methanol.</td></tr>
<tr><td colspan="3">Pictograms</td><td colspan="3">Signal word</td></tr>
<tr><td colspan="3">  </td><td colspan="3">DANGER</td></tr>
</table>

2.6.2 STOT – Repeated Exposure (STOT-RE)

Characterization of orange-xylen.
Only the hazards *skin and eye irritation* and *STOT-RE* will be considered here.

Orange-xylen (n° CAS 3618-43-7)						
Hazards	Specific concentrations, M-factor (CLP annex VI) or other available data	As per authorities	Hazard categories and classes	Pictogram	Signal word	Hazard statement
Physical	/	CLP (GHS) & ECHA	No hazards	/	/	/
Health	/		No hazards	/	/	/
Environmental	/		No hazards	/	/	/
NaCl (n° CAS 7647-14-5)						
Physical	/	CLP (GHS)	No hazards	/	/	/
Health	Skin irritation		cat. 2		Warning	H315
	Eye irritation		cat. 2			H319
	STOT RE (irrit. resp.w.)	ECHA	cat. 2			H335
Reasoning for the categorization and classification of the mixture:						
1g in 1kg so 0.1% orange-xylen in sodium chloride.						
Health	Skin irrit.	Vol. 2, tab. 2.2.1: C < 10% → out. cat.		/	/	/
	Eye irrit.	Vol. 2, tab. 2.3.2: C < 10% → out. cat.				/
	STOT-RE (irrit. resp. w.)	Vol. 2, tab. 2.6.2: C < 1% → out. cat.				/
Labelling of the 0.1% orange-xylen mixture in sodium chloride						
Pictogram				Signal word		
/				/		

Characterization of a blue methylene solution.
Only the hazard *acute toxicity*, *skin and eye irritation*, and *STOT-RE & STOT-SE* will be considered here.

<table>
<tr><th colspan="7">Methylene blue (n° CAS 61-73-4)</th></tr>
<tr><td>Hazards</td><td>Specific concentrations, M-factor (CLP annex VI) or other available data</td><td>As per authorities</td><td>Hazard categories and classes</td><td>Pictogram</td><td>Signal word</td><td>Hazard statement</td></tr>
<tr><td rowspan="5">Health</td><td>/</td><td>CLP (GHS)</td><td>AT oral cat. 4</td><td rowspan="4">  </td><td rowspan="3">Warning</td><td>H302</td></tr>
<tr><td>/</td><td rowspan="4">ECHA (notif.)</td><td>Skin irrit. cat. 2</td><td>H315</td></tr>
<tr><td>/</td><td>Eye irrit. cat. 2</td><td>H319</td></tr>
<tr><td>/</td><td>STOT-SE (lungs) cat. 3</td><td>Warning</td><td>H335</td></tr>
<tr><td>/</td><td>STOT-RE (blood) cat. 2</td><td>  </td><td>Warning</td><td>H373</td></tr>
<tr><td colspan="7">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="7">1g methylene blue in 1L water, that is a 0.1% aqueous solution.</td></tr>
<tr><td rowspan="5">Health</td><td>AT oral</td><td>100/ATE= 0.1/500
→ ATE= 5.10^5 → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td>Skin irritation</td><td>Vol. 2, tab. 2.2.1:
C < 1% → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td>Eye irritation</td><td>Vol. 2, tab. 2.3.2:
C < 10% → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td>STOT-SE (lungs)</td><td colspan="4">Threshold values must be evaluated individually by an expert</td></tr>
<tr><td>STOT-RE (blood)</td><td>Vol. 2, tab. 2.6.2:
C < 1% → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td colspan="7">Labelling of the 0.1% methylene blue aqueous solution</td></tr>
<tr><td colspan="4">Pictogram</td><td colspan="3">Signal word</td></tr>
<tr><td colspan="4">  (if positive test for STOT-SE lungs)</td><td colspan="3">/</td></tr>
</table>

2.7 Danger par aspiration

Tests according to RTMD must be performed to determine the classification.

3. Environmental hazards

3.1 Hazardous to the aquatic environment (short and long term)

***Example 1*:** Classification of the mixture X including the ingredients stated below.

Ingredients	Acute toxicity	Chronic toxicity	Pictogram	Proportion of ingredient in mixture X
Ingredient 1	Cat. 1 with M= 10	Cat. 1 with M= 10		0.01%
Ingredient 2	Cat. 2	Cat. 2		1.0%
Ingredient 3	Not classified	Cat. 4	/	25%
Ingredient 4	Not classified			73.99%

All the needed data on the ingredients are not available. One must then apply the case C & D (Vol. 2, Fig. 3.1.2). Given the lack of the toxic concentration values, the addition formulae C-1 and C-2 cannot be applied. However, the mixture contains acute toxics I, II and chronic toxics I, II and IV. The multiplication factor M must then be applied (table 3.1.5 of Vol. 2) to the addition formulae (Vol. 2, tab. 3.1.3 and 3.1.4).

If one considers ingredient 1 as relevant despite its concentration <0.1%:

- Classification of mixture X being an acute toxic for the aquatic environment (AT_E) ?
- (AT^1_E cat. 1) x M = 0.01% x 10= 0.1% < 25% so the mixture is not an AT_E cat. 1.
- (M x 10 x AT^1_E cat. 1) + (AT^2_E cat. 2) = 10 x 10 x 0.01% + 1.0% = 2% so the mixture is not an AT_E cat. 2.
- (M x 100 x AT^1_E cat. 1) + (10 x AT^2_E cat. 2) + (AT_E cat. 3) =10 x 100 x 0.01% + (10 x 1.0%) + 0 = 20% so the mixture is not an AT_E cat. 3.

- Classification of mixture X being a chronic toxic for the aquatic environment (CT_E) ?
- (CT^1_E cat. 1) x M = 0.01% x 10 = 0.1% < 25% so the mixture is not a CT_E cat. 1.
- (M x 10 x CT^1_E cat. 1) + (CT^2_E cat. 2) = 10 x 10 x 0.01% + 1.0% = 2% < 25% so the mixture is not a CT_E cat. 2.
- (M x 100 x CT^1_E cat. 1) + (10 x CT^2_E cat. 2) + (CT_E cat. 3) = 10 x 100 x 0.01% + (10 x 1.0%) + 0 = 20% < 25% so the mixture is not a CT_E cat. 3.
- CT^1_E cat. 1 + CT^2_E cat. 2 + CT_E cat. 3 + CT^3_E cat. 4 = 0.01% + 1.0% + 0 + 25% = 26.01% > 25% so the mixture **is** a **TC_E cat. 4**.

The ingredients 3 and 4 are not classified. Yet, one must consider them (Vol. 2, Fig. 3.1.2, case E) particularly since they represent the main part of the mixture → the mixture will also have to include the following notice: "The mixture is composed at 98.99% of ingredients whose hazards related to the aquatic environment are unknown".

Conclusion: The label of the mixture X will not have any pictogram nor signal word but will have a hazard statement *May cause long lasting harmful effects to the aquatic life* (H413). The mixture X will include the following statement: "Mixture X is made of X % of ingredients whose hazards to the aquatic environment are unknown".

Example 2: Classification of the mixture Y including the ingredients stated below.

Ingredients	Chronic toxicity	NOEC or EC_x	Rapidly degradable	Composition of mixture Y
Ingredient 1	NOEC (28 days for fishes)	4.1 mg/l	yes	15%
	NOEC (21 days for crustacean)	0.13 mg/l		
Ingredient 2	NOEC (for algae)	0.8 mg/l	no	5%
Ingredient 3	Cat. 3	/		80%

The part (that is 20%) of the mixture having information on chronic toxicity (that is ingredients 1 & 2) have an $EqNOEC_m$= 0.1 mg/l because:

$$\frac{15+5}{\text{EqNOECm}} = \frac{15}{0.13} + \frac{5}{0.1\text{x}0.8} \rightarrow \text{EqNOEC}_m\text{= 0.1 mg/l}$$

Since there is no degradability data for both the ingredient 1 and the ingredient 2, one must apply the most restrictive approach, that is to consider the assembly as not rapidly degradable (Vol. 2, tab. 3.1.5). Thus, according to table 3.1.2 (Vol. 2) the assembly of ingredient 1 & 2 is classified as chronic toxic cat. 1 for the aquatic environment (CT_E cat. 1) since 0.1 is ≤ 0.1 mg/l.

The mixture Y can be represented as follows:

Ingredients	Chronic toxicity for the aquatic environment	Composition of mixture Y
Ingredient 1+2	Cat. 1	20%
Ingredient 3	Cat. 3	80%

According to table 3.1.5 (Vol. 2), we have factor M = 1.

- Classification of mixture Y as chronic toxic for the aquatic environment (CT_E)?
- (CT_E cat. 1) x M = 20% x 1= 20% < 25% so the mixture is not a CT_E cat. 1.
- (M x 10 x CT_E cat. 1) + (CT_E cat. 2) = (1 x 10 x 20%) + 0% = 200% > 25% so the mixture is **CT_E cat. 2**.

Conclusion: The label of the mixture Y will include the pictogram  without signal words but will have the following hazard statement *Toxic to aquatic life with long lasting effects* (H411).

Example 3: Classification of the mixture Z including the ingredients stated below.

Ingredients	Acute toxicity	L(E)C_{50}	Chronic toxicity	Composition of the mixture Z
Ingredient 1	LC_{50} (for fishes)	12 mg/l	Cat. 1 with M= 1	5%
	EC_{50} (for crustacean)	18 mg/l		
	ErC_{50} (for algae)	0.9 mg/l		
Ingredient 2	LC_{50} (for fishes)	40 mg/l	Cat. 2	1.5%
	EC_{50} (for crustacean)	25 mg/l		
	ErC_{50} (for algae)	9.5 mg/l		
Ingredient 3	LC_{50} (for fishes)	> 100 mg/l	Cat. 4	93.5%
	EC_{50} (for crustacean)	> 100 mg/l		
	ErC_{50} (for algae)	> 100 mg/l		

Results obtained after test done on mixture Z:

Acute toxicity	L(E)C_{50}
LC_{50} (for fishes)	68 mg/l
EC_{50} (for crustacean)	90 mg/l
ErC_{50} (for algae)	12.5 mg/l

- Classification of the mixture Z as an acute toxic for the aquatic environment (AT_E)?

According to table 3.1.1, the mixture Z must be an **AT_E Cat. 3**.

- Classification of the mixture Z as a chronic toxic for the aquatic environment (CT_E)?

- (CT^1_E cat. 1) x M = 5% x 1= 5% < 25% so the mixture is not a CT_E cat. 1.
- (M x 10 x CT^1_E cat. 1) + (CT^2_E cat. 2)= (1 x 10 x 5%) + 1.5% = 51.5% > 25% so the mixture is a **CT_E Cat. 2**.

***Conclusion*:** The label of the mixture Z will have the pictogram  without signal word but will have the hazard notice *Toxic to aquatic life with long lasting effects* (H411).

Example 4: Classification of the mixture M including the ingredients stated below.

Ingredients	Toxicity	Hazard Statement	Relevant ingredient	Composition of mixture M
Ingredient 1	Chronic aq. Cat 3	H412	no; < 1%	0.2%
Ingredient 2	Acute aq. Cat 1	H400	yes; > 1% with M= 1	0.15%
	Chronic aq. Cat 1	H410	yes; < 0.1% with M= 1	
Ingredient 3	Chronic aq. Cat 2	H411	no; < 1%	0.4%
Ingredient 4	Chronic aq. Cat 3	H412	yes; > 1%	5.5%
Ingredient 5	Acute aq. Cat 1	H400	yes; > 0.1% with M= 1	24.9%
Ingredient 6	Chronic aq. Cat 4	H413	yes; > 1%	21%
Ingredient 7	/	/	/	47.85%

Classification of mixture M:

- No result from the mixture testing.
- No data for similar mixtures.
- No data for all its ingredients → Addition formula not possible

→ Sum approach:

- Classification of mixture M as an acute toxic for aquatic environment (AT_E)?
  - (AT_E cat. 1) x M = 0.15% x 1 + 24.9% x 1= 25.05% > 25% so the mixture is an **AT_E Cat. 1**.

- Classification of mixture M as toxic chronic for the aqueous environment (CT_E)?
  - (CT_E cat. 1) x M = 0.15% x 1= 0.15% < 25% so the mixture is not a CT_E cat. 1.
  - (M x 10 x CT_E cat. 1) + (CT_E cat. 2) = (1 x 10 x 0.15%) + 0% = 1.5% < 25% so the mixture is not a CT_E cat. 2.
  - (M x 100 x CT_E cat. 1) + (10 x CT_E cat. 2) + (CT_E cat. 3) = 1 x 100 x 0.15% + (10 x 0%) + 5.5% = 20.5% < 25% so the mixture is not a CT_E cat. 3.
  - CT_E cat. 1 + CT_E cat. 2 + CT_E cat. 3 + CT_E cat. 4 = 0.15% + 0% + 5.5% + 21% = 26.65% > 25% so the mixture is a **CT_E Cat. 4**.

Conclusion: The label of the mixture M will display the pictogram  with the signal word *Warning* and will include the hazard statement *Very toxic for aquatic life* (H400) and *May cause long lasting harmful effects to aquatic life* (H413).

ENVIRONMENTAL HAZARDS

Characterization of a hypochlorite sodium solution.
Only the hazards *skin irritation and corrosion*, *eye irritation* and *acute toxic for the aqueous environment* will be considered here.

<table>
<tr><th colspan="7">Sodium hypochlorite (n° CAS 7681-52-9)</th></tr>
<tr><td>Hazards</td><td>Specific concentrations, M-factor (CLP annex VI) or other available data</td><td>As per authorities</td><td>Hazard categories and classes</td><td>Pictogram</td><td>Signal word</td><td>Hazard statement</td></tr>
<tr><td>Physical</td><td>/</td><td rowspan="4">CLP (GHS)</td><td>No hazards</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td rowspan="4">Health</td><td rowspan="2">2.5% ≤ C < 5%</td><td>Skin irrit. cat. 2</td><td>  </td><td>Warning</td><td>H315</td></tr>
<tr><td>Eye dmg. cat. 1</td><td>  </td><td rowspan="2">Danger</td><td>H318</td></tr>
<tr><td>10% ≤ C < 20%</td><td>Skin corr. cat. 1B</td><td>  </td><td>H314</td></tr>
<tr><td colspan="5">if C ≥ 5%: EUH031</td></tr>
<tr><td>For aqueous environment</td><td>M = 10</td><td>CLP (GHS)</td><td>AT. aq. env. cat. 1</td><td>  </td><td>Warning</td><td>H400</td></tr>
<tr><td colspan="7">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="7">6% sodium hypochlorite aqueous solution.</td></tr>
<tr><td>Health</td><td>Skin corr.</td><td colspan="2">Vol. 2, tab. 2.2.1:
C_{NaOH} > 5% → cat. 1</td><td>  </td><td>Danger</td><td>H314</td></tr>
<tr><td>For aqueous environment</td><td>AT aq. env.</td><td colspan="2">Vol. 2, tab. 3.1.3:
6x10 > 25% → cat. 1</td><td>  </td><td>Warning</td><td>H400</td></tr>
<tr><td colspan="7">Labelling of the 6% sodium hypochlorite aqueous solution</td></tr>
<tr><td colspan="4">Pictograms</td><td colspan="3">Signal word</td></tr>
<tr><td colspan="4">  </td><td colspan="3">DANGER</td></tr>
<tr><td colspan="7">Since C_{NaOH} ≥ 5%, the hazard statement EUH031 must be indicated in addition to the other hazards.</td></tr>
</table>

Characterization of a potassium permanganate solution.

Only the hazards *oxidizer, acute toxicity, skin corrosion, STOT-RE* and *acute toxic for the aqueous environment* will be considered here.

<table>
<tr><th colspan="7">Potassium permanganate (n° CAS 7722-64-7)</th></tr>
<tr><td>Hazards</td><td>Specific concentrations, M-factor (CLP annex VI) or other available data</td><td>As per authorities</td><td>Hazard categories and classes</td><td>Pictogram</td><td>Signal word</td><td>Hazard statement</td></tr>
<tr><td>Physical</td><td>/</td><td rowspan="3">CLP (GHS)</td><td>Ox. solid cat. 2</td><td>  </td><td>Danger</td><td>H272</td></tr>
<tr><td rowspan="3">Health</td><td>/</td><td>AT oral cat. 4</td><td>  </td><td>Warning</td><td>H302</td></tr>
<tr><td>/</td><td>Skin corr. 1B</td><td>  </td><td>Danger</td><td>H314</td></tr>
<tr><td>/</td><td>REACH</td><td>STOT RE cat. 2</td><td>  </td><td>Warning</td><td>H373</td></tr>
<tr><td rowspan="2">For aqueous environment</td><td rowspan="2">M = 10</td><td rowspan="2">CLP (GHS)</td><td>AT aq. env. cat. 1</td><td rowspan="2">  </td><td rowspan="2">Warning</td><td>H400</td></tr>
<tr><td>CT aq. env. cat. 1</td><td>H410</td></tr>
<tr><td colspan="7">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="7">0.02 M ≡ 0.02x158.03 = 3.16 g, that is a 0.316% $KMnO_4$ aqueous solution.</td></tr>
<tr><td>Physical</td><td>oxidizer?</td><td colspan="5">If no other comparable and categorized substance exists, one cannot make an extrapolation and testing is the only way.</td></tr>
<tr><td rowspan="3">Health</td><td>AT oral cat. 4</td><td>100/ATE = 0.316/500 → ATE = $15.8.10^4$ → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td>Skin corr. 1B</td><td>Vol. 2, tab. 2.2.1: 10x0.316 =3.16% → Irrit. cat. 3</td><td>/</td><td>Warning</td><td>H316</td></tr>
<tr><td>STOT RE</td><td>Vol. 2, tab. 2.6.2: C < 1% → out cat.</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td rowspan="2">For aqueous environment</td><td rowspan="2">M = 10</td><td rowspan="2">Vol. 2, tab. 3.1.3+3.1.4: 10x10x0.316 > 25% → cat. 2</td><td>/</td><td>/</td><td>H401</td></tr>
<tr><td>  </td><td>/</td><td>H411</td></tr>
<tr><td colspan="7">Labelling of the mixture with 0,02M $KMnO_4$:</td></tr>
<tr><td colspan="4">Pictograms</td><td colspan="3">Signal word</td></tr>
<tr><td colspan="4">  (if positive test)  </td><td colspan="3">WARNING</td></tr>
</table>

ENVIRONMENTAL HAZARDS

Characterization of a copper aqueous solution.

Only the hazards *acute toxicity*, *skin and eye irritation*, and *acute and chronic toxicity for the aqueous environment* will be considered here.

Citric acid monohydrate (n° CAS 5949-29-1)						
Hazards	Specific concentrations, M-factor (CLP annex VI) or other available data	As per authorities	Hazard categories and classes	Pictogram	Signal word	Hazard statement
Health	/	CLP (GHS)	Eye irrit. cat. 2		Warning	H319
Sodium carbonate decahydrate (n° CAS 6132-02-1)						
Health	/	CLP (GHS)	Eye irrit. cat. 2		Warning	H319
Copper sulfate pentahydrate (n° CAS 7758-99-8)						
Health	/	CLP (GHS)	AT oral cat. 4		Warning	H302
	/		Skin irrit. cat. 2			H315
	/		Eye irrit. cat. 2			H319
Aqueous environment	M = 10		AT aq. env. cat. 1		Warning	H400
			CT aq. env. cat. 1			H410
Reasoning for the categorization and classification of the mixture:						
388 g Na_2CO_3*10H_2O in 1 L H_2O, that is a 38.8% solution						
Health	Eye irrit.	Vol. 2, tab. 2.3.2: C > 10% → Eye irrit. cat. 2			Warning	H319
50 g citric acid monohydrate in 1 L H_2O, that is a 5% aqueous solution						
Health	Eye irrit.	No need to determine since it is already determined with C_{Na2CO3}.				
25 g $CuSO_4$*5H_2O, that is a 2.5% solution						
Health	AT oral	100/ATE= 2.5/500 → ATE= 2.10^4 → hors cat.		/	/	/
	Skin irrit.	Vol. 2, tab. 2.2.1: 1 ≤ C < 10% → cat. 3		/	Warning	H316
	Eye irrit.	No need to determine since it is already determined with C_{Na2CO3}.				
Aqueous environment	AT aq. env.	Vol. 2, tab. 3.1.3+3.1.4: 2.5x10 = 25% → cat. 1			Warning	H400
	CT aq. env.					H410
Labelling of the copper-alkaline solution:						
Even if some of the ingredients react together, the solution will remain irritating for the skin, the eyes and toxic for the aqueous environment.						
Pictograms				Signal word		
				WARNING		

ENVIRONMENTAL HAZARDS

Characterization of a zinc sulfate solution (Carrez II).
Only the hazards *acute toxicity*, *serious eye damage*, and *acute and chronic toxicity for the aqueous environment* will be considered here.

$ZnSO_4*7H_2O$ (n° CAS 7446-20-0)						
Hazards	Specific concentrations, M-factor (CLP annex VI) or other available data	As per authorities	Hazard categories and classes	Pictogram	Signal word	Hazard statement
Health	/	CLP (GHS)	AT oral cat. 4		Warning	H302
	/		Eye corr. cat. 1		Danger	H318
For aqueous environment	M = 1		AT aq. env. cat. 1		Warning	H400
			CT aq. env. cat. 1			H410
Reasoning for the categorization and classification of the mixture:						
300 g heptahydrate zinc sulfate in 1 L H_2O, that is a 30% solution.						
Health	AT	100/ATE = 30/500 → ATE= 1667 → cat. 4			Warning	H302
	Eye corr.	Vol. 2, tab. 2.3.2: C > 3% → cat. 1			Danger	H318
Aqueous environment	AT aq. env.	Vol. 2, tab. 3.1.3+3.1.4: 30x1 > 25% → cat. 1			Warning	H400
	CT aq. env.					H410
Labelling of the Carrez II solution:						
Pictograms				Signal word		
				DANGER		

ENVIRONMENTAL HAZARDS

Characterization of a copper sulfate solution.
Only the hazards *acute toxicity*, *skin and eye irritation*, and *acute and chronic toxicity for the aqueous environment* will be considered here.

<table>
<tr><th colspan="7">Copper sulfate pentahydrate (n° CAS 7758-99-8)</th></tr>
<tr><td>Hazards</td><td>Specific concentrations, M-factor (CLP annex VI) or other available data</td><td>As per authorities</td><td>Hazard categories and classes</td><td>Pictogram</td><td>Signal word</td><td>Hazard statement</td></tr>
<tr><td rowspan="3">Health</td><td>/</td><td rowspan="4">CLP (GHS)</td><td>AT oral cat. 4</td><td rowspan="3">  </td><td rowspan="3">Warning</td><td>H302</td></tr>
<tr><td>/</td><td>Skin irrit. cat. 2</td><td>H315</td></tr>
<tr><td>/</td><td>Eye irrit. cat. 2</td><td>H319</td></tr>
<tr><td rowspan="2">Aqueous environment</td><td rowspan="2">M= 10</td><td>AT aq. env. cat. 1</td><td rowspan="2">  </td><td rowspan="2">Warning</td><td>H400</td></tr>
<tr><td>CT aq. env. cat. 1</td><td>H410</td></tr>
<tr><td colspan="7">Reasoning for the categorization and classification of the mixture:</td></tr>
<tr><td colspan="7">200 g $CuSO_4*5H_2O$ in 1L water, that is a 20% solution.</td></tr>
<tr><td rowspan="3">Health</td><td>AT</td><td>100/ATE= 20/500
→ ATE= 2500 → cat. 5</td><td>/</td><td>/</td><td>/</td></tr>
<tr><td rowspan="2">Skin & eye irr.</td><td rowspan="2">Vol. 2, tab. 2.2.1 & 2.3.2
C > 10% → cat. 2</td><td rowspan="2">  </td><td rowspan="2">Warning</td><td>H315</td></tr>
<tr><td>H319</td></tr>
<tr><td rowspan="2">Aqueous environment</td><td>AT aq. env.</td><td rowspan="2">Vol. 2, tab. 3.1.3 & 3.1.4:
20x10 > 25% → cat. 1</td><td rowspan="2">  </td><td rowspan="2">Warning</td><td>H400</td></tr>
<tr><td>CT aq. env.</td><td>H410</td></tr>
<tr><td colspan="7">Labelling of the 20% copper sulfate solution:</td></tr>
<tr><td colspan="4">Pictograms</td><td colspan="3">Signal word</td></tr>
<tr><td colspan="4">  </td><td colspan="3">WARNING</td></tr>
</table>

Exercise: Let's consider a mixture S made of the following ingredients.

Mixture S	Concentration (%)	Toxicologic data
Ingredient A	4	Acute toxic, cat. 3, oral
		Skin corrosion, cat. 1B
		Carcinogenicity C2
		Skin sensitization cat. 1
Ingredient B	2	Skin irritation cat. 2
		Acute toxic, cat. 4, oral
		Acute toxic aq. env., cat. 1; LC_{50}= 0.03 mg/l
		Chronic toxic aq. env., cat. 1 with M=10
Water	94	Not classified

How will the mixture **S** be classified and what will the label include?

1) Health hazards

Acute oral toxicity:

- According to table 2.1.2 (Vol. 2):

$$\frac{100}{ATE_{mix}} = \frac{4}{100} + \frac{2}{500}$$

so $ATE_{oral,\ mix}$= 2273 mg/kg which would correspond to a classification in cat. 5 but the CLP does not include this category

→ **S** is not an acute toxic for health.

Skin irritation and corrosion:

- Table 2.2.1: 10 x 4% + 1 x 2%= 42% thus >10%

→ **S** is classified as **skin irritant Cat. 2.**

Serious eye damage and eye irritation:

- Table 2.3.2: a mixture containing ≥ 3% ingredients classified as skin corrosion category 1 will also be serious eye damage Cat. 1. Ingredient A possess 4% of a Cat. 1 ingredient

→ **S** is classified as **serious eye damage Cat. 1.**

Carcinogenicity:

- Table 2.5.2: presence of a carcinogenic C2 (ingredient A) ≥ 0.1%

→ **S** is classified as **C2**.

Skin sensitization:

- Table 2.4.1: presence of a skin sensitizer > 0.1% (ingredient A)

  → **S** classified as **skin sensitizer cat.1**.

2) Environmental hazards

Acute toxicity for the aqueous environment:

- Table 3.1.5: The M factor for ingredient B is 10 because its LC_{50} is 0.03 mg/l.

→ table 3.1.3: 10 x 2% = 20%

→ **S** is not an acute toxic for the aqueous environment.

But according to the following row of the same table: 10 x 10 x 2% = 200%

→ **S** is classified as an **acute toxic for the aqueous environment Cat. 2**.

Chronic toxicity for the aqueous environment:

- According the data on mixture S, the factor M of ingredient B is equal to 10.

→ Table 3.1.4: 10 x 2% = 20%

→ **S** is not a chronic toxic Cat. 1 for the aqueous environment.

But according to the following row of the same table: 10 x 10 x 2% = 200%

→ **S** is classified as a **chronic toxic for the aqueous environment Cat. 2**.

In summary :

	Relative toxicities	**Pictograms**	**Signal word**	**Hazard statements (H sentences)**
Solution **S** (made up of A and B)	Carcinogenic C2		Warning	Suspected of causing cancer (H351)
	Skin sensitizer cat. 1		Warning	May cause an allergic skin reaction (H317)
	Skin irritant cat. 2		Warning	Causes skin irritation (H315)
	Serious eye damage, cat. 2		Warning	Causes serious eye damage (H318)
	AT_E cat. 2		/	Toxic to aquatic life, long lasting harmful effects (H411)

The label will include the three hazards pictograms and will precise in a fully written notice the Signal word *WARNING* and will include the hazard statements (H sentences). Reminder: unless more are needed, up to six precautionary statements (P sentences) will be reported on this label (see ***G**enerally **H**armonized **S**ystem of classification and labelling of chemicals* (GHS and its European version – CLP) – Volume 1 available on https://scc.epfl.ch).

3.2 Hazardous to the ozone layer

Consider the insecticide aerosol A which composition is:

Aerosol A (1.1 bar)	**Concentration (%)**	**Toxicological data**
Tetramethrin	0.2	LC_{50} 96h (Rainbow trout)= 6.4 µg/l; EC_{50} 48h (Daphnia magna)= 49 µg/l
Isopropanol	10.8	Eye irritation, cat. 2 (H319)
		Specific target organ toxicity – single exposure, cat. 3, central nervous system (H336)
Water	54	
Propane/ butane	35	

How will this **A** insecticide be classified and what will the label include?

1) Physical hazards

Gas under pressure?

Since the mixture is at a pressure below 2 bar(g), it does not constitute a mixture under pressure.

Flammable aerosol mixture?

According to fig. 1.8.1 (Vol. 2), this mixture is a vaporized aerosol. To determine its category, one must proceed with flammability trials.

2) Health hazards

Regarding the propelling gas mixture (propane/butane), it should not be considered as toxic ingredient of the aerosol A since it does not possess toxicity and does not modify the isopropanol properties.

Irritation/serious eye damage?

Table 2.3.2 (Vol. 2): a mixture containing ≥ 10% ingredients classified as *eye irritant* cat. 2. Isopropanol being present at 10.8% % → **A** classified as **eye irritant Cat. 2**.

Remark: if we did not disregard the propelling system, one had then to convert the 10.8% isopropanol to the total volume of the aerosol container. So, 10.8% x 100%/ 65% = 16.6%. Thus, for the irritant effect calculation, one had to consider: 16.6%/ 10%= 1.66%. So according to table 2.3.2, a mixture containing ≥ 1% but < 3% ingredients classified *as eye irritant* cat. 2 would be classified in category 1.

→ A would be classified in serious eye damage Cat. 1. It would then have the pictogram  , the signal word *Danger* and the hazard statement *Cause serious eye damage* (H318).

STOT?

➢ Table 2.6.1: classification only if presence of ingredients of cat. 1 and/ or 2.
→ A is not a STOT.

3) Environmental hazards

Acute toxic (short term) for aqueous environment:

The provided EC_{50} 48h indicates that tetramethrin is an acute toxic I for the aqueous environment (Vol. 2, tab. 3.1.1). Remark: then, only the tetramethrin will have the hazard pictogram related to the aqueous environment, the signal word *Warning* and the hazard statement *Very toxic for aquatic organisms* (H400).

According to the table 3.1.5 (Vol. 2) and the lowest EC_{50} = 6 µg/l that is 0.006 mg/l, a factor M=100 must be applied to the sum method (table 3.1.3):

- classification of aerosol A as an acute toxic for the aqueous environment (AT_E)?
- (AT_E cat. 1) x M ≥ 25% = 0.2% x 100= 20% < 25% so the mixture is not an AT_E cat. 1.
- (M x 10 x AT_E cat. 1) + (AT_E cat. 2) = 100 x 10 x 0.2% + 0% = 200% > 25% so the mixture is an **AT_E cat. 2**.

→ **A** is an **acute toxic cat. 2 for the aqueous environment**.

Chronic toxic (long term) for aqueous environment:

If the EC_{50} 48h (Daphnia magna) = 49 µg/L data is related to the chronic toxicity, then the tetramethrin is a chronic toxic I for the aqueous environment (table 3.1.1, Vol. 2). Remark: then, only the tetramethrin will have the environmental hazard pictogram, the signal word *Warning* and the hazard statement *Very toxic for aquatic organisms, cause harmful effect at long term* (H410).

According to the table 3.1.5, a factor M=10 must be applied to the sum method (Vol. 2, tab. 3.1.4):

- (CT_E cat. 1) x M = 0.2% x 10= 2% < 25% so the mixture is not CT_E cat. 1.
- (M x 10 x CT_E cat. 1) + (CT_E cat. 2) ≥ 25%, = (10 x 10 x 0.2%) + 0% = 20% < 25% so the mixture is not CT_E cat. 2.
- (M x 100 x CT_E cat. 1) + (10 x CT_E cat. 2) + (CT_E cat. 3) = 10 x 100 x 0.2% + (10 x 0%) + 0% = 200% > 25% so the mixture is **CT_E cat. 3**.

→ **A** is a **chronic toxic cat. 3 for the aqueous environment**.

Hazardous to the ozone layer?

No ingredients from aerosol A are reported in the Montreal Protocol.

In summary :

	Relative toxicities	Pictogram	Signal word	Hazard statement (phrases H)
Insecticide aerosol A	Eye irritant cat. 2		Warning	Causes severe eye irritation (H319).
	AT_E cat. 2	/	/	Toxic to aquatic life (H401)
	CT_E cat. 3	/	/	Harmful to aquatic life with long lasting effects (H412)

In addition to the relative signalization to physical hazard/s (potentially revealed by flammability measurements), the label will have the hazard pictogram  and will precise in fully written notices the signal word *Warning* as well as the hazard statements H319, H401 and H412.

Complementary information

§	Paragraph
/ (diagonal bar)	No data available or does not apply
Annex VI	Annex to the CLP rules. It is divided in 3 parts and it is the tables of the third part that allows finding the specific concentrations and M factors needed for the classification and categorization of mixtures. Consult the website of the European agency of chemicals: https://echa.europa.eu/fr/information-on-chemicals/annex-vi-to-clp
Aq. env.	Aqueous environment
AT	Acute toxicity (short term)
ATE	Acute toxicity estimation
AT_E	Acute toxicity (short term) for aqueous environment
BP	Boiling point
C or conc.	Concentration
C&L	C&L inventory is a database containing data related to the classification and labelling of ingredients notified and recorded, received from manufacturer and importers. It contains also the harmonized classification list (table 3.1 and 3.2 from annex VI to the CLP rules) as well as the harmonized ingredients name translated in all languages of the European union. (https://echa.europa.eu/fr/information-on-chemicals/cl-inventory-database).
C1A, C1B or C2	Carcinogenic cat. 1A, 1B or 2
Cat.	Category
CE	European community
CEr	Growth rate
CFC-11	Trichlorofluoromethane
CLP	European version of the General Harmonized System of classification and labelling of chemicals
Corr.	Corrosion
CT	Chronic toxicity (long term)
CT_E	Chronic toxicity (long term) for aqueous environment
ECHA	European agency of chemicals
ECHA (notif.)	submitted (of classification and categorization according to CLP) notification by provider and retained by the ECHA
ECHA (reported)	Provider information reported to the ECHA
Factor M	Multiplication factor that is applied to the concentration of an ingredient classified as hazardous for the aquatic environment, chronic or acute toxic category 1, to obtain by the sum method (p. 63 Volume 2), the classification of a mixture in which the ingredient is present.
Flam.	Flammable
FP	Flash point
GHS	Globally harmonized system of classification and labelling of chemicals https://www.unece.org/fr/trans/danger/publi/ghs/ghs_welcome_f.html
Ingest.	Ingestion
Inhal.	Inhalation
Irrit.	Irritation

ISO	International standardization organism
LFL	Lower flammability limit (explosivity)
Liq.	Liquid
M1A, M1B or M2	mutagenicity cat. 1A, 1B or 2
Met.	Metals
$NOEC_i$	No observed effect concentration (or other admitted measures for the chronic toxicity for the ingredient i (mg/l))
P	Pressure
R1A, R1B or R2	Reproductive toxicity cat. 1A, 1B or 2
RE	Repeated exposure
REACH	Regulation on the recording, evaluation, authorization and restriction regarding chemicals substances https://echa.europa.eu/fr/regulations/reach/understanding-reach
Ref.	Reference
Resp.	Respiratory
Resp. ways	Respiratory ways
RTMD	*Recommendations related to the transport of hazardous goods, handbook of trials and criteria* (ST/SG/AC.10/11/Rev.6 ; ISBN 978-92-1-239128-0)
SDS	Safety data sheet
SE	Single exposure
Sens.	Sensitization
SFL	Superior flammability limit (explosivity)
STOT	Specific target organ toxicity
SUVA	Schweizerische Unfallversicherungsanstalt; main accident insurance provider in Switzerland
T	Temperature
Tab.	Table

Hazard statements

Physical hazards		
Explosiveness	H200	Unstable explosive.
	H201	Explosive; mass explosion hazard.
	H202	Explosive; severe projection hazard.
	H203	Explosive; fire, blast or projection hazard.
	H204	Fire or projection hazard.
	H205	May mass explode in fire.
	H206	Fire, blast or projection hazard; increased risk of explosion if desensitizing agent is reduced.
	H207	Fire or projection hazard; increased risk of explosion if desensitizing agent is reduced.
	H208	Fire hazard; increased risk of explosion if desensitizing agent is reduced.
Flammability	H220	Extremely flammable gas.
	H221	Flammable gas.
	H222	Extremely flammable aerosol.
	H223	Flammable aerosol.
	H224	Extremely flammable liquid and vapor.
	H225	Highly flammable liquid and vapor.
	H226	Flammable liquid and vapor.
	H227	Combustible liquid.
	H228	Flammable solid.
	H229	Pressurized container: May burst if heated.
	H230	May react explosively even in the absence of air.
	H231	May react explosively even in the absence of air at elevated pressure and/or temperature.
Unstable when heated	H240	Heating may cause an explosion.
	H241	Heating may cause a fire or explosion.
	H242	Heating may cause a fire.
Unstable when in contact with air	H250	Catches fire spontaneously if exposed to air.
	H251	Self-heating; may catch fire.
	H252	Self-heating in large quantities; may catch fire.
Unstable when in contact with water	H260	In contact with water releases flammable gases which may ignite spontaneously.
	H261	In contact with water releases flammable gas.
Oxidizer	H270	May cause or intensify fire; oxidizer.
	H271	May cause fire or explosion; strong oxidizer.
	H272	May intensify fire; oxidizer.
Gas	H280	Contains gas under pressure; may explode if heated.
	H281	Contains refrigerated gas; may cause cryogenic burns or injury.
Corrosive to metals	H290	May be corrosive to metals.

Acute toxicity		
Acute hazard if swallowed	H300	Fatal if swallowed.
	H301	Toxic if swallowed.
	H302	Harmful if swallowed.
	H303	May be harmful if swallowed.

	H304	May be fatal if swallowed and enters airways.
	H305	May be harmful if swallowed and enters airways.
Acute toxicity by skin or eye contact	H310	Fatal in contact with skin.
	H311	Toxic in contact with skin.
	H312	Harmful in contact with skin.
	H313	May be harmful in contact with skin.
	H314	Causes severe skin burns and eye damage.
	H315	Causes skin irritation.
	H316	Causes mild skin irritation.
	H317	May cause an allergic skin reaction.
	H318	Causes serious eye damage.
	H319	Causes serious eye irritation.
	H320	Causes eye irritation.
Acute toxicity by inhalation	H330	Fatal if inhaled.
	H331	Toxic if inhaled.
	H332	Harmful if inhaled.
	H333	May be harmful if inhaled.
	H334	May cause allergy or asthma symptoms or breathing difficulties if inhaled.
	H335	May cause respiratory irritation.
	H336	May cause drowsiness or dizziness.
H300+H310		Fatal if swallowed or in contact with skin.
H300+H330		Fatal if swallowed or if inhaled.
H310+H330		Fatal in contact with skin or if inhaled.
H300+H310+H330		Fatal if swallowed, in contact with skin or if inhaled.
H301+H311		Toxic if swallowed or in contact with skin.
H301+H331		Toxic if swallowed or if inhaled.
H311+H331		Toxic in contact with skin or if inhaled.
H301+H311+H331		Toxic if swallowed, in contact with skin or if inhaled.
H302+H312		Harmful if swallowed or in contact with skin.
H302+H332		Harmful if swallowed or if inhaled.
H312+H332		Harmful in contact with skin or if inhaled.
H302+H312+H332		Harmful if swallowed, in contact with skin or if inhaled.
H303+H313		May be harmful if swallowed or in contact with skin.
H303+H333		May be harmful if swallowed or if inhaled.
H313+H333		May be harmful in contact with skin or if inhaled.
H303+H313+H333		May be harmful if swallowed, in contact with skin or if inhaled.
H315+H320		Causes skin and eye irritation.

Chronic toxicity		
Mutagenicity	H340	May cause genetic defects (state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard).
	H341	Suspected of causing genetic defects (state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard).
Carcinogenicity	H350	May cause cancer (state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard).
	H351	Suspected of causing cancer (state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard).
Reproductive toxicity	H360	May damage fertility or the unborn child (state specific effect if known) (state route of exposure if it is conclusively proven that no other routes of

		exposure cause the hazard).
	H361	Suspected of damaging fertility or the unborn child (state specific effect if known) (state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard).
	H362	May cause harm to breast-fed children.
STOT – UE/RE	H370	Causes damage to organs (or state all organs affected, if known) (state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard).
	H371	May cause damage to organs (or state all organs affected, if known) (state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard).
	H372	Causes damage to organs (state all organs affected, if known) through prolonged or repeated exposure (state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard).
	H373	May cause damage to organs (state all organs affected, if known) through prolonged or repeated exposure (state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard).
Environmental toxicity		
Toxic to the environment	H400	Very toxic to aquatic life.
	H401	Toxic to aquatic life.
	H402	Harmful to aquatic life.
	H410	Very toxic to aquatic life with long lasting effects.
	H411	Toxic to aquatic life with long lasting effects.
	H412	Harmful to aquatic life with long lasting effects.
	H413	May cause long lasting harmful effects to aquatic life.
	H420	Harms public health and the environment by destroying ozone in the upper atmosphere.

Precautionary statements

General	P101	If medical advice is needed, have product container or label at hand.
	P102	Keep out of reach of children.
	P103	Read label before use.
Prevention	P201	Obtain special instructions before use.
	P202	Do not handle until all safety precautions have been read and understood.
	P210	Keep away from heat, hot surfaces, sparks open flames and other ignition sources. – No smoking.
	P211	Do not spray on an open flame or other ignition source.
	P220	Keep away from clothing/ .../ combustible materials.
	P221	Take any precaution to avoid mixing with combustibles/ ...
	P222	Do not allow contact with air.
	P223	Do not allow contact with water.
	P230	Keep wetted with ...
	P231	Handle and store contents under inert gas.
	P232	Protect from moisture.
	P233	Keep container tightly closed.
	P234	Keep only in original packaging.
	P235	Keep cool.
	P240	Ground/ bond container and receiving equipment.
	P241	Use explosion-proof [electrical/ ventilating/ lighting/ ...] equipment.
	P242	Use only non-sparking tools.
	P243	Take precautionary measures against static discharge.
	P244	Keep valves and fittings free from oil and grease.
	P250	Do not subject to grinding/shock/…/ friction.
	P251	Do not pierce or burn, even after use.
	P260	Do not breathe dust/ fume/ gas/ mist/ vapors/ spray.
	P261	Avoid breathing dust/ fume/ gas/ mist/ vapors/ spray.
	P262	Do not get in eyes, on skin, or on clothing.
	P263	Avoid contact during pregnancy/ while nursing.
	P264	Wash ... thoroughly after handling.
	P270	Do not eat, drink or smoke when using this product.
	P271	Use only outdoors or in a well-ventilated area.
	P272	Contaminated work clothing should not be allowed out of the workplace.
	P273	Avoid release to the environment.
	P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
	P282	Wear cold insulating gloves and either face shield or eye protection.
	P283	Wear fire resistant or flame-retardant clothing.
	P284	[In case of inadequate ventilation] wear respiratory protection.
	P231+232	Handle and store contents under inert gas/… Protect from moisture.
	P235+P410	Keep cool. Protect from sunlight.
Intervention	P301	IF SWALLOWED:
	P302	IF ON SKIN:
	P303	IF ON SKIN (or hair):
	P304	IF INHALED:
	P305	IF IN EYES:
	P306	IF ON CLOTHING:
	P308	IF exposed or concerned:
	P310	Immediately call a POISON CENTER/ doctor/ …

	P311	Call a POISON CENTER/ doctor/ ...
	P312	Call a POISON CENTER /doctor/ … if you feel unwell.
	P313	Get medical advice/ attention.
	P314	Get medical advice/ attention if you feel unwell.
	P315	Get immediate medical advice/ attention.
	P320	Specific treatment is urgent (see ... on this label).
	P321	Specific treatment (see ... on this label).
	P330	Rinse mouth.
	P331	Do NOT induce vomiting.
	P332	If skin irritation occurs:
	P333	If skin irritation or rash occurs:
	P334	Immerse in cool water [or wrap in wet bandages].
	P335	Brush off loose particles from skin.
	P336	Thaw frosted parts with lukewarm water. Do not rub affected area.
	P337	If eye irritation persists:
	P338	Remove contact lenses, if present and easy to do. Continue rinsing.
	P340	Remove person to fresh air and keep comfortable for breathing.
	P342	If experiencing respiratory symptoms:
	P351	Rinse cautiously with water for several minutes.
	P352	Wash with plenty of water.
	P353	Rinse skin with water [or shower].
	P360	Rinse immediately contaminated clothing and skin with plenty of water before removing clothes.
	P361	Take off immediately all contaminated clothing.
	P362	Take off contaminated clothing.
	P363	Wash contaminated clothing before reuse.
	P364	And wash it before reuse.
	P370	In case of fire:
	P371	In case of major fire and large quantities:
	P372	Explosion risk.
	P373	DO NOT fight fire when fire reaches explosives.
	P375	Fight fire remotely due to the risk of explosion.
	P376	Stop leak if safe to do so.
	P377	Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
	P378	Use ... to extinguish.
	P380	Evacuate area.
	P381	In case of leakage, eliminate all ignition sources if safe to do so.
	P390	Absorb spillage to prevent material damage.
	P391	Collect spillage.
P301+P310		IF SWALLOWED: Immediately call a POISON CENTER/ doctor/ ...
P301+P312		IF SWALLOWED: Call a POISON CENTER/doctor/…if you feel unwell.
P302+P334		IF ON SKIN: Immerse in cool water [or wrap in wet bandages].
P301+P330+P331		IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
P302+P334		IF ON SKIN: Immerse in cool water/wrap in wet bandages.
P302+P352		IF ON SKIN: Wash with plenty of water/ ...
P302+P335+P334		IF ON SKIN: Brush off loose particles from skin. Immerse in cool water [or wrap in wet bandages].
P303+P361+P353		IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water [or shower].
P304+P312		IF INHALED: Call a POISON CENTER or doctor/physician if you feel unwell.

P304+P340		IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P305+P351+P338		IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P306+P360		IF ON CLOTHING: Rinse immediately contaminated clothing and skin with plenty of water before removing clothes.
P308+P311		IF exposed or concerned: Call a POISON CENTER/ doctor/ ...
P308+P313		IF exposed or concerned: Get medical advice/ attention.
P332+P313		If skin irritation occurs: Get medical advice/ attention.
P333+P313		If skin irritation or rash occurs: Get medical advice/ attention.
P335+P334		Brush off loose particles from skin. Immerse in cool water/ wrap in wet bandages.
P337+P313		If eye irritation persists: Get medical advice/ attention.
P342+P311		If experiencing respiratory symptoms: Call a POISON CENTER/ doctor/ ...
P361+P364		Take off immediately all contaminated clothing and wash it before reuse.
P362+P364		Take off contaminated clothing and wash it before reuse.
P370+P376		In case of fire: Stop leak if safe to do so.
P370+P378		In case of fire: Use ... to extinguish.
P370+P380		In case of fire: Evacuate area.
P370+P380+P375		In case of fire: Evacuate area. Fight fire remotely due to the risk of explosion.
P371+P380+P375		In case of major fire and large quantities: Evacuate area. Fight fire remotely due to the risk of explosion.
P370+P372+P380+ P373		In case of fire: Explosion risk. Evacuate area. Do NOT fight fire when fire reaches explosives.
P370+P380+P375 [+P378]		In case of major fire. Evacuate area. Fight fire remotely due to the risk of explosion. [Use … to extinguish].
Storage	P401	Store in accordance with …
	P402	Store in a dry place.
	P403	Store in a well-ventilated place.
	P404	Store in a closed container.
	P405	Store locked up.
	P406	Store in corrosive resistant/ ... container with a resistant inner liner.
	P407	Maintain air gap between stacks/ pallets.
	P410	Protect from sunlight.
	P411	Store at temperatures not exceeding …°C/ …°F.
	P412	Do not expose to temperatures exceeding 50°C/ 122°F.
	P413	Store bulk masses greater than…kg/…lbs at temperatures not exceeding …°C/ …°F.
	P420	Store separately.
	P422	Store contents under ...
	P402+P404	Store in a dry place. Store in a closed container.
	P403+P233	Store in a well-ventilated place. Keep container tightly closed.
	P403+P235	Store in a well-ventilated place. Keep cool.
	P410+P403	Protect from sunlight. Store in a well-ventilated place.
	P410+P412	Protect from sunlight. Do not expose to temperatures exceeding 50°C/ 122°F.
	P411-P235	Store at temperatures not exceeding ... °C/...°F. Keep cool.
Disposal	P501	Dispose of contents/container to ...
	P502	Refer to manufacturer or supplier for information on recovery or recycling

Additional sentences EUH

Physical properties	EUH001	Explosive when dry.
	EUH006	Explosive with or without contact with air.
	EUH014	Reacts violently with water.
	EUH018	In use may form flammable/explosive vapor-air mixture.
	EUH019	May form explosive peroxides.
	EUH044	Risk of explosion if heated under confinement.
Health properties	EUH029	Contact with water liberates toxic gas.
	EUH031	Contact with acids liberates toxic gas.
	EUH032	Contact with acids liberates very toxic gas.
	EUH066	Repeated exposure may cause skin dryness or cracking.
	EUH070	Toxic by eye contact.
	EUH071	Corrosive to the respiratory tract.
Environmental property	EUH059	Hazardous to the ozone layer.
	EUH202	Cyanoacrylate. Danger. Bonds skin and eyes in seconds. Keep out of the reach of children.
	EUH203	Contains chromium(VI). May produce an allergic reaction.
	EUH204	Contains isocyanates. May produce an allergic reaction.
	EUH205	Contains epoxy constituents. May produce an allergic reaction.
	EUH206	Warning! Do not use together with other products. May release dangerous gases (chlorine).
	EUH207	Warning! Contains cadmium. Dangerous fumes are formed during use. See information supplied by the manufacturer. Comply with the safety instructions.
	EUH208	Contains (name of sensitive substances). May produce an allergic reaction.
	EUH210	Safety data sheet available on request.
	EUH401	To avoid risks to human health and the environment, comply with the instructions for use.