Series « What should I know ? »

Generally Harmonized System of classification and labelling of chemicals

***Volume 2** – Classification principles*

Safety Competence Center (DSPS-SCC)

Station 6 - CH J2

CH-1015 Lausanne

go.epfl.ch/Support-SCC

epfl.ch/campus/security-safety/en/lab-safety

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Introduction

This booklet follows the Volume 1[1] dedicated to the introduction of the **Globally Harmonized System of Classification and Labelling of Chemicals** (GHS) and its European (Switzerland included) counterpart, the **Classification, Labelling and Packaging** (CLP) legislation.

This booklet describes the rules for assigning the hazard classes and categories to **pure substances** and **mixtures of chemical substances** (gas, liquid and solid). The acronyms and explanations of the terms used herein are grouped in the *Complementary information* appendix at the end of this document. Examples illustrating these principles and classification rules, including suggestions for labelling, can be found in Volume 3[1].

The present document shall be considered as an aid. It is only an interpretation of the original regulations. Therefore, this aid should not be considered exhaustive nor a substitute for official regulations.

Classification principles

The classification of pure substances and mixtures (mixture/s or solution/s of at least two substances which do not react with each other, including ingredients dissolved in solvent/s) according to their hazards is based on the availability of data on the critical effects. Therefore, if one or more individual substances have intrinsic hazards, any mixture containing one or more of these substances should be assessed and classified. This booklet focuses solely on methods for the classification of hazards by so-called deductive methods; only in the absence of data will *in vitro* & eventually *in* vivo tests be performed (these experimental tests are only mentioned herein).

To classify and categorize pure substances and mixtures, one must consider what has already been formalized and proceed sequentially as follows[2]:

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 page 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] Volumes 1 and 3 are available at https://www.epfl.ch/campus/security-safety/en/lab-safety/hazards/chemical-hazards
[2] Unless specified, the indicated/used concentrations are mass concentrations (% by weight).

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 page 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 this booklet.
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).

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

SUVA: https://www.suva.ch

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

1. Physical hazards

These **17 types of hazards** are presented and, as depicted below, regrouped according to their pictograms.

Hazard Classes	Hazard categories and pictograms			
Explosives	Unstable explosive 1.1 to 1.3	1.4	1.5	1.6
Deactivated explosives	1, 2	3, 4		
Self-reactive substances/mixtures	A B C, D	E, F		G
Pyrophoric liquids & solids	1			
Self-heating substances/mixtures	1	2		
Substances/mixtures which, in contact with water, emit flammable gases	1, 2	3		
Flammable/ chemically unstable gases	1		2	
Flammable liquids	1, 2	3	4*	
Flammable solids	1	2		
Flammable aerosols	1	2		3
Oxidizing gases	1			
Oxidizing liquids/ solids	1, 2	3		
Gases under pressure		compressed/ liquefied/ dissolved gas refrigerated/ liquefied gas		
Corrosive to metals		1		

*not included in the CLP.

1.1. Explosives and deactivated explosives

This category includes explosive substances and mixtures, explosive articles as well as substances, mixtures and articles manufactured to produce a practical explosive or pyrotechnic effect.

An **explosive** substance is a solid or liquid substance (or mixture) which is capable of releasing gases at a temperature, pressure and velocity such that damages to the surrounding area will result.

A **pyrotechnic** substance is a solid or liquid substance (or mixture) intended to produce a calorific, light, sound, gas and/or smoke effect as a result of self-sustaining exothermic chemical reactions.

The classification of a substance (or mixture, article) as explosive and its assignment in one of the categories is a three-step process that refers to the first part of the European agreement concerning the international carriage of dangerous goods by road, Tests and Criteria (ECC/TRANS/257 Vol.I) (RTMD).

Amongst others, this manual includes the tests in series 1 to 8, used to determine whether the substances (and/or mixtures, articles) do have explosive properties and how to classify them in the corresponding category.

GHS defines the explosivity categories as follows:

- An **unstable explosive** is thermally unstable and/or too sensitive for normal handling, transport and use. Special precautions are necessary.
- **Category 1.1:** Substances, mixtures and articles which have a mass explosion hazard (a mass explosion is one which affects almost the entire quantity present virtually instantaneously).
- **Category 1.2:** Substances, mixtures and articles which have a projection hazard, but not a mass explosion hazard.
- **Category 1.3:** Substances, mixtures and articles which have a fire hazard and either a minor blast hazard or a minor projection or both, but not a mass explosion hazard.
- **Category 1.4:** Substances, mixtures and articles, which present no significant hazard: substances, mixtures and articles which present only a small hazard in the event of ignition or initiation. The effects are largely confined to the package and no projection of fragments of appreciable size or range is to be expected. An external fire shall not cause virtually instantaneous explosion of almost the entire contents of the package.
- **Category 1.5:** Substances or mixture, which have a mass explosion hazard, but are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal conditions.
- **Category 1.6:** Extremely insensitive articles, which do not have an explosion hazard; articles which predominantly contain extremely insensitive substances or mixtures and which demonstrate a negligible probability of accidental initiation or propagation.

To determine the category in which a substance and/or an explosive mixture belongs to, the following two decision diagrams should be followed (Fig. 1.1.1 and 1.1.2).

Figure 1.1.1: Decision diagram for the classification of explosives (part 1).

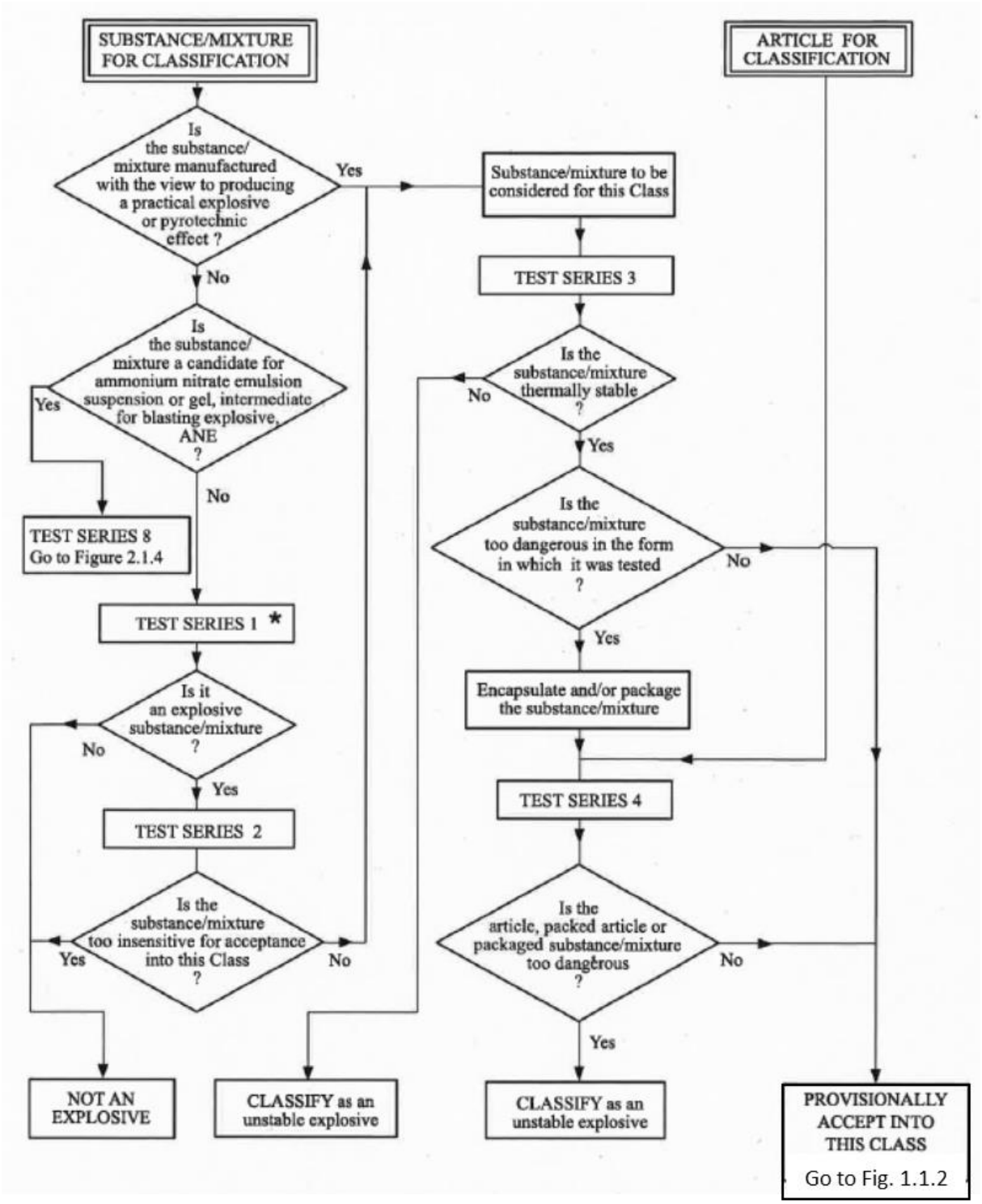
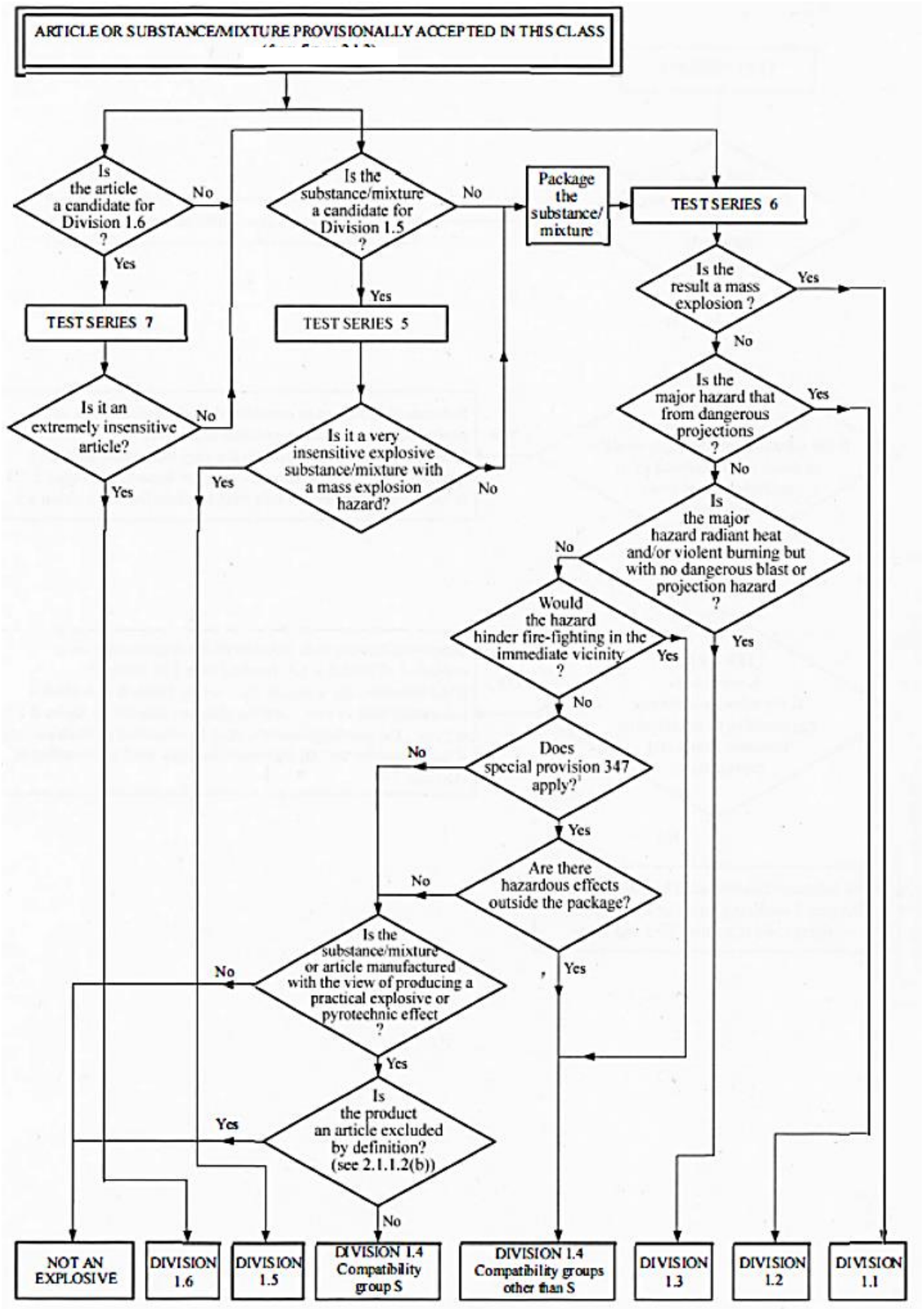


Figure 1.1.2: Decision diagram for the classification of explosives (part 2).



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The labelling elements are:

Hazard pictograms						/
Hazard categories[1]	**Unstable explosive**	**1.1**	**1.2**	**1.3**	**1.4**	**1.5**
Signal words	***Danger***				***Warning***	***Danger***
Hazard statements	**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.

The precautionary statements are:

Hazard category		**Unstable explosive**				
Precautionary statements	*Prevention*	**P201:** Obtain special instructions before use. **P202:** Do not handle until all safety precautions have been read and understood.				
	Response	**P372:** Explosion risk **P373:** DO NOT fight fire when fire reaches explosives. **P380:** Evacuate area.				
	Storage	**P401:** Store in accordance with […][2]				
	Waste	**P501:** Dispose of contents/container to […][2]				
Hazard categories[1]		**1.1**	**1.2**	**1.3**	**1.4**	**1.5**
Precautionary statements	*Prevention*	**P210:** Keep away from heat, hot surfaces, sparks open flames and other ignition sources. – No smoking. **P230:** Keep wetted with […][2] **P234:** Keep only in original packaging. **P240:** Ground/bond container and receiving equipment. **P250:** Do not subject to grinding/shock/…/friction. **P280:** Wear protective gloves/protective clothing/eye protection/face protection.				
	Response	**P370+P380+P375:** In case of fire: Evacuate area. Fight fire remotely due to the risk of explosion. **P372:** Explosion risk. **P373:** DO NOT fight fire when fire reaches explosives.				
	Storage	**P401:** Store in accordance with […][2]				
	Waste	**P501:** Dispose of contents/container to […][2]				

1) Category 1.6 was excluded from the tables above because it has no signal word, no hazard statement and no precautionary statement.

2) *In accordance with local/regional/national/international regulation*. They are supplied by the manufacturer/supplier and indicated on the container, on the SDS or both.

1.2. Desensitized explosives

A desensitized explosive is an explosive substance or mixture (solid or liquid) which was phlegmatized to suppress their explosives properties in such a manner that they do not mass explode and do not burn too rapidly (and therefore can be removed from the hazard class "Explosives").

Desensitized explosives can be:

- Solids, which are wetted with water or alcohols or are diluted with other substances, to form a homogeneous solid mixture to suppress their explosive properties.
- Liquids, which are dissolved or suspended in water or other liquid substances, to form a homogeneous mixture to suppress their explosive properties.

The classification is done according to their corrected burning rate (A_c), and following table 1.2.1. The test "burning rate test" is described in sub-section 51.4 of the RTMD (Part V).

Table 1.2.1: Classification criteria for desensitized explosives.

Criteria	Categories
Desensitized explosive substances with a corrected burning rate (A_c) ≥ 300 kg/min but not more than 1200 kg/min	1
140 kg/min ≤ A_c < 300 kg/min	2
60 kg/min ≤ A_c < 140 kg/min	3
A_c < 60 kg/min	4

The labelling elements are:

Pictogram				
Hazard categories	**Cat.1**	**Cat.2**	**Cat.3**	**Cat.4**
Signal words	***Danger***		***Warning***	
Hazard statements	**H206:** Fire, blast or projection hazard; increased risk of explosion if desentsitizing agent is reduced.	**H207:** Fire or projection hazard; increased risk of explosion if desentsitizing agent is reduced.		**H208:** Fire hazard; increased risk of explosion if desentsitizing agent is reduced.

The precautionary statements are:

Hazard categories		Cat.1	Cat.2	Cat.3	Cat.4
Precautionary statements	*Prevention*	**P210:** Keep away from heat, hot surfaces, sparks open flames and other ignition sources. – No smoking. **P212:** Avoid heating under confinement or reduction of the desensitizing agent. **P230:** Keep wetted with […][1] **P233:** Keep container tightly closed. **P280:** Wear protective gloves/ protective clothing/ eye protection/ face protection.			

	Response	**P371+P380+P375:** In case of major fire and large quantities: Evacuate area. Fight fire remotely due to the risk of explosion.
	Storage	**P401:** Store in accordance with […][1]
	Waste	**P501:** Dispose of contents/container to […][1]

1) *In accordance with local/regional/national/international regulation.* They are supplied by the manufacturer/ supplier and indicated on the container, on the SDS or both.

1.3. Self-reactive chemicals and organic peroxides

Self-reactive chemicals (**SRC**) are substances or mixtures (solids or liquids) that are thermally unstable and liable to undergo a strong exothermic decomposition even without the participation of oxygen (air).

Organic peroxides (**OP**) are substances or mixtures (solids or liquids) which contain a bivalent -O-O- structure and may be considered derivative of hydrogen peroxides, where one or both of the hydrogen atoms have been replaced by organic radicals. OP are thermally unstable and may undergo exothermic self-accelerating decomposition; be liable to explosive decomposition; burn rapidly; be sensitive to impact and friction; or react dangerously with other substances.

Any OP shall be considered for classification in this class, unless it contains:

- Not more than 1.0 % available oxygen from the organic peroxide when containing not more than 1.0 % hydrogen peroxide; or
- Not more than 0.5 % available oxygen from the organic peroxide when containing more than 1.0 % but not more than 7.0 % hydrogen peroxide.

The available oxygen content (%) of an organic peroxide mixture is given by the following formula:

$16 \times \sum_{i}^{n} \left(\frac{n_i \times c_i}{m_i} \right)$	n_i	Number of peroxygen groups per molecule of organic peroxide i
	c_i	Concentration (mass %) of organic peroxide i
	m_i	Molecular mass of organic peroxide i in the mixture ($g.mol^{-1}$)

SRC and **OP** are classified in one of the seven categories "A to G", according to the definitions provided in table 1.3.1. The decision diagram (Fig. 1.3.1) gives a step-by-step procedure to classify these substances according to the tests (tests A to G) described in the RTMD document (Part II).

Table 1.3.1: Classification criteria for self-reactive substances or mixture and for organic peroxides.

Definitions	Categories
Which can detonate or deflagrate rapidly, as packaged.	**A**
Possessing explosive properties and which, as packaged, neither detonates nor deflagrate rapidly, but is liable to undergo a thermal explosion in that package.	**B**
Possessing explosive properties and which, as packaged, cannot detonate nor deflagrate rapidly or undergo a thermal explosion.	**C**
Which, in laboratory testing: i) detonates partially, does not deflagrate rapidly and shows no violent effect when heated under confinement; ii) does not detonate at all, deflagrates slowly and shows no violent effect when heated under confinement; iii) does not detonate or deflagrates at all and shows a medium effect when heated under confinement.	**D**

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Which, in laboratory testing, neither detonates nor deflagrates at all and shows low or no explosive power when heated under confinement.	**E**
Which, in laboratory testing, neither detonates in the cavited state nor deflagrates at all and shows low or no effect when heated under confinement, as well as low or no explosive power.	**F**
Which, in laboratory testing, neither detonates in the cavited state nor deflagrates at all and shows no effect when heated under confinement nor any explosive power is classified as **TYPE G**, provided that it is thermally stable (self-accelerating decomposition temperature is 60 to 75°C for a 50 kg package), and, for liquid mixtures, a diluent having boiling point greater than or equal to 150°C is used for desensitization. If the mixture is not thermally stable or a diluent having a boiling point less than 150°C is used for desensitization is classified as **TYPE F**.	**G**

The labelling elements for SRC and OP are:

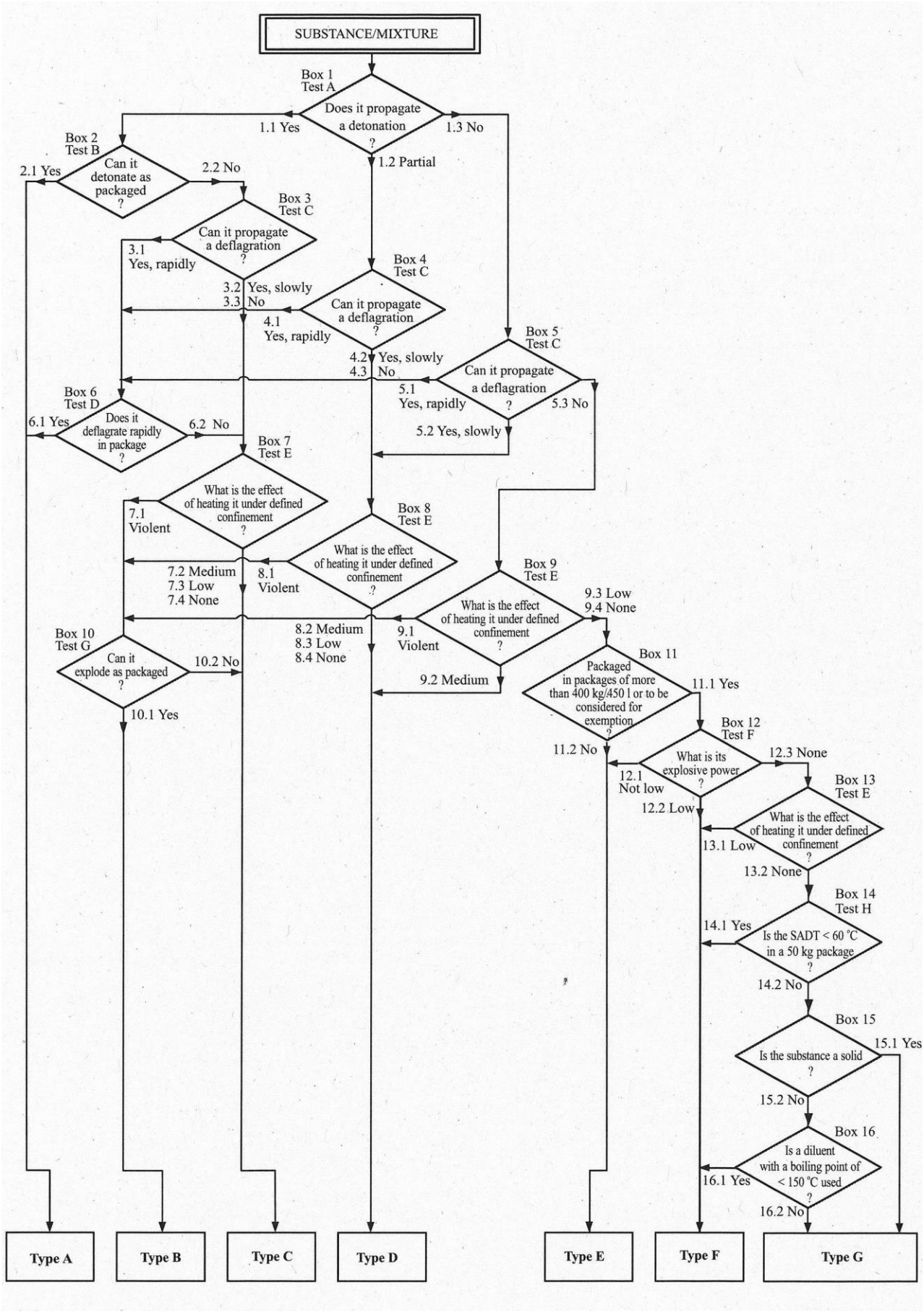
Hazard pictograms		 and 			/
Hazard categories	**Type A**	**Type B**	**Type C+D**	**Type E+F**	**Type G**
Signal words	***Danger***			***Warning***	/
Hazard statements	**H240:** Heating may cause an explosion.	**H241:** Heating may cause a fire or explosion.	**H242:** Heating may cause a fire.		/

The precautionary statements for SRC and OP are:

Hazard categories		Type A	Type B	Type C+D	Type E+F
Precautionary statements	*Prevention*	**P210:** Keep away from heat, hot surfaces, sparks open flames and other ignition sources. – No smoking. **P220:** Keep away from clothing/ .../ combustible materials. **P234:** Keep only in original packaging. **P235:** Keep cool. **P240:** Ground and bound container and receiving equipment. **P280:** Wear protective gloves/ protective clothing/ eye protection/ face protection.			
	Response	**P370+P380+P375:** In case of fire: Evacuate area. Fight fire remotely due to the risk of explosion.			
	Storage	**P403:** Store in a well-ventilated place. **P410:** Protect from sunlight. **P411:** Store at temperatures not exceeding …°C/ …°F [1]. **P420:** Store separately.			
	Waste	**P501:** Dispose of contents/container to…[1]			

1) *In accordance with local/regional/national/international regulation.* They are supplied by the manufacturer/ supplier and indicated on the container, on the SDS or both.

Figure. 1.3.1: Decision diagram for the classification of self-reactive substances and organic peroxides.



1.4. Self-heating substances

Substances or mixtures (solid or liquid), other than pyrophoric, which by reaction with air and without energy supply, is liable to self-heat; this substance or mixture differs from a pyrophoric in that it will ignite only when in large amounts (kilograms) and after a long period of time (hours or days).

Classification in one of the two categories is done following table 1.4.1, according to the test N.4 described in the RTMD document (part III, sub-section 33.3.1.6).

Table 1.4.1: Classification criteria for self-heating substances.

Criteria	Categories
If a positive result is obtained in a test using a 25 mm sample cube at 140°C (test 1).	1
If a positive result is obtained in a test using a 100 mm sample cube at 140°C (and a negative result is obtained during test 1), and the substance or mixture is to be packed in packages with a volume of more than 3 m^3.	2
If a positive result is obtained in a test using a 100 mm sample cube at 120°C (and a negative result is obtained during test 1), and the substance or mixture is to be packed in packages with a volume of more than 450 L.	
If a positive result is obtained in a test using a 100 mm sample cube at 140°C (and a negative result is obtained during test 1), and a positive result is obtained in a test using a 100 mm cube sample at 100°C.	

The labelling elements are:

Pictogram		
Hazard categories	**Cat.1**	**Cat.2**
Signal words	***Danger***	***Warning***
Hazard statements	**H251:** Self-heating; may catch fire.	**H252:** Self-heating in large quantities; may catch fire.

The precautionary statements are:

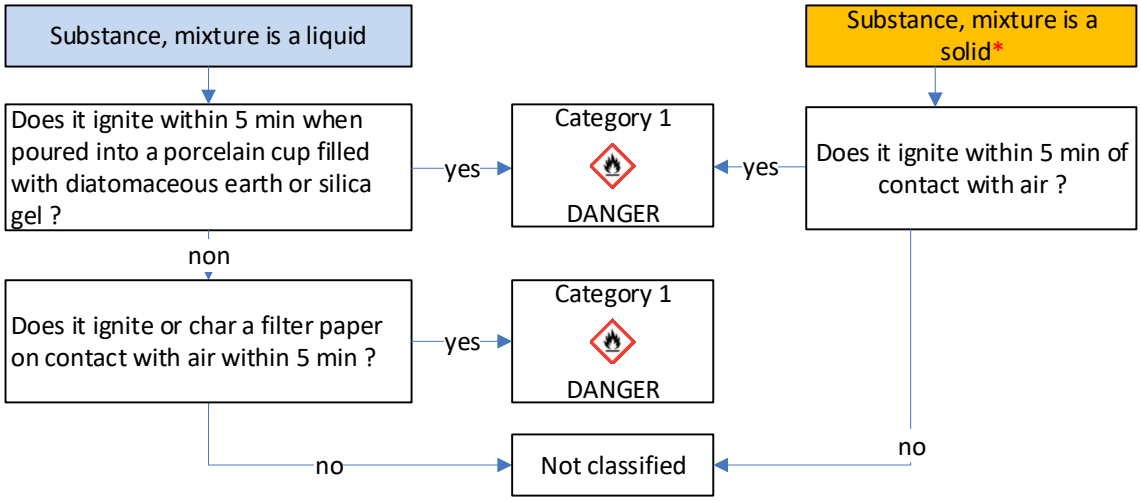
Hazard categories		Cat.1	Cat.2
Precautionary statements	*Prevention*	**P235:** Keep cool (unless P413 is given on the label). **P280:** Wear protective gloves/ protective clothing/ eye protection/ face protection.	
	Response	/	
	Storage	**P407:** Maintain air gap between stacks/ pallets. **P410:** Protect from sunlight. **P413:** Store bulk masses greater than…kg/…lbs at temperatures not exceeding …°C/ …°F [1]. **P420:** Store separately.	
	Waste	/	

1) *In accordance with local/regional/national/international regulation*. They are supplied by the manufacturer/ supplier and indicated on the container, on the SDS or both.

1.5. Pyrophoric liquids and solids

Substances or mixtures (solid or liquid) which, even in small quantities, are liable to ignite within five minutes after coming into contact with air. These substances or mixtures are classified in a single category, using test N.3 of the RTMD document (Part III, sub-section 33.3.1.5) and summarized in figure 1.5.1.

Figure 1.5.1: Decision diagram for pyrophoric liquids and solids.



* For classification test on solid substances and mixtures, the tests should be performed on the substance or mixture as presented. If for example, for the purposes of supply or transport, the same chemical is to be presented in a physical form different from that which was tested and which is considered likely to materially alter its performance in a classification test, the substance or mixture must also be tested in the new form.

The labelling elements are:

Pictogram	
Hazard category	**Cat.1**
Signal word	***Danger***
Hazard statement	**H250:** Catches fire spontaneously if exposed to air.

The precautionary statements are:

Hazard category		**Cat.1**
Precautionary statements	*Prevention*	**P210:** Keep away from heat, hot surfaces, sparks open flames and other ignition sources. – No smoking. **P222:** Do not allow contact with air. **P233:** Keep container tightly closed. **P280:** Wear protective gloves/ protective clothing/ eye protection/ face protection.
	Response	**P302+P334:** IF ON SKIN: Immerse in cool water [or wrap in wet bandages]. **P370+P378:** In case of fire: Use ... to extinguish.[1]
	Storage	/
	Waste	/

1) *In accordance with local/regional/national/international regulation.* They are supplied by the manufacturer/ supplier and indicated on the container, on the SDS or both.

1.6. Flammable, pyrophoric and chemically unstable gases

A **flammable gas** is a gas having a flammability range with air at 20°C and at standard pressure (101.3kPa).

A **pyrophoric gas** is a gas that is liable to ignite spontaneously in air and at a temperature of 54°C or below.

A **chemically unstable gas** is a gas flammable gas that is able to react explosively even in the absence of air or oxygen.

The flammable range (explosive range) is the range of a concentration of a gas or vapor that will burn (or explode) if an ignition source is introduced:

- The **Lower Flammable Limit** (LFL) (lower explosive limit) is the minimum concentration of flammable liquid vapor or gas in air that will support the propagation of flame.
- The **Upper Flammable Limit** (UFL) (upper explosive limit) is the maximum concentration of vapor/gas in air that will support the propagation of flame.
- Increasing the fraction of inert gas in a mixture increases the LFL, but decreases the UFL.

Classification in one of the three categories is done according to table 1.6.1.

Table 1.6.1: Classification criteria for flammable/pyrophoric and chemically unstable gases.

Categories		Criteria
1A	Flammable gas	Gases, which at 20°C and a standard pressure of 101.3 kPa: Are ignitable when in a mixture of 13 vol. % in air; or Have a flammable range with air of at least 12 vol. % regardless of the LEL.
	Pyrophoric gas	Flammable gases that ignite spontaneously in air at a temperature of 54°C or below.
	Chemically unstable gas	**1A** if chemically unstable at 20°C and a standard pressure of 101.3 kPa.
		1B if chemically unstable at a temperature > 20°C and/or a pressure > 101.3 kPa.
1B	Flammable gas	Gases, which meet the flammability criteria for Category 1A, but which are not pyrophoric, nor chemically unstable, and which have at least either: • A LEL < 6 vol. % in air; or • A fundamental burning velocity of less than 10 cm/s.
2	Flammable gas	Gases, other than those in Cat. 1A or 1B, which at 20°C and a standard pressure of 101.3 kPa, have a flammable range while mixed in air.

The flammability of a gas mixture must be evaluated either by calculation or by tests in accordance with the methods adapted by ISO (ISO 10156:2010 and, if using the fundamental burning velocity for category 1B, see ISO 817:2014, annex C).

The determination of a flammable gas mixture by calculation is done according to the following formula. If the calculated value is ≥ 1, then the gas mixture must be classified as flammable (and the flammable pictogram must appear on the label).

$\sum_{i}^{n} \frac{V_i\,\%}{T_{ci}}$	V%	Equivalent flammable gas content.
	Tc*i*	Maximum concentration of a flammable gas in nitrogen at which the mixture is still not flammable in air.
	i	First gas in the mixture.
	n	N^{th} gas in the mixture

The labelling elements are:

Pictogram						/
Hazard categories	**Flammable**	**Pyrophoric**	**Chemically unstable**		**Flammable**	
	1A	**1A**	**1A**	**1B**	**1B**	**2**
Signal words	***Danger***					***Warning***
Hazard statements	**H220:** Extremely flammable gas.	**H220:** Extremely flammable gas. **H232:** May ignite spontaneously if exposed to air.	**H220:** Extremely flammable gas. **H230:** May react explosively even in the absence of air.	**H220:** Extremely flammable gas. **H231:** May react explosively even in the absence of air at elevated pressure and/or temperature.	**H221:** Flammable gas.	

The precautionary statements are:

Hazard categories		**Cat.1A and 1B**	**Cat.2**
Precautionary statements	*Prevention*	**P210:** Keep away from heat, hot surfaces, sparks open flames and other ignition sources. – No smoking.	
	Response	**P377:** Leaking gas fire: Do not extinguish, unless leak can be stopped safely. **P381:** In case of leakage, eliminate all ignition sources.	
	Storage	**P403:** Store in a well-ventilated place.	
	Waste	/	

The following additional Precautionary Statements must be taken into account:

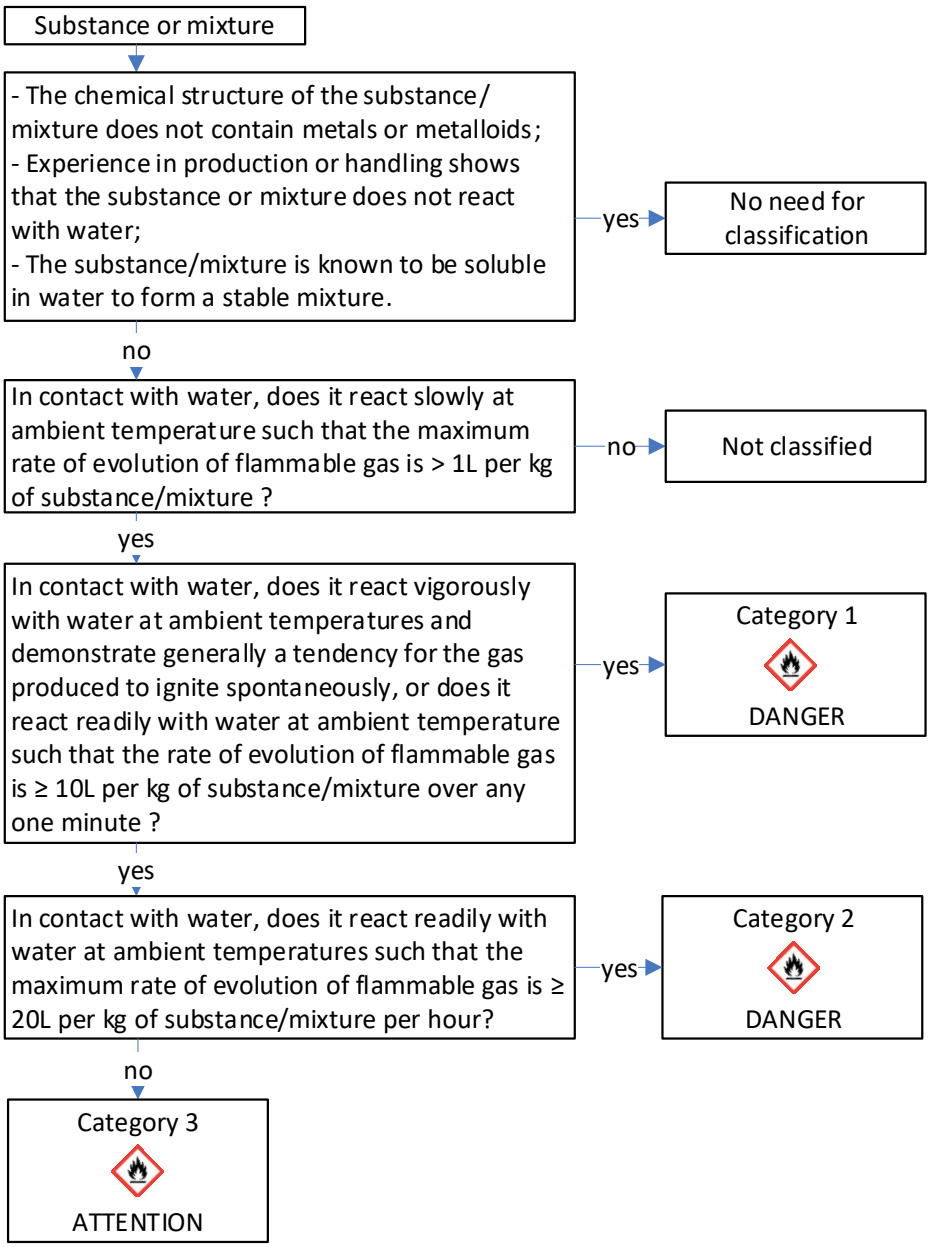
a) Pyrophoric gases (Cat. 1A)
   - **P222:** Do not allow contact with air.
   - **P280:** Wear protective gloves/ protective clothing/ eye protection/ face protection.

b) Chemically unstable gases (Cat. 1A et 1B)
   - **P202:** Do not handle until all safety precautions have been read and understood.

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

Substances or mixtures (solids or liquids) which, by interaction with water, are liable to become spontaneously flammable or give off flammable gases in dangerous quantities. These substances and mixtures are classified in one of the three categories, using test N.5 of the RTMD (Part III, sub-section 33.4.1.4) as illustrated in figure 1.7.1 below.

Figure 1.7.1: Decision diagram for substances and mixtures (solids and liquids) which, when in contact with water, emit flammables gases.



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The labelling elements are:

Pictogram			
Hazard categories	**Cat.1**	**Cat.2**	**Cat.3**
Reacts with water at room temperature	- vigorously; - gas produced ignite spontaneously, or produces flammable gases ≥ 10L/ kg per minute.	- readily; - flammable gas produced≥ 20 L/kg per hour, and which does not meet the criteria for Cat. 1	- slowly; - flammable gas produced ≥ 1 L/kg per hour, and which does not meet the criteria for Cat. 1 and 2.
Signal words	***Danger***		***Warning***
Hazard statements	**H260:** In contact with water releases flammable gases, which may ignite spontaneously.	**H261:** In contact with water releases flammable gas.	

The precautionary statements are:

Hazard categories		**Cat.1**	**Cat.2**	**Cat.3**
Precautionary statements	*Prevention*	**P223:** Do not allow contact with water.		/
		P231+P232: Handle and store contents under inert gas/… Protect from moisture. **P280:** Wear protective gloves/ protective clothing/ eye protection/ face protection.		
	Response	**P302+P335+P334:** IF ON SKIN: Brush off loose particles from skin and immerse in cold water.		/
		P370+P378: In case of fire: Use[1] ... to extinguish.		
	Storage	**P402+P404:** Store in a dry place. Store in a closed container.		
	Waste	**P501:** Dispose of contents/container to…[1]		

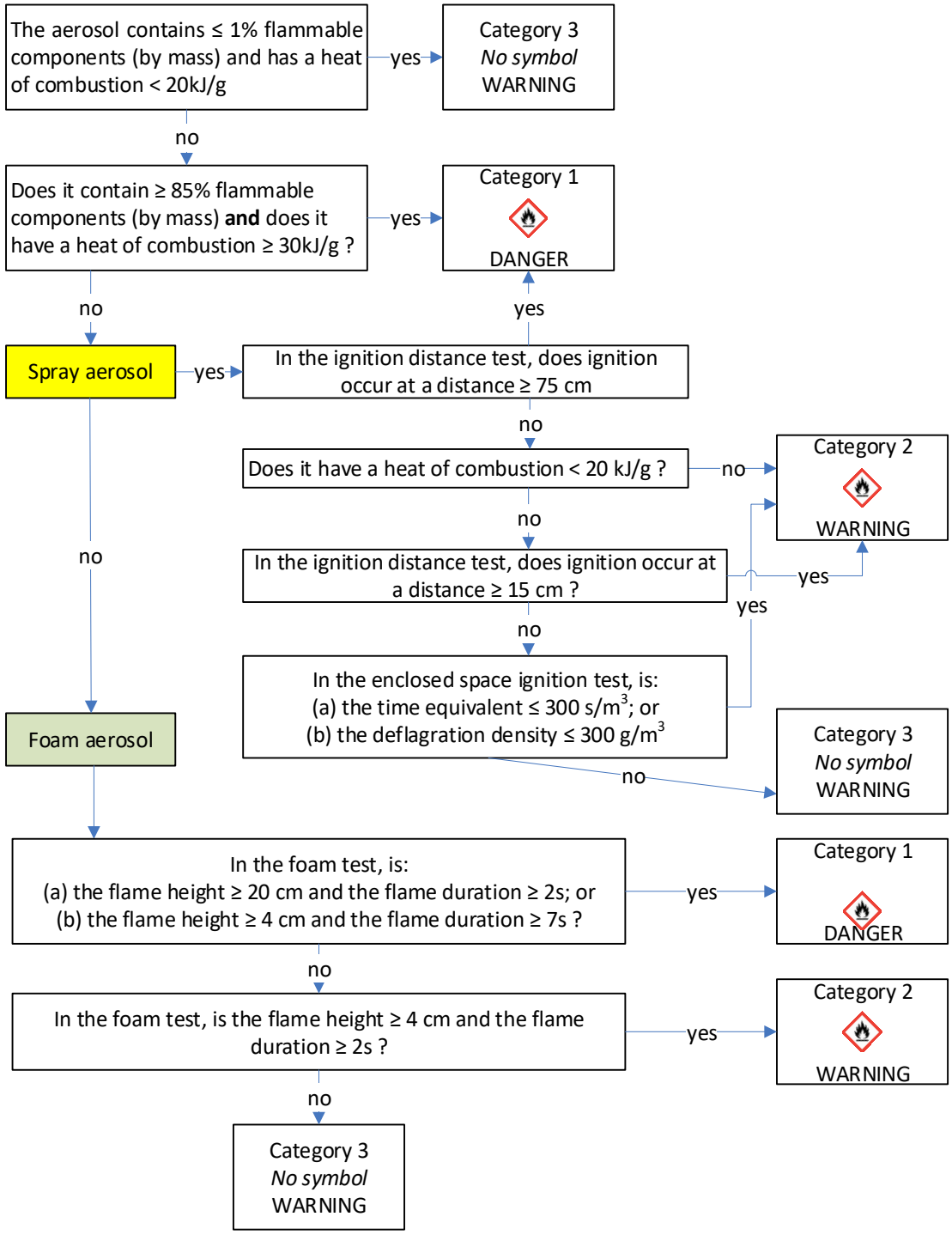
1) *In accordance with local/regional/national/international regulation.* They are supplied by the manufacturer/ supplier and indicated on the container, on the SDS or both.

1.8. Aerosols (dispensers)

Aerosols dispensers are non-refillable receptacles made of metal, glass or plastic and containing a gas compressed, liquefied or dissolved under pressure, with or without a liquid, paste or powder, and fitted with a release device allowing the content to be ejected as solid or liquid particles in suspension in a gas, as a foam, paste or powder or in a liquid state or in a gaseous state. Note that the propelling gas is not taken into account when calculating the aerosol toxicity, unless it contributes to the overall toxicity of the mixture.

Aerosols dispensers are classified in one of three categories depending on their flammable properties and their heat of combustion, according to figure 1.8.1.

Figure 1.8.1: Decision diagram for aerosols dispensers.



PHYSICAL HAZARDS

The labelling elements are:

Pictogram			
Hazard categories	**Cat.1**	**Cat.2**	**Cat.3**
Classification criteria	Contains ≥ 85% flammable components (by mass) and has a heat of combustion ≥ 30kJ/g.	Positive towards the enclosed space ignition test.	Not flammable.
Signal words	***Danger***	***Warning***	
Hazard statements	**H222:** Extremely flammable aerosol.	**H223:** Flammable aerosol.	/
	H229: Pressurized container. May burst if heated.		

The precautionary statements are:

Hazard categories		**Cat.1**	**Cat.2**	**Cat.3**
Precautionary statements	*Prevention*	**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.		/
		P251: Do not pierce or burn, even after use.		
	Response	/		
	Storage	**P410+P412:** Protect from sunlight. Do not expose to temperatures exceeding 50°C/122°F.		
	Waste	/		

For composite aerosols formulation, the chemical heat of combustion is the summation of the weighted heats of combustion of each the individual components, as follows:

$$\Delta H_c \text{ (produit)} = \sum_{i}^{n} [w_i \% \text{ x } \Delta H_{c(i)}]$$

ΔH_c	Chemical heat of combustion (kJ/g)
$w_i\%$	Mass fraction of component I in the product
$\Delta H_{c(i)}$	Specific heat of combustion (kJ/g) of component I in the product

The chemical heats of combustions can be found in the literature, calculated or determined by tests (see norms ASTM D 240, ISO/FDIS 13943:1999 (E/F) 86.1 to 86.3 and NFPA 30B).

For the classification of foam aerosols, one must know the tests results for the flame height & duration; and for the spray aerosols, one must know the results of the ignition distance test and the enclosed space ignition test (RTMD part III, sub-sections 31.4 to 31.6).

1.9. Flammable liquids

A flammable liquid means a liquid with a **flash point** (**FP**) ≤ 93°C. They are classified in one of the four categories depending on their flash points, their boiling points (BP) as indicated in figure 1.10 (note that figure 1.10 regroups flammable liquids and solids).

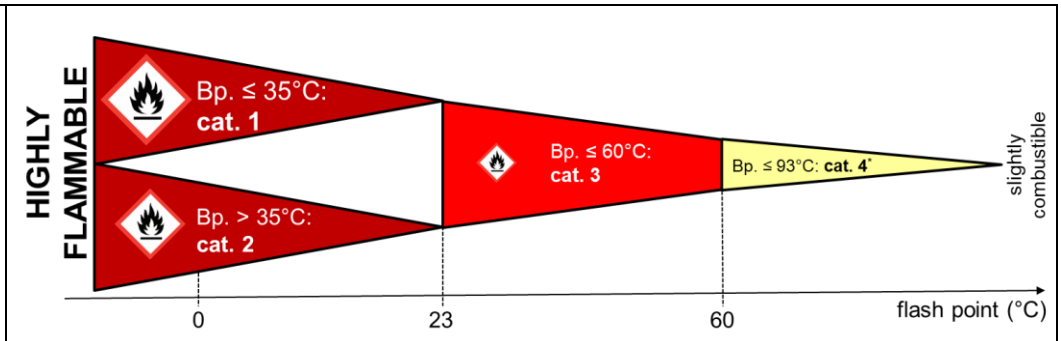
The **FP** means the lowest temperature (corrected to a standard pressure of 101.3kPa) at which the application of an ignition source causes the vapors of a liquid to ignite. In other words, the FP of a liquid is reached when its vapor pressure is equal to the lower flammability limit. The total vapor pressure of a liquid mixture is the sum of the individual components' partial pressures.

The partial pressure (Pi) of a component i of the mixture is equal to the vapor pressure of the pure component at the temperature of the mixture multiplied by its mole fraction in this mixture. Partial pressures Pi are calculated according to Raoult's law: $\mathbf{P_i = x_i \gamma_i P_i^{sat}}$ where:

P_i	Partial pressure of component *i* in gaseous phase above the liquid at T = boiling temperature
x_i	Molar fraction of component *i* in liquid phase ($\sum_i x_i = 1$)
γ_i	Activity coefficient of component *i* in liquid phase at temperature T in the mixture.
P_i^{sat}	Saturation pressure of component *i* in liquid phase at temperature T in the mixture.

P_i^{sat} can be calculated according to the law of Antoine: $\mathbf{\log P_i^{sat} = A_i - B_i / (T+C_i)}$ with T in Kelvin and P_i^{sat} in bars. A, B and C are empirical parameters called Antoine's coefficients.

The labelling elements and the classification criteria are:

<table>
<tr><td>Pictogram</td><td colspan="4"> 
</td></tr>
<tr><td>Hazard categories</td><td>Cat.1</td><td>Cat.2</td><td>Cat.3</td><td>Cat.4*</td></tr>
<tr><td>Flash point (FP)</td><td colspan="2">< 23°C</td><td>23°C ≤ PE ≤ 60°C</td><td>60°C ≤ PE ≤ 93°C</td></tr>
<tr><td>Boiling point (BP)</td><td>≤ 35°C</td><td colspan="3">> 35°C</td></tr>
<tr><td>Signal words</td><td colspan="2">Danger</td><td colspan="2">Warning</td></tr>
<tr><td>Hazard statements</td><td>H224: Extremely flammable liquid and vapor.</td><td>H225: Highly flammable liquid and vapor.</td><td>H226: Flammable liquid and vapor.</td><td>H227: Combustible liquid.</td></tr>
</table>

*not included in the CLP.

The precautionary statements are:

<table>
<tr><th colspan="2">Hazard categories</th><th>Cat.1</th><th>Cat.2</th><th>Cat.3</th><th>Cat.4*</th></tr>
<tr><td rowspan="5">Precautionary statements</td><td rowspan="2">Prevention</td><td colspan="3">P233: Keep container tightly closed.
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.</td><td>/</td></tr>
<tr><td colspan="4">P210: Keep away from heat, hot surfaces, sparks open flames and other ignition sources. – No smoking.
P280: Wear protective gloves/ protective clothing/ eye protection/ face protection.</td></tr>
<tr><td>Response</td><td colspan="4">P303+P361+P353: IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water [or shower].
P370+P378: In case of fire: Use[1] ... to extinguish.</td></tr>
<tr><td>Storage</td><td colspan="4">P403+P235: Store in a well-ventilated place. Keep cool.</td></tr>
<tr><td>Waste</td><td colspan="4">P501: Dispose of contents/container to…[1]</td></tr>
</table>

*not included in the CLP.

1) *In accordance with local/regional/national/international regulation*. They are supplied by the manufacturer/ supplier and indicated on the container, on the SDS or both.

1.10. Flammable solids

A **flammable solid** is a substance or a mixture, which is readily combustible, or may cause or contribute to fire through friction.

A **readily flammable solid** is a powered, granular, or pasty substance or a mixture which is dangerous if it can be easily ignited by brief contact with an ignition source such as a burning match, and if the flame spreads rapidly.

Such substances or mixture must be classified in one of the two categories of this hazard class according to their time and rate of burning. The classification criteria are presented in figure 1.10 and summarized in the table below.

The labelling elements and the classification criteria are:

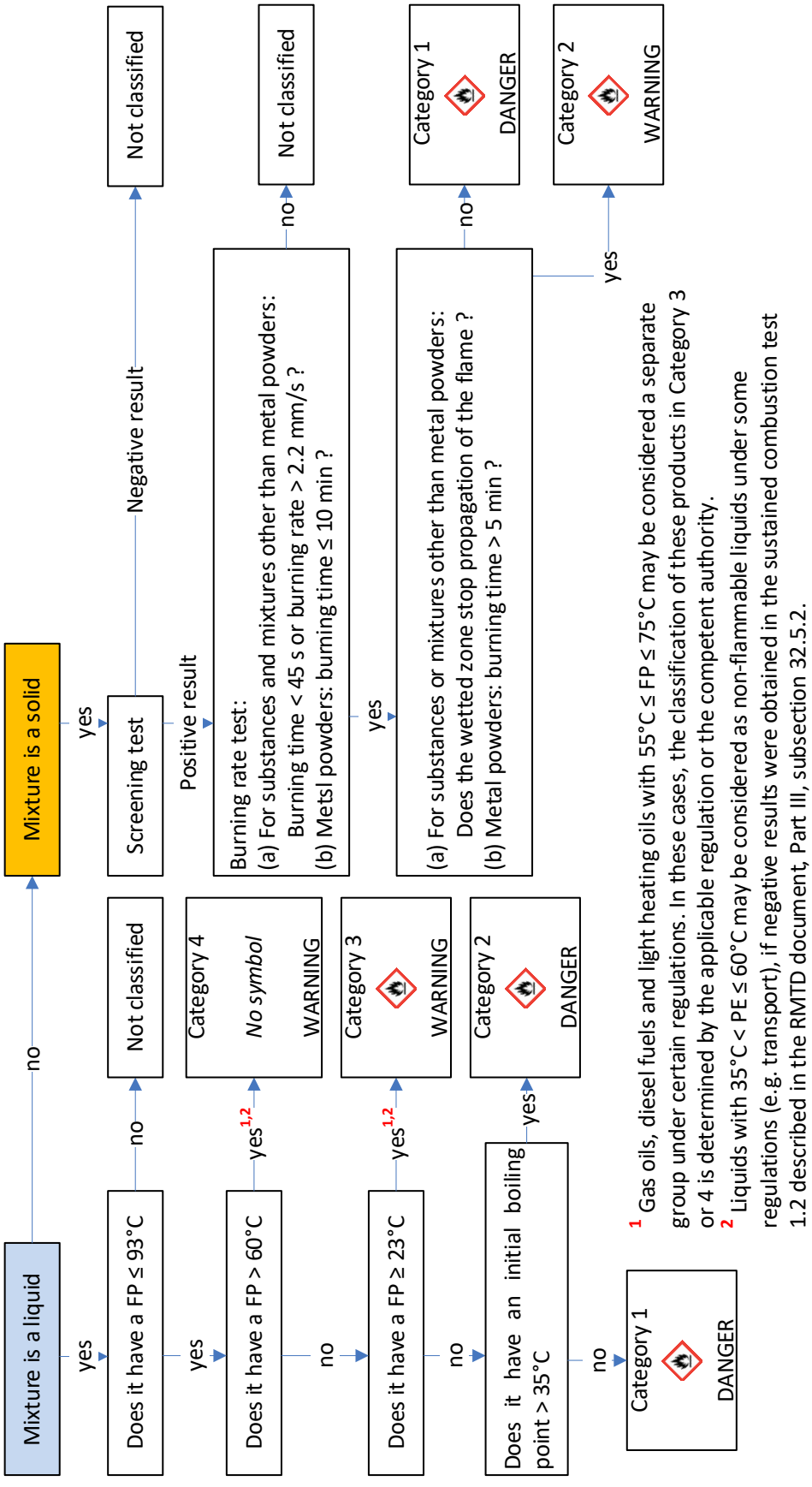
Pictogram				
Hazard categories	**Cat.1**		**Cat.2**	
Solid type	Substances or mixtures other than metal powders	Metal powders	Substances or mixtures other than metal powders	Metal powders
Wetted zone	does not stop fire	n/a	stops the fire for at least 4 min	n/a
Burning time (Tc) Burning rate (Vic)	Tc < 45 sec or Vc > 2.2 mm/s	Tc ≤ 5 min	Tc < 45 sec or Vc > 2.2 mm/s	5 min ≤ Tc ≤ 10 min
Signal words	***Danger***		***Warning***	
Hazard statement	**H228:** Flammable solid.			

The precautionary statements are:

Hazard categories		**Cat.1**	**Cat.2**
Precautionary statements	*Prevention*	**P210:** Keep away from heat, hot surfaces, sparks open flames and other ignition sources. – No smoking. **P240:** Ground/ bond container and receiving equipment. **P241:** Use explosion-proof [electrical/ ventilating/ lighting/ ...] equipment. **P280:** Wear protective gloves/ protective clothing/ eye protection/ face protection.	
	Response	**P370+P378:** In case of fire: Use[1] ... to extinguish.	
	Storage	/	
	Waste	/	

1) *In accordance with local/regional/national/international regulation*. They are supplied by the manufacturer/ supplier and indicated on the container, on the SDS or both.

Figure 1.10: Decision diagram for flammable substances and mixtures, solids or liquids.



1.11. Oxidizing gases

An oxidizing gas is any gas which may, generally by providing oxygen, cause or contribute to the combustion of other material more than air does. This means a pure gas or a gas mixture with an **oxidizing power** > 23.5 % must be classified in the single category of this hazard class.

The oxidizing power (PC = Pouvoir Comburant in French) is calculated as follow:

$$PC = \frac{\sum_{i=1}^{n} x_i C_i}{\sum_{i=1}^{n} x_i + \sum_{k=1}^{p} K_k B_k}$$

x_i	Molar fraction of the i^{th} oxidizing gas in the mixture
C_i	Coefficient of oxygen equivalency of the i^{th} oxidizing gas in the mixture
K_k	Coefficient of equivalency of the inert gas k compared to nitrogen
B_k	Molar fraction of the k^{th} inert gas in the mixture
N	Total number of oxidizing gases in the mixture
P	Total number of inert gases in the mixture

The labelling elements are:

Pictogram	
Hazard category	**Cat.1**
Signal word	***Danger***
Hazard statement	**H270:** May cause or intensify fire; oxidizer.

The precautionary statements are:

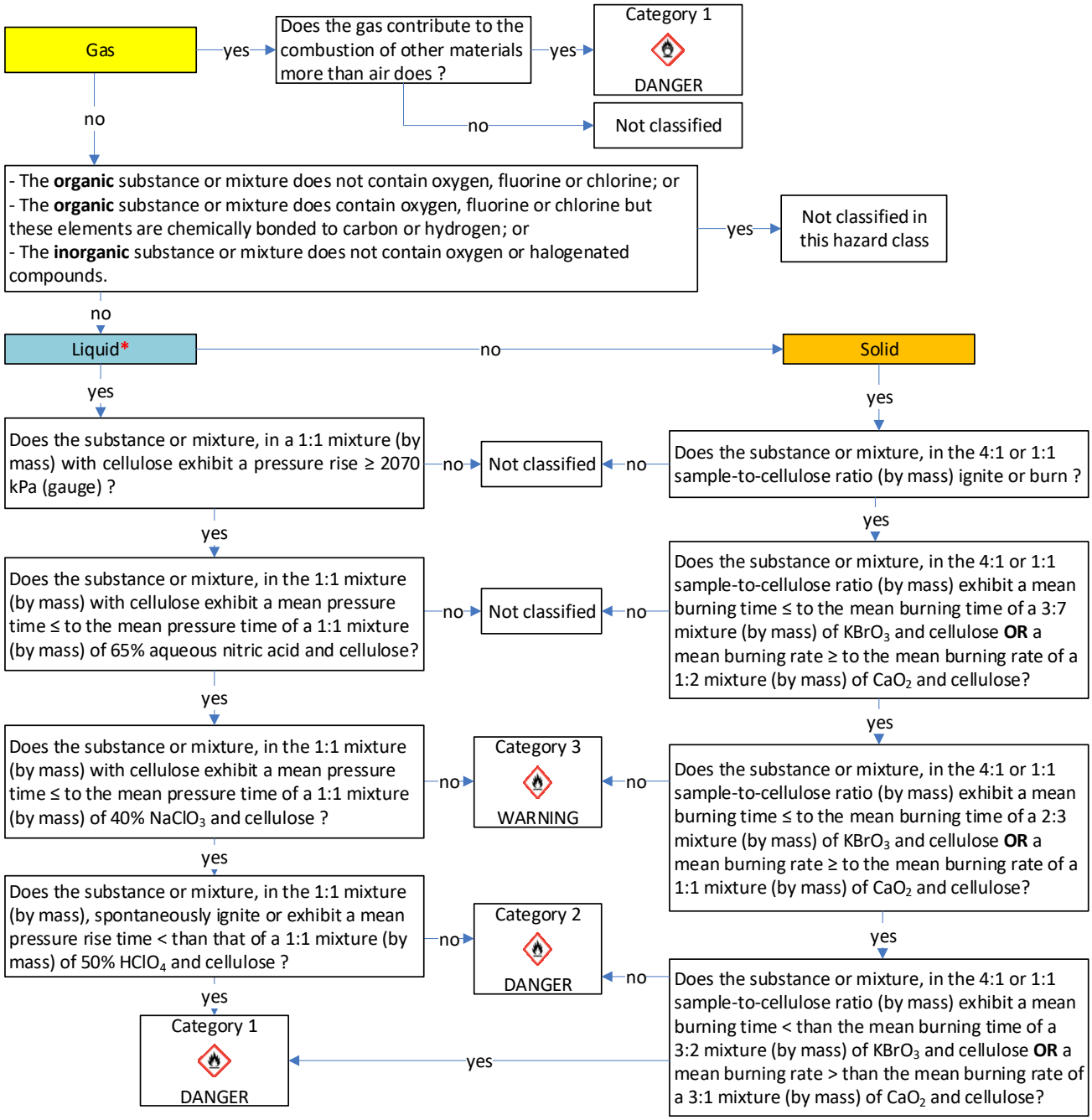
Hazard category		**Cat.1**
Precautionary statements	*Prevention*	**P220:** Keep away from clothing/ .../ combustible materials. **P244:** Keep valves and fittings free from oil and grease.
	Response	**P370+P376:** In case of fire: Stop leak if safe to do so.
	Storage	**P403:** Store in a well-ventilated place.
	Waste	/

1.12. Oxidizing liquids and solids

A substance or mixture (solid or liquid) which, while in itself not necessarily combustible, may, generally by providing oxygen, cause or contribute to the combustion of other material.

These substances and mixtures are classified in one of the three categories according to the RTMD (part III, sub-section 34.4.1 and 34.4.2 for solids and liquids respectively). Figure 1.12.1 describes the classification process for oxidizing solids liquids and gases as well.

Figure 1.12.1: Decision diagram for oxidizing gases, liquids and solids.



*For certain liquid materials, a higher or lower pressure rise than expected may occur due to chemical reactions unrelated to the oxidizing properties of the material. In this case, it may be necessary to repeat the test described in sub-section 34.4.2 of the RTMD, using an inert diatomite material, instead of cellulose, in order to have a non-ambiguous reactive reaction.

PHYSICAL HAZARDS

The labelling elements are:

Pictogram			
Hazard categories	**Cat.1**	**Cat.2**	**Cat.3**
Signal words	***Danger***		***Warning***
Hazard statements	**H271:** May cause fire or explosion; strong oxidizer.	**H272:** May intensity fire; oxidizer.	

The precautionary statements are:

Hazard categories		**Cat.1**	**Cat.2**	**Cat.3**
Precautionary statements	*Prevention*	**P210:** Keep away from heat, hot surfaces, sparks open flames and other ignition sources. – No smoking. **P220:** Keep away from clothing/ .../ combustible materials. **P280:** Wear protective gloves/ protective clothing/ eye protection/ face protection.		
		P283: Wear fire resistant or flame retardant Clothing.	/	
	Response	**P306+P360:** IF ON CLOTHING: Rinse immediately contaminated clothing and skin with plenty of water before removing clothes. **P371+P380+P375:** In case of major fire and large quantities: Evacuate area. Fight fire remotely due to the risk of explosion.	/	
		P370+P378: In case of fire: Use[1] ... to extinguish.		
	Storage	**P420:** Store separately.	/	
	Waste	**P501:** Dispose of contents/container to…[1]		

1) *In accordance with local/regional/national/international regulation*. They are supplied by the manufacturer/ supplier and indicated on the container, on the SDS or both.

1.13. Gases under pressure

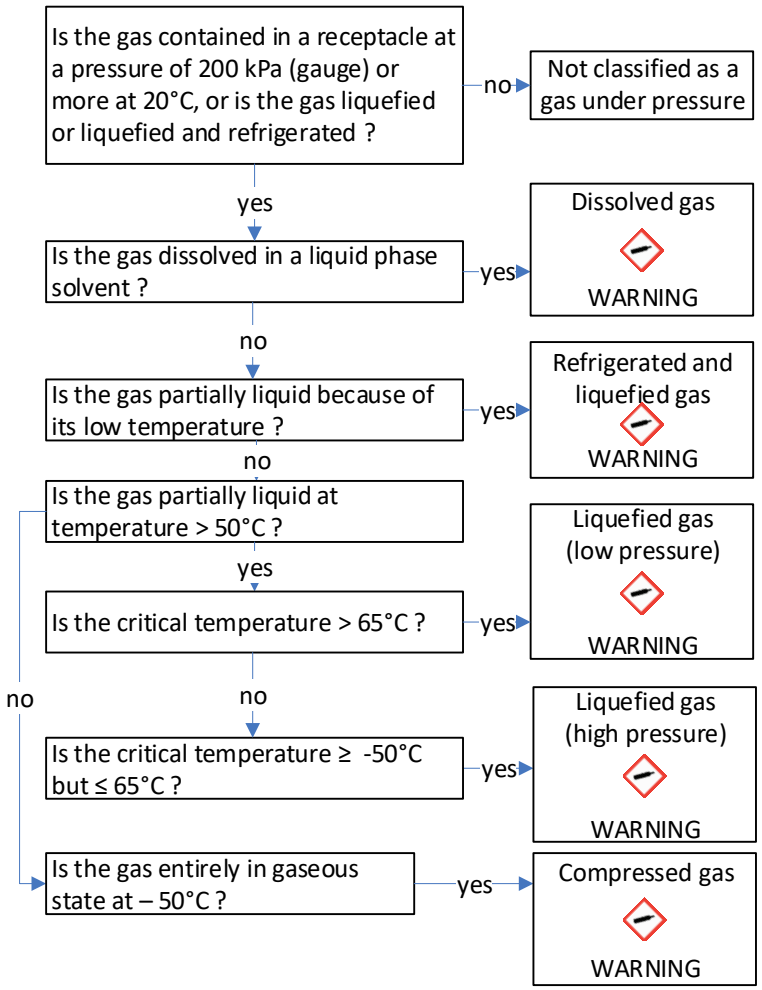
Gases under pressure means gases, which are contained in a receptacle at a pressure of 200 kPa or more at 20°C, or which are liquefied or liquefied and refrigerated. They are comprised of compressed gases, liquefied gases, dissolved gases and refrigerated liquefied gases.

Such a gas under pressure must be classified in one of the four categories following figure 1.13.1 and according to their physical state when packaged. The following information must be known:

- Vapor pressure at 50°C;
- Physical state at 20°C at standard ambient pressure;
- Critical temperature (temperature above which a pure gas cannot be liquefied, regardless of the degree of compression).

These values can be found in the literature, calculated or determined by testing. Most pure gases are already classified in the RTMD document.

Figure 1.13.1: Decision diagram for gases under pressure.



PHYSICAL HAZARDS

The labelling elements are:

Pictogram				
Hazard Classification *(hazard class divided into 'Groups' instead of 'Categories')*	**Compressed** (entirely gaseous @ -50°C: includes gases with a critical temp. (T_c) ≤ -50°C).	**Liquefied** (partially liquid at T >-50°C: high pressure liquefied gas: -50°C <T_c ≤+65°C and gas with T_c> +65°C).	**Dissolved** (dissolved in a liquid phase solvent).	**Refrigerated liquefied** (partially liquid because of its low temperature).
Signal word	***Warning***			
Hazard statements	**H280:** Contains gas under pressure; may explode if heated.			**H281:** Contains refrigerated gas; may cause cryogenic burns or injury.

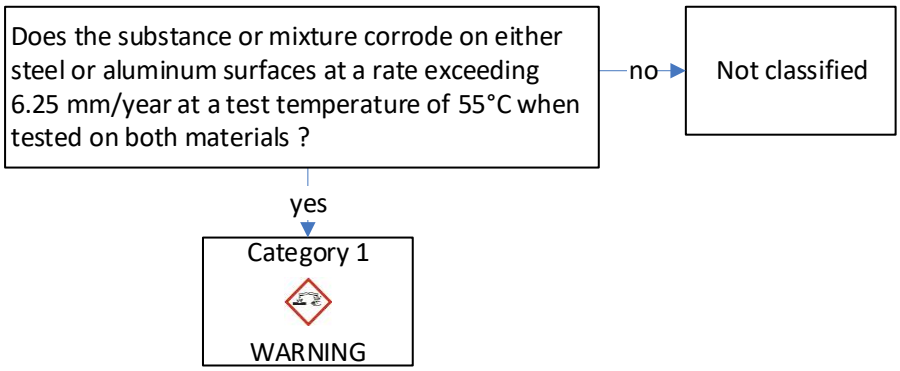
The precautionary statements are:

Hazard categories		**Compressed, liquefied or dissolved**	**Refrigerated liquefied**
Precautionary statements	*Prevention*	/	**P282:** Wear cold insulating gloves and either face shield or eye protection.
	Response	/	**P336+P315:** Thaw frosted parts with lukewarm water. Do not rub affected area. Get immediate medical advices/attention.
	Storage	**P410+P403:** Protect from sunlight. Store in a well-ventilated place.	**P403:** Store in a well-ventilated place.
	Waste	/	

1.14. Corrosive to metals

Substances or mixtures (solid or liquid) which by chemical action will materially damage or even destroy metals. Such a substance or mixture must be classified in the single category for this hazard class, using the RTMD document (part III, sub-section 37.4), and presented in figure 1.14.1.

Figure 1.14.1: Decision diagram for substances corrosive to metals.



** Where an initial test on either steel or aluminum indicates the substance or mixture being tested is corrosive the follow-up test on the other material in not required.*

The labelling elements are:

Pictogram	
Hazard category	**Cat.1**
Signal word	***Warning***
Hazard statement	**H290:** May be corrosive to metals.

The precautionary statements are:

Hazard category		**Cat.1**
Precautionary statements	*Prevention*	**P234:** Keep only in original packaging.
	Response	**P390:** Absorb spillage to prevent material-damage.
	Storage	**P406:** Store in a corrosion resistant/ …[1] container with a resistant inner liner. May be omitted if **P234** is given on the label.
	Waste	/

1) *In accordance with local/regional/national/international regulation*. They are supplied by the manufacturer/ supplier and indicated on the container, on the SDS or both.

2. Health hazards

The **10 classes of health hazards** of the GHS system are presented and, as depicted below, regrouped according to their pictograms (for more clarity, some classes have been grouped according to their pictograms and hazard categories).

Hazard classes			Hazard categories				
Short term toxicity	Acute toxicity		1 to 3	4			5*
	Skin	Corrosion/ irritation	1A, B & C	2			3*
		Sensitization		1			
	Serious eye damage/ eye irritation		1	2A			2B*
	Respiratory tract	Sensitization	1				
		Irritation		STOT-SE 3			
Long term toxicity	Mutagenicity		1A & 1B	2			
	Carcinogenicity		1A & 1B	2			
	Reprotoxicity		1A & 1B	2	effects on lactation		
	Specific Target Oriented Toxicity (STOT)	Single exposure (SE)	1	2			
				3			
		Repeated exposure (RE)	1	2			
	Aspiration hazard		1	2*			

*not included in CLP.

2.1 Acute toxicity

Acute toxicity refers to those adverse effects (including death) occurring through oral or dermal administration of a single dose of a substance, or multiple doses given within 24 hours, or through an inhalation exposure of 4 hours.

Substances can be allocated to one of five toxicity categories (cat. 5 is not included in CLP) based on acute toxicity by the oral, dermal or inhalation route according to the numeric Cut-off Values as shown in table 2.1.1.

In addition, the classification can be established for each route of exposure, but it is only necessary for a single route when this route is valid for all components. If acute toxicity is determined for several routes of exposure, the most severe hazard category will be used for the classification.

Acute toxicity values are expressed as **LD_{50}** values (oral and dermal exposure), **LC_{50}** (inhalation exposure), or **Acute Toxicity Estimate** (**ATE**) according to table 2.1.1. Category 5 (excluded from Table 2.1.1) indicates a low acute toxicity, but still potentially dangerous for vulnerable populations (i.e. children, elderly). The LD_{50} (oral or dermal) for this category is in the range of 2000-5000 mg/kg of body weight.

Useful definitions:

LC_{50} : median lethal concentration (lethal response in 50% of the population)

LD_{50} : median lethal dose

Dust: solid particles of a substance or mixture suspended in a gas (usually air).

Mist: liquid droplets of a substance or mixture suspended in a gas (usually air).

Vapor: the gaseous form of a substance or mixture released from its liquid or solid state.

Dust is generally formed by mechanical processes. Mist is generally formed by condensation of supersaturated vapors or by physical shearing of liquids. Dusts and mists generally have sizes ranging from less than 1 to about 100 µm.

Table 2.1.1: Acute toxicity estimate (ATE) for hazard category determination.

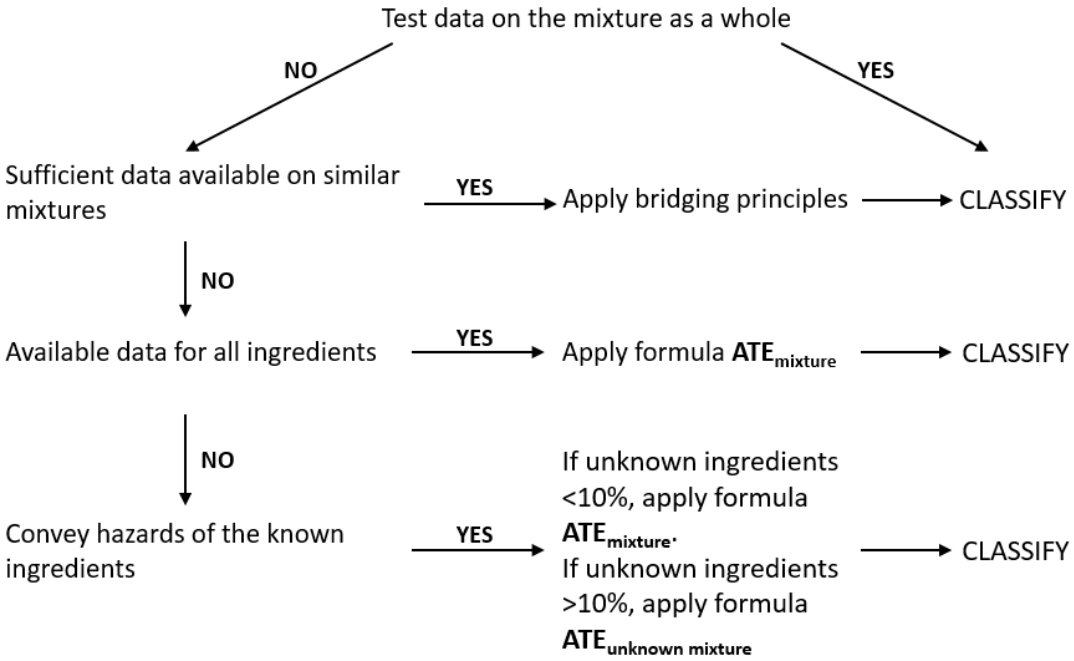
Exposure routes	Cat. 1	Cat. 2	Cat. 3	Cat. 4
Oral (mg/kg bodyweight)	ATE ≤ 5	5 < ATE ≤ 50	50 < ATE ≤ 300	300 < ATE ≤ 2000
Dermal (mg/kg bodyweight)	ATE ≤ 50	50 < ATE ≤ 200	200 < ATE ≤ 1000	1000 < ATE ≤ 2000
Gases (ppmV)	ATE ≤ 100	100 < ATE ≤ 500	500 < ETA ≤ 2500	2500 < ATE ≤ 20000
Vapors (mg/l)	ATE ≤ 0.5	0.5 < ATE ≤ 2	2 < ATE ≤ 10	10 < ATE ≤ 20
Dust/mist (mg/l)	ATE ≤ 0.05	0.05 < ATE ≤ 0.5	0.5 < ATE ≤ 1	1 < ATE ≤ 5

Notes:

1. The ATE for the substances is derived directly from the LD_{50} and LC_{50} values, where available.
2. The ATE for mixtures is derived from the LD_{50} and LC_{50} values, where available; otherwise from the appropriate conversion values resulting from a test or a classification category (table 2.1.2).
3. The threshold values for inhalation are based on a 4h exposure. To convert the data to express an exposure per hour, divide by 2 for gases and vapors, and by 4 for dusts and mists.

For the classification of mixtures, it is necessary to proceed stepwise according to the available information for the mixture itself and for its components (Fig. 2.1.1).

Figure 2.1.1: Tiered approach to classification of mixtures for acute toxicity. See explanations below for $ATE_{mixture}$ and $ATE_{unknown\ mixture}$.



The **bridging principles** are:

Dilution:
If a mixture is diluted with a diluent that has an equivalent or lower toxicity classification than the least toxic original ingredient, and which is not expected to affect the toxicity of the other ingredients, then the new diluted mixture may be classified as equivalent to the original mixture or substance.

Batching:
The toxicity of one production batch of a mixture can be assumed to be substantially equivalent to that of another production batch of the same commercial product, and produced by or under the control of the same manufacturer, unless there is reason to believe there is significant variation such that the toxicity of the batch has changed. If the latter occurs, new classification is necessary.

Concentration of highly toxic mixtures:
If a mixture is already classified in the highest hazard category, an untested mixture that contains a higher concentration of those ingredients that are in that category should be classified in the same highest category without additional testing.

Interpolation within one hazard category:
For three mixtures (A, B and C) with identical ingredients, where mixtures A and B have been tested and are in the same toxicity category, and where untested mixture C has the same toxicologically active ingredients as mixtures A and B, but has concentrations of toxicologically active ingredients intermediate to the concentrations in mixtures A and B, then mixture C is assumed to be in the same hazard category as A and B.

Substantially similar mixtures:

a) Giving the following two mixtures: i) A+B

ii) C+B

b) The concentration of ingredient B is essentially the same in both mixtures ($[B]^{i} \approx [B]^{ii}$);

c) The concentration of ingredient A in mixture (i) equals that of ingredient C in mixture (ii) ($[A]^{i} = [C]^{ii}$);

d) Data on toxicity for A and C are available and substantially equivalent, i.e. they are in the same hazard category and are not expected to affect the toxicity of B.

If the mixture (i) or (ii) is already classified based on test data, then the other mixture can be assigned the same hazard category.

ATE mixture:

If the ATE values for all relevant ingredients are known, the ATE of the mixture is determined by the following formula for Oral, Dermal or Inhalation toxicity:

$\frac{100}{ATE_{mix}} = \sum_{n} \frac{C_i}{ATE_i}$	C_i	Concentration of ingredient i (% w/w or v/v)
	n	Number of ingredients i from 1 à n
	ATE_i	Acute Toxicity Estimate of ingredient i

Notes:

1. This formula can be used as long as the total concentration of the ingredient(s) with unknown acute toxicity is ≤ 10 %.
2. Ignore ingredients that are presumed not acutely toxic (e.g., water, sugar).
3. Ignore ingredients if the oral limit test does not show acute toxicity at 2'000 mg/kg/body weight.

If for a component the LD_{50} or LC_{50} is not available but the classification of this component is already known, it is possible to find an equivalence of ATE_i according to table 2.1.2. Once the $ATE_{mixture}$ is known, use the same table to obtain the corresponding classification.

ATE unknown mixture:

If the total concentration of the ingredient(s) with unknown toxicity is > 10 %, the following formula applies:

$\frac{100 - (\sum C_{unknown})}{ATE_{mix}} = \sum_{n} \frac{C_i}{ATE_i}$	$C_{unknown}$	Concentration of each ingredient for which no toxicological data is available.

Finally, when the concentration of a component in a mixture is ≥ 1 % and no valid toxicological information about the compound's acute toxicity exist, it shall be indicated as: "X % of the mixture consists of component(s) of unknown acute toxicity". The competent authority will decide whether this indication should appear on the SDS, on the product label or on both.

Table 2.1.2: Conversion from the experimentally obtained acute toxicity range values (or acute toxicity hazard categories) to acute toxicity point estimates for use in the formulas for the classification of mixtures.

Exposure routes	**Classification or experimentally obtained acute toxicity range estimate**	**Conversion to estimated acute toxicity values**
Oral (mg/kg bodyweight)	0 < Category 1 ≤ 5 5 < Category 2 ≤ 50 50 < Category 3 ≤ 300 300 < Category 4 ≤ 2000	0.5 5 100 500
Dermal (mg/kg bodyweight)	0 < Category 1 ≤ 50 50 < Category 2 ≤ 200 200 < Category 3 ≤ 1000 1000 < Category 4 ≤ 2000	5 50 300 1100
Gases (ppmV: parts per million per volume)	0 < Category 1 ≤ 100 100 < Category 2 ≤ 500 500 < Category 3 ≤ 2500 2500 < Category 4 ≤ 20000	10 100 700 4500
Vapors (mg/L)	0 < Category 1 ≤ 0.5 0.5 < Category 2 ≤ 2.0 2.0 < Category 3 ≤ 10.0 10.0 < Category 4 ≤ 20.0	0.05 0.5 3 11
Dust/mist (mg/L)	0 < Category 1 ≤ 0.05 0.05 < Category 2 ≤ 0.5 0.5 < Category 3 ≤ 1.0 1.0 < Category 4 ≤ 5.0	0.005 0.05 0.5 1.5

The labelling elements are:

Hazard pictograms					/
Hazard categories	**Cat. 1**	**Cat. 2**	**Cat. 3**	**Cat. 4**	**Cat. 5***
Signal words	***Danger***			***Warning***	
Hazard statements	**H300:** Fatal if swallowed. **H310:** Fatal in contact with skin. **H330:** Fatal if inhaled.		**H301:** Toxic if swallowed. **H311:** Toxic in contact with skin. **H331:** Toxic if inhaled.	**H302:** Harmful if swallowed. **H312:** Harmful in contact with skin. **H332:** Harmful if inhaled.	**H303:** May be harmful if swallowed. **H313:** May be harmful in contact with skin. **H333:** May be harmful if inhaled.

*not included in CLP.

The precautionary statements for the different exposure routes are:

Ingestion		Cat. 1	Cat. 2	Cat. 3	Cat. 4
Precautionary statements	*Prevention*	**P264:** Wash … thoroughly after handling. **P270:** Do not eat, drink or smoke when using this product.			/
	Response	**P301+P310:** IF SWALLOWED: immediately call a POISON Center/ doctor/ … **P321:** Specific treatment (see … on this label).			**P301+P312:** IF SWALLOWED: Call a POISON CENTER/ doctor/…/ if you feel unwell.
		P330: Rinse mouth.			
	Storage	**P405:** Store locked up.			/
	Waste	**P501:** Dispose of contents/container to …[1]			

Dermal		Cat. 1	Cat. 2	Cat. 3	Cat. 4
Precautionary statements	*Prevention*	**P262:** Do not get in eyes, on skin, or on Clothing. **P264:** Wash … thoroughly after handling. **P270:** Do not eat, drink or smoke when using this product.		/	/
		P280: Wear protective gloves/ protective clothing/ eye protection/ face protection.			/
	Response	**P302+P352:** IF ON SKIN: wash with plenty of water/ ...			
		P310: Immediately call a POISON Center/ doctor/ …		**P312:** Call a POISON CENTER/doctor/…/if you feel unwell.	
		P321: Specific treatment (see … on this label). **P361+P364:** Take off immediately all contaminated clothing and wash it before reuse.			
	Storage	**P405:** Store locked up.			/
	Waste	**P501:** Dispose of contents/container to …[1]			

1) *in accordance with local/regional/national/international regulation.* They are supplied by the manufacturer/ supplier and indicated on the container, on the SDS or both.

HEALTH HAZARDS

<table>
<tr><th colspan="2">Inhalation</th><th>Cat. 1</th><th>Cat. 2</th><th>Cat. 3</th><th>Cat. 4</th></tr>
<tr><td rowspan="5">Precautionary statements</td><td rowspan="2">Prevention</td><td colspan="2">P260: Do not breathe dust/fumes/gas/mist/vapors/spray.
P284: [in case of inadequate ventilation] wear respiratory protection.</td><td colspan="2">P261: Avoid breathing dust/ fume/ gas/ mist/ vapors/ spray.</td></tr>
<tr><td colspan="4">P271: Use only outdoors or in a well-ventilated area.</td></tr>
<tr><td rowspan="2">Response</td><td colspan="4">P304+P340: IF INHALED: Remove person to fresh air and keep comfortable for breathing.</td></tr>
<tr><td colspan="2">P310: Immediately call a POISON CENTER/doctor/…
P320: Specific treatment is urgent (see … on this label).</td><td>P311: Call a POISON CENTER/ doctor/…
P321: Specific treatment (see … on this label).</td><td>P312: Call a POISON CENTER/doctor/ …/if you feel unwell.</td></tr>
<tr><td>Storage</td><td colspan="3">P403+P233: Store in a well ventilated place. Keep container tightly closed.
P405: Store locked up.</td><td>/</td></tr>
<tr><td>Waste</td><td colspan="3">P501: Dispose of contents/container to …[1]</td><td>/</td></tr>
</table>

1) *in accordance with local/regional/national/international regulation.* They are supplied by the manufacturer/ supplier and indicated on the container, on the SDS or both.

2.2 Skin corrosion and irritation

Skin corrosion is the production of irreversible damage to the skin whereas skin irritation is the production of reversible damage to the skin. Authorities wishing for a more refined classification may subdivide Category 1 (skin corrosion) into three sub-categories (1A, 1B, and 1C) depending on the exposure time and the observation period of the effects. Substances and mixtures should be tested according to the OECD Test guideline n°404.

The three main hazard categories are:

- Category 1 : skin corrosion
- Category 2 : skin irritation
- Category 3 : mild skin irritation

The classification of mixtures starts by using the **bridging principles** (see page 36).

If these principles are not applicable, the classification of mixtures as corrosive or irritant to the skin is based on the **additivity principle** such that each skin corrosive or irritant ingredient contributes to the overall corrosive or irritant properties of the mixture in proportion to its potential and concentration (table 2.2.1).

A weighting factor of 10 is used for corrosive components when they are present at a concentration below the concentration limit for classification with Category 1, but are at a concentration that will contribute to the classification of the mixture as an irritant. The mixture is classified as corrosive or irritant when the sum of the concentrations of such components exceeds a Cut-off value.

Table 2.2.1: Cut-off values for components classified as category 1, 2 or 3 that determine the classification of a mixture as corrosive or irritating to the skin (additivity approach).

Sum of the ingredients classified as:	**Cut-off value triggering classification of a mixture as:**		
	Corrosive	**Irritant**	
	Cat. 1	**Cat. 2**	**Cat. 3***
Category 1	≥ 5 %	≥ 1 % but < 5 %	/
Category 2	/	≥ 10 %	≥ 1 % but < 10 %
Category 3	/	/	≥ 10%
(10 x Category 1) + Category 2	/	≥ 10 %	≥ 1% but < 10 %
(10 x Category 1) + Category 2 + Category 3	/	/	≥ 10 %

Notes for authorities using subcategories of category 1 (corrosive):

1) Where the sub-categories of Skin Category 1 (corrosive) are used, the sum of all ingredients of a mixture classified as sub-category 1A, 1B or 1C respectively, should each be ≥ 5 % in order to classify the mixture as either skin sub-category 1A, 1B or 1C.
2) Where the sum of 1A ingredients is < 5 % but the sum of the 1A+1B ingredients is ≥ 5 %, the mixture should be classified as sub-category 1B.
3) Similarly, where the sum of 1A+1B ingredients is < 5 % but the sum of 1A+1B+1C ingredients is ≥ 5 % the mixture world be classified as sub-category 1C.

HEALTH HAZARDS

The labelling elements are:

Hazard pictograms			/
Hazard categories	**Cat. 1**	**Cat. 2**	**Cat. 3***
Signal words	***Danger***	***Warning***	
Hazard statements	**H314:** Causes severe skin burns and eye damage.	**H315:** Causes skin irritation.	**H316:** Causes mild skin irritation.

*not included in CLP.

The precautionary statements are:

Hazard categories		**Cat. 1**	**Cat. 2**	**Cat. 3***
Precautionary statements	*Prevention*	**P260:** Do not breathe dust/fumes/gas/mist/vapors/spray.	/	/
		P264: Wash … thoroughly after handling. **P280:** Wear protective gloves/ protective clothing/ eye protection/ face protection.		
	Response	**P310:** Immediately call a POISON CENTER/doctor/… **P363:** Wash contaminated clothing before reuse. **P304+340:** IF INHALED: Remove person to fresh air and keep comfortable for breathing. **P301+330+331:** IF SWALLOWED: Rinse mouth. Do NOT induce vomiting. **P303+361+353:** IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/ shower. **P305+351+338:** IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do – continue rinsing.	**P302+352:** IF ON SKIN: Wash with plenty of water/… **P332+313:** If skin irritation occurs: Get medical advice/Warning. **P362+364:** Take off contaminated clothing and wash it before reuse.	/
		/	**P332+313:** If skin irritation occurs: Get medical advice/Warning.	
		P321: Specific treatment (see … on this label).		/
	Storage	**P405:** Store locked up.	/	
	Waste	**P501:** Dispose of contents/container to …[1]	/	

1) *in accordance with local/regional/national/international regulation.* They are supplied by the manufacturer/ supplier and indicated on the container, on the SDS or both.

2.3 Serious eye damage / eye irritation

Serious eye damage refers to eye damage that is not completely reversible, while eye irritation is completely reversible.

Substances that can cause such injuries must be classified in one of the three categories according to the criteria presented in table 2.3.1 (from the OECD Test guideline n°405).

Table 2.3.1: Classification criteria for substances that may cause serious eye damage or irritation.

Criteria**	Categories
A substance that produces : a) in at least one animal effects on the cornea, iris or conjunctiva that are not expected to reverse or have not fully reversed within an observation period of normally 21 days; and/or b) in at least 2 of 3 tested animals, a positive response of: (i) corneal opacity ≥ 3; and/or (ii) iritis > 1.5. calculated as the mean scores following grading at 24, 48 and 72 hours after instillation of the test material.	**1**
A substance that produces in at least 2 of 3 tested animals, a positive response of: a) corneal opacity ≥ 1; and/or b) iritis ≥ 1; and/or c) conjunctival redness ≥ 2; and/or d) conjunctival edema (chemosis) ≥ 2 calculated as the mean scores following grading at 24, 48 and 72 hours after instillation of the test material, and which fully reverses within an observation period of normally 21 days.	**2A**
Within Category 2, an eye irritant is considered mildly irritant to eyes when the effects listed above are fully reversible within 7 days of observation.	**2B***

* not included in CLP.

** Grading criteria are understood as described in OECD Test guideline n°405. Evaluation of a 4, 5 or 6-animal test study follow different criteria.

The classification of mixtures starts by using the **bridging principles** (see page 36).

If these principles are not applicable, the classification of mixtures as severe eye damage or eye irritant is based on the **additivity principle** such that each eye damaging or irritating ingredient contributes to the overall eye damaging or irritating properties of the mixture in proportion to its potential and concentration (table 2.3.2).

A weighting factor of 10 is used for corrosive components when they are present at a concentration below the concentration limit for classification with Category 1, but are at a concentration that will contribute to the classification of the mixture as an irritant. The mixture is classified as eye damaging or irritant when the sum of the concentrations of such components exceeds a Cut-off value.

Table 2.3.2: Cut-off values of components classified as category 1 or 2 ocular or category 1 dermal that determine the classification of a mixture as dangerous for the eyes (additivity approach).

Sum of the ingredients classified as:	**Cut-off value triggering classification of a mixture as:**	
	Serious eye damage	**Eye irritation**
	Cat. 1	**Cat. 2/2A**
Skin category 1 + Eye category 1[1]	≥ 3 %	≥ 1 % but < 3 %
Eye category 2	/	≥ 10 %[2]
(Skin category 1 + Eye category 1) x 10 + Eye category 2	/	≥ 10 %

1) If a component is classified in both Category 1 skin and Category 1 ocular its concentration is counted only once in the calculation.

2) A mixture may be classified in category 2B ocular when all components are classified in Category 2B ocular

The labelling elements are:

Hazard pictograms			/
Hazard categories	**Cat. 1**	**Cat. 2A**	**Cat. 2B***
Signal words	***Danger***	***Warning***	
Hazard statements	**H318:** Causes serious eye damage.	**H319:** Causes serious eye irritation.	**H320:** Causes eye irritation.

*not included in CLP.

The precautionary statements are:

Hazard categories		**1A**	**2A**	**2B***
Precautionary statements	*Prevention*	**P280:** Wear protective gloves/protective clothing/eye protection/face protection.		/
		/	**P264:** Wash … thoroughly after handling.	
	Response	**P305+351+338:** IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do – continue rinsing.		
		P310: Immediately call a POISON CENTER/doctor/…	**P337+313:** If eye irritation persists, get medical advice/Warning.	
	Storage	/		
	Waste	/		

Remarks regarding chapters *Skin corrosion and skin irritation* (2.2), and *Serious eye damage and eye irritation* (2.3):

Particular care must be taken when classifying mixtures containing certain types of chemicals such as strong acids and bases, inorganic salts, aldehydes, phenols, and surfactants. In these cases, the approach presented in table 2.3.3 should be used. For example, a mixture containing ≥ 1 % of a strong acid (pH ≤ 2) or of a strong base (pH ≥ 11.5), or of a category 1 corrosive will be classified as Skin corrosion Cat.1 and Serious eye damage Cat.1. Similarly, if a mixture contains ≥ 3 % of a Skin or Eye irritant ingredient classified in Category 2, then the mixture will be classified Skin and Eye Irritant Category 2, respectively.

Table 2.3.3: Concentration of ingredients of a mixture classifying its hazardousness (when the additivity approach cannot be applied).

Ingredients	Concentration	Mixture classified as	
		Skin	Eye
Acid with pH ≤ 2	≥ 1 %	Cat. 1	Cat. 1
Base with pH ≥ 11.5			
Other corrosive (Cat. 1) ingredients			
Other irritant (Cat. 2 or 3) ingredients, including acids and bases	≥ 3 %	Cat. 2 or 3	Cat. 2

Additionally, when a mixture only contains one corrosive or irritant ingredient (acid or base) with a known specific concentration limit (SCL), the mixture should be classified according to this SCL. Note that the SCL reflects a situation where the mixture does not contain any other ingredient that might affect the classification. if other ingredients in the mixture affect the irritant/corrosive properties, it must be taken into account (see next paragraph).

If a mixture contains any other substances than the one with an SCL, which may affect the corrosive or irritant properties of the mixture, the SCL cannot be used to determine the classification of the mixture. In that case, the classification should be based on the pH value of the mixture. Thus, the classification of mixtures whose components do not fit the additivity approach nor the approach presented in table 2.3.3 must be done as follows: If a mixture's pH ≤ 2 or pH ≥ 11.5 (regardless of the concentration limits listed in Table 2.3.3), it should be classified directly into category 1 Skin corrosive and category 1 Serious eye damage.

2.4 Respiratory or skin sensitization

Respiratory sensitization refers to hypersensitivity of the respiratory tract occurring after inhalation of a substance or mixture. Skin sensitization refers to an allergic reaction that occurs after contact of the skin with a substance or mixture. According to the results of a whole series of tests (e.g. lymph node tests or maximization tests in guinea pig) and after evaluation by an expert, the substances will be classified or not in the only category of this class. However, for both respiratory and skin sensitization, some authorities may require a more refined classification in categories 1A and 1B, depending on whether awareness or likelihood of triggering sensitization is considered high or low.

The classification of mixtures starts by using the **bridging principles** (see page 36). If these principles are not applicable, the classification of mixtures as leading to respiratory or skin sensitization is based on the Cut-off values of ingredients of a mixture classified as either skin sensitizers or respiratory sensitizers (table 2.4.1).

Table 2.4.1: Cut-off values for components classified as category 1 or 2 respiratory or category 1 dermal that determine the classification of a mixture as a respiratory and skin sensitizer (additivity approach).

Ingredients classified as:	**Cut-off values triggering classification of a mixture as:**		
	Respiratory sensitizer Cat. 1		**Skin sensitizer Cat. 1**
	Solid/liquid	**Gas**	**All physical states**
Respiratory sensitizer Cat. 1	≥ 0.1 % ; or ≥ 1 %[1]	≥ 0.1 % ; or ≥ 0.2 %[1]	/
Respiratory sensitizer sub-cat. 1A	≥ 0.1 %	≥ 0.1 %	
Respiratory sensitizer sub-cat. 1B	≥ 1 %	≥ 0.2 %	
Skin sensitizer Cat. 1	/		≥ 0.1 % ; or ≥ 1 %[1]
Skin sensitizer sub-cat. 1A			≥ 0.1 %
Skin sensitizer sub-cat. 1B			≥ 1 %

1) The cut-off value may vary according to the competent authority. In addition, some authorities may require only a SDS is made available or an additional labelling.

The labelling elements are:

Hazard pictograms		
Hazard categories	**Respiratory sensitization Cat. 1**	**Skin sensitization Cat. 1**
Signal words	***Danger***	***Warning***
Hazard statements	**H334:** May cause allergy or asthma symptoms or breathing difficulties if inhaled.	**H317:** May cause an allergic skin reaction.

The precautionary statements are:

<table>
<tr><td colspan="2">Hazard categories</td><td>Respiratory sensitization
Cat. 1</td><td>Skin sensitization
Cat. 1</td></tr>
<tr><td rowspan="4">Precautionary statements</td><td rowspan="2">Prevention</td><td colspan="2">P261: Avoid breathing dust/ fume/ gas/ mist/ vapors/ spray.</td></tr>
<tr><td>P284: [in case of inadequate ventilation] wear respiratory protection.</td><td>P272: Contaminated work clothing should not be allowed out of the workplace.
P280: Wear protective gloves/ protective clothing/ eye protection/ face protection.</td></tr>
<tr><td>Response</td><td>P304+340: IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P342+311: If experiencing respiratory symptoms: Call a POISON CENTER/doctor/…</td><td>P302+352: IF ON SKIN: Wash with plenty of water/…
P333+313: If skin irritation or a rash occurs: Get medical advice/Warning.
P321: Specific treatment (see … on this label).
P362+364: Take off contaminated clothing and wash it before reuse.</td></tr>
<tr><td>Storage</td><td colspan="2">/</td></tr>
<tr><td>Waste</td><td colspan="2">P501: Dispose of contents/container to …[1]</td></tr>
</table>

1) *in accordance with local/regional/national/international regulation.* They are supplied by the manufacturer/ supplier and indicated on the container, on the SDS or both.

2.5 Carcinogenicity – Germ cell Mutagenicity – Reproductive toxicity

CMR substances or mixtures are **C**arcinogenic, **M**utagenic and/or **R**eprotoxic (toxic for the reproduction).

Carcinogenicity denotes a chemical substance or a mixture of chemical substances that induce cancer or increase its incidence.

Germ cell Mutagenicity causes mutations in the germ cells of humans and these mutations can be transmitted to the progeny.

Reproductive toxicity (Reprotoxicity) includes adverse effects on sexual function and fertility in adult males and females, as well as developmental toxicity in the offspring.

For each of these classes, it is possible to classify the substances or mixtures in three categories (1A, 1B or 2). The reproductive toxicity class also includes an additional hazard category for effects on or via breastfeeding.

For **CMRs**:

- Category **1A** means the effect on the human beings has been proven.
- Category **1B** means the effect on the human beings is supposed (based on animal data).
- Category **2** means the effect on the human beings is suspected (insufficient evidence).

Examples:

- A **C**1A substance is carcinogenic for humans.
- A **M**1B substance may induce human cell germ mutations.
- A **R**2 substance is suspected to be reprotoxic.

The classification of CMR substances and mixtures is based on validated test results in accordance with various OECD Tests guidelines. The evaluation of the results must be done by an expert. Table 2.5.1 provides a brief explanation for each of these categories.

Table 2.5.1: Hazard categories for CMR substances.

Carcinogenicity	Mutagenicity	Reprotoxicity	Categories
Known to have carcinogenic potential for humans; the placing of the substance is largely based on human evidence.	Substances known to induce heritable mutations in the germ cells of humans.	Known human reproductive toxicant.	**1A**
Presumed to have carcinogenic potential for humans (based on animal evidence).	Substances that should be regarded as if they induce heritable mutations in the germ cells of humans.	Presumed human reproductive toxicant.	**1B**
Suspected human carcinogens.	Substances that cause concern for humans owing to the possibility that they may induce heritable mutations in the germ cells of humans.	Suspected human toxicant.	**2**

Similarly to the previous chapters, the classification of CMR mixtures starts by using the **bridging principles** (see page 36).

If these principles are not applicable, the classification of mixtures as CMR is based on the cut-off values of ingredients of a mixture classified as carcinogenic or mutagenic (table 2.5.2) or as reprotoxic (table 2.5.3).

Table 2.5.2: Cut-off values of the components of a mixture classified as a carcinogen or mutagen that determine the classification of the mixture in category 1A, 1B or 2.

Ingredients classified as:	**Cut-off values triggering classification of a mixture as:**		
	Carcinogen or mutagen		
	Cat. 1A	**Cat. 1B**	**Cat. 2**
Carcinogen or mutagen category 1A	≥ 0.1 %	/	/
Carcinogen or mutagen category 1B	/	≥ 0.1 %	/
Carcinogen or mutagen category 2	/	/	≥ 0.1 %[1]

1) If a category 2 carcinogen or mutagen ingredient is present in the mixture at a concentration ≥ 1.0 %, both the SDS and the label should display the information.

Table 2.5.3: Cut-off values of the components of a mixture classified as reprotoxic that determine the classification of the mixture in category 1A, 1B or 2.

Ingredients classified as:	**Cut-off values triggering classification of a mixture as:**			
	Reprotoxic			Additional category for effect on or via lactation
	Cat. 1A	**Cat. 1B**	**Cat. 2**	
Reprotoxic category 1A	≥ 0.1 %[1]	/	/	/
Reprotoxic category 1B	/	≥ 0.1 %[1]	/	/
Reprotoxic category 2	/	/	≥ 0.1 %[2]	/
Additional category for effect on or via lactation	/	/	/	≥ 0.1 %[1]

1) If a category 1 reprotoxic ingredient or a substance classified in the additional category “effect on or via lactation” is present in the mixture at a concentration ≥ 0.3 %, both the SDS and the label should display the information.

2) If a category 2 reprotoxic ingredient is present in the mixture at a concentration ≥ 3.0 %, both the SDS and the label should display the information.

HEALTH HAZARDS

The labelling elements are:

Hazard pictogram			
Hazard categories	**Cat. 1A**	**Cat. 1B**	**Cat. 2**
Signal words	***Danger***		***Warning***
Hazard statements	**H350:** May cause cancer. **H340:** May cause genetic defects. **H360:** May damage fertility or the unborn child (state specific effect if known).		**H351:** Suspected of causing cancer. **H341:** Suspected of causing genetic defects. **H361:** Suspected of damaging fertility or the unborn child.

When possible, each Hazard statement must be completed with the following information: «*State route of exposure if it is conclusively proven that no other routes of exposure cause the hazard*».

The precautionary statements are:

Hazard categories		Cat. 1A	Cat. 1B	Cat. 2
Precautionary	*Prevention*	**P201:** Obtain special instructions before use. **P202:** Do not handle until all safety precautions have been read and understood. **P280:** Wear protective gloves/ protective clothing/eye protection/face protection		
	Response	**P308+313:** If exposed: Call a POISON CENTER or doctor/physician.		
	Storage	**P405:** Store locked up.		
	Waste	**P501:** Dispose of contents/container to …[1]		

1) *in accordance with local/regional/national/international regulation.* They are supplied by the manufacturer/ supplier and indicated on the container, on the SDS or both.

Regarding the hazard category **effects on** or **via breastfeeding**, no hazard pictogram nor signal word exist, but hazard statement exists:

H362: May cause harm to breast-fed children.

Additionally to the above-mentioned precautionary statements, there are the followings:

P260: Do not breathe dust/ fume/ gas/ mist/ vapors/ spray.

P263: Avoid contact during pregnancy/ while nursing.

P264: Wash … thoroughly after handling.

P270: Do not eat, drink or smoke when using this product.

2.6 Specific target organ toxicity (STOT)

Specific target organ toxicity (STOT) refers to specific, non-lethal toxic effects on target organs occurring after a single or repeated exposure to a substance or mixture. All significant health effects that can impair function, both reversible and irreversible, immediate and/or delayed. The main exposure routes are oral, dermal and inhalation.

STOT – Single exposure (SE): the effects are significant, specific and occur after a single exposure to a chemical substance or mixture.

STOT – Repeated exposure (RE): similar to STOT-SE, except that the effects occur after two or more exposures.

Substances or mixtures are classified in one of three categories for single exposures and/or in one of two categories for repeated exposures. For individual substances, the classification is done by an expert who will consider all available data (recommended guideline values, duration of exposure, doses or concentrations, etc.).

Table 2.6.1 Brief explanations for each of STOT-SE and STOT-RE categories.

STOT – Single exposure	**Categories**
Substance which, following a unique exposure, produced significant toxic effects in humans or that can be assumed likely to be significantly toxic to humans, based on data from epidemiological and/or animal studies, that it is.	**1**
Substances for which animal studies suggest they may be harmful to human health as a result of a single exposure.	**2**
Transient effects on target organs: this category only includes irritation effects on the respiratory tract as well as narcotic effects.	**3**
STOT – Repeated exposure	
Substance which, following repeated exposure, produced significant toxic effects in humans or that can be assumed likely to be significantly toxic to humans, based on data from epidemiological and/or animal studies, that it is.	**1**
Substances for which animal studies suggest they may be harmful to human health as a result of repeated exposure.	**2**

The classification of mixtures starts by using the **bridging principles** (see page 36). If these principles are not applicable, the classification will be based on the information available on the components of that mixture. In this case, the mixture will be classified as STOT-SE or STOT-RE for a target organ (the organ will be specified) if it contains at least one component classified as STOT-SE or STOT-RE respectively, of Category 1 or 2 at a concentration equal or greater than the cut-off values given in table 2.6.2. Cut-off values for STOT-SE category 3 ingredients must be evaluated by an expert.

Table 2.6.2: Cut-off values of components of a mixture classified as STOT-EU/ER that determine the classification of the mixture in STOT-EU/ER category 1 or 2.

Ingredient classified as:	**Cut-off values triggering classification of the mixture as:**		
	Cat. 1	**Cat. 2**	**Cat. 3**
STOT-SE/RE Cat. 1	≥ 1 % ≥ 10 %	/	/
STOT-SE/RE Cat. 2	/	≥ 1 %	/
STOT-SE/RE Cat. 3	/	/	1)

1) Cut-off values for ingredients classified as STOT-EU Category 3 must be assessed on a case-by-case basis by an expert.

STOT – Single exposure (SE):

The labelling elements are:

Hazard pictogram			
Hazard categories	**Cat. 1**	**Cat. 2**	**Cat. 3**
Signal words	***Danger***	***Warning***	
Hazard statements	**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).	**H335:** May cause respiratory irritation; or **H336:** May cause drowsiness or dizziness.

The precautionary statements are:

<table>
<tr><th colspan="2">Categories</th><th>Cat. 1</th><th>Cat. 2</th><th>Cat. 3</th></tr>
<tr><td rowspan="5">Precautionary statements</td><td>Prevention</td><td colspan="2">P260: Do not breathe dust/fumes/gas/mist/vapors/spray.
P264: Wash … thoroughly after handling.
P270: Do not eat, drink or smoke when using this product.</td><td>P261: Avoid breathing dust/fumes/gas/mist/vapors/spray.
P271: Use only outdoors or in a well-ventilated area.</td></tr>
<tr><td rowspan="2">Response</td><td colspan="2">P308+P311: If exposed or concerned: Call a POISON CENTER/ doctor/…</td><td>P304 + P340: IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P312: Call a POISON CENTER/ doctor/…/if you feel unwell.</td></tr>
<tr><td>P321: Specific treatment (see … on this label).</td><td>/</td><td>/</td></tr>
<tr><td rowspan="2">Storage</td><td colspan="3">P405: Store locked up.</td></tr>
<tr><td colspan="2">/</td><td>P403+P233: Store in a well ventilated place. Keep container tightly closed.</td></tr>
<tr><td>Waste</td><td colspan="3">P501: Dispose of contents/container to …[1]</td></tr>
</table>

1) *in accordance with local/regional/national/international regulation.* They are supplied by the manufacturer / supplier and indicated on the container, on the SDS or both.

STOT – Repeated exposure (RE):

The labelling elements are:

Hazard pictogram		
Hazard categories	**Cat. 1**	**Cat. 2**
Signal words	***Danger***	***Warning***
Hazard statements	**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).

The precautionary statements are:

Hazard categories		**Cat. 1**	**Cat. 2**
Precautionary statements	*Prevention*	**P260:** Do not breathe dust/fumes/gas/mist/vapors/spray.	
		P264: Wash … thoroughly after handling. **P270:** Do not eat, drink or smoke when using this product.	/
	Response	**P314:** Get medical advice/Warning if you feel unwell.	
	Storage	/	
	Waste	**P501:** Dispose of contents/container to …[1]	

1) *in accordance with local/regional/national/international regulation.* They are supplied by the manufacturer/ supplier and indicated on the container, on the SDS or both.

2.7 Aspiration hazard

Aspiration means the entry of a liquid or solid chemical directly through the mouth or nose, or indirectly from vomiting, into the trachea and lower respiratory tract. Aspiration hazards include severe acute effects such as chemical pneumonitis, varying degrees of lung injury, or death following aspiration.

Substances and mixtures representing an aspiration hazard are classified in one of the two categories according to table 2.7.1.

Table 2.7.1: Criteria for the classification of substances and mixtures with aspiration hazards.

Substances	Categories
When there is reliable and good quality human evidence, or If it is a hydrocarbon and has a kinematic viscosity ≤ 20.5 mm^2/s, measured at 40°C.	1
Based on existing animal studies and expert judgment that takes into account surface tension, water solubility, boiling point, and volatility, substances, other than those classified in category 1, with a kinematic viscosity ≤ 14 mm^2/s, measured at 40°C.	2
Mixtures	
A mixture is classified as Cat. 1 when containing ≥ 10% of one or more Cat. 1 ingredients and the mixture has a kinematic viscosity ≤ 20.5 mm^2/s, measured at 40°C.	1
In case of a mixture that separates into two or more distinct layers, the entire mixture is Classified as Cat. 1 if in any distinct layer the sum of concentrations of Category 1 ingredients is ≥ 10%, and it has a kinematic viscosity ≤ 20.5 mm^2/s, measured at 40°C.	
A mixture is classified as Cat. 2 when containing ≥ 10% of one or more Cat. 2 ingredients and the substance or mixture has a kinematic viscosity ≤ 14 mm^2/s, measured at 40°C.	2
In classifying mixtures in this category, the use of expert judgment that considers surface tension, water solubility, boiling point, volatility is critical and especially when Category 2 substances are mixed with water.	
In case of a mixture which separates into two or more distinct layers, the entire mixture is classified Cat. 2 if in any distinct layer the sum of concentrations of Category 2 ingredients is ≥ 10%, and it has a kinematic viscosity ≤ 14 mm^2/s, measured at 40°C.	

HEALTH HAZARDS

The labelling elements are:

Hazard pictogram		
Hazard categories	**Cat. 1**	**Cat. 2**
Signal words	***Danger***	***Warning***
Hazard statements	**H304:** May be fatal if swallowed and enters airways.	**H305:** May be harmful if swallowed and enters airways.

The precautionary statements are:

Hazard categories		**Cat. 1**	**Cat. 2**
Precautionary statements	*Prevention*	/	
	Response	**P301+310:** IF SWALLOWED: Immediately call a POISON CENTER/doctor/… **P331:** do NOT induce vomiting.	
	Storage	**P405:** Store locked up.	
	Waste	**P501:** Dispose of contents/container to …[1]	

1) *in accordance with local/regional/national/international regulation.* They are supplied by the manufacturer / supplier and indicated on the container, on the SDS or both.

3. Environmental hazards

The **2 classes of environmental hazards** of the GHS system are presented and, as depicted below, regrouped according to their pictograms.

	Hazard categories / pictograms		
Acute aquatic toxicity (short term)	Cat. 1 		2 & 3*
Chronic aquatic toxicity (long term)	Cat. 1 	Cat. 2 	3 & 4*
Hazardous to the ozone layer	Cat. 1 		

* not included in CLP.

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

The GHS recognizes that hazards to the aquatic environment can be of acute nature (i.e. short-term effects) and of chronic nature (i.e. long-term effects). Therefore, the classification of a substance or a mixture in one or in both categories is applied independently.

Useful definitions:

Bioaccumulation: net results of uptake, transformation and elimination of a substance in an organism due to all routes of exposure (i.e. air, water, sediment/soil and food).

Bioconcentration: net results of uptake, transformation and elimination of a substance in an organism due to waterborne exposure.

Bioconcentration factor (BCF): experimental BCF values should be determined according to the OECD Test Guideline 305. If BCF is not known, one can use the Potential for Bioaccumulation determined using the octanol/water partition coefficient (usually reported as a K_{ow}).

Rapid degradability: decomposition of organic molecules into smaller ones and finally into carbon dioxide, water and salts. This degradation can be biotic or abiotic and is measured experimentally using the biodegradability tests (OECD Test Guideline 301 for freshwater and 306 for marine water). Where such data is not available, a biological oxygen demand BOD (5 days)/ chemical oxygen demand COD ratio ≥ 0.5 is considered as indicative of rapid degradation.

EC_{50}: half-maximal effective concentration (yield an effective response on 50% of the population tested).

LC_{50}: median lethal concentration (lethal response on 50% of the population).

ErC_{50}: concentration inducing a reduction of the growth rate of 50% of the population.

NOEC: *No Observed Effect Concentration*; the concentration immediately below the lowest tested concentration with statistically significant adverse effect. The NOEC has no statistically significant adverse effect.

ENVIRONMENTAL HAZARDS

The classification of a substance or a mixture in acute categories 1 to 3 is based on the available acute toxicity data only (EC_{50} and LC_{50} values presented in table 3.1.1).

The classification of a substance or a mixture in chronic categories 1 to 3 follows a tiered approach where the first step is to see if available information on chronic toxicity merits long-term hazard classification. In the absence of adequate chronic toxicity data, the subsequent step is to combine two type of information: acute toxicity data and environmental fate data (degradability and bioaccumulation data; see figure 3.1.1 and table 3.1.2).

Table 3.1.1: Classification criteria for acute (short-term) aquatic toxicity.

Category Acute 1[1]	
LC_{50} 96h (for fish)	≤ 1mg/L and/or
EC_{50} 48h (for crustacean)	≤ 1mg/L and/or
ErC_{50} 72 or 96h (for algae or other aquatic plants)	≤ 1mg/L
Category Acute 2	
LC_{50} 96h (for fish)	> 1 but ≤ 10 mg/L and/or
EC_{50} 48h (for crustacean)	> 1 but ≤ 10 mg/L and/or
ErC_{50} 72 or 96h (for algae or other aquatic plants)	> 1 but ≤ 10 mg/L
Category Acute 3	
LC_{50} 96h (for fish)	> 10 but ≤ 100 mg/L and/or
EC_{50} 48h (for crustacean)	> 10 but ≤ 100 mg/L and/or
ErC_{50} 72 or 96h (for algae or other aquatic plants)	> 10 but ≤ 100 mg/L

1) When classifying in Acute 1 and Chronic 1 toxicity categories, the appropriate multiplication factor M should be specified (see Table 3.1.5).

Table 3.1.2: Classification criteria for chronic (long-term) aquatic toxicity.

i) Non-rapidly[2] degradable substances for which there are adequate chronic toxicity data available.

Category Chronic 1[1]	
NOEC or EC_x Chronic (for fish)	≤ 0.1 mg/L and/or
NOEC or EC_x Chronic (for crustacean)	≤ 0.1 mg/L and/or
NOEC or EC_x Chronic (for algae or other aquatic plants)	≤ 0.1 mg/L
Category Chronic 2	
NOEC or EC_x Chronic (for fish)	≤ 1 mg/L and/or
NOEC or EC_x Chronic (for crustacean)	≤ 1 mg/L and/or
NOEC or EC_x Chronic (for algae or other aquatic plants)	≤ 1 mg/L

ii) Rapidly[2] degradable substances for which there are adequate chronic toxicity data available.

Category Chronic 1[1]	
NOEC or EC_x Chronic (for fish)	≤ 0.01 mg/L and/or
NOEC or EC_x Chronic (for crustacean)	≤ 0.01 mg/L and/or
NOEC or EC_x Chronic (for algae or other aquatic plants)	≤ 0.01 mg/L
Category Chronic 2	
NOEC or EC_x Chronic (for fish)	≤ 0.1 mg/L and/or
NOEC or EC_x Chronic (for crustacean)	≤ 0.1 mg/L and/or
NOEC or EC_x Chronic (for algae or other aquatic plants)	≤ 0.1 mg/L
Category Chronic 3	
NOEC or EC_x Chronic (for fish)	≤ 1 mg/L and/or
NOEC or EC_x Chronic (for crustacean)	≤ 1 mg/L and/or
NOEC or EC_x Chronic (for algae or other aquatic plants)	≤ 1 mg/L

iii) Substances for which adequate chronic toxicity data is not available.

Category Chronic 1[1]	
LC_{50} 96h (for fish)	≤ 1mg/L and/or
EC_{50} 48h (for crustacean)	≤ 1mg/L and/or
ErC_{50} 72 or 96h (for algae or other aquatic plants)	≤ 1mg/L
Category Chronic 2	
LC_{50} 96h (for fish)	> 1 but ≤ 10 mg/L and/or
EC_{50} 48h (for crustacean)	> 1 but ≤ 10 mg/L and/or
ErC_{50} 72 or 96h (for algae or other aquatic plants)	> 1 but ≤ 10 mg/L
Category Chronic 3	
LC_{50} 96h (for fish)	> 10 but ≤ 100 mg/L and/or
EC_{50} 48h (for crustacean)	> 10 but ≤ 100 mg/L and/or
ErC_{50} 72 or 96h (for algae or other aquatic plants)	> 10 but ≤ 100 mg/L

1) When classifying in Acute 1 and Chronic 1 toxicity categories, the appropriate multiplication factor M should be specified (see Table 3.1.5).

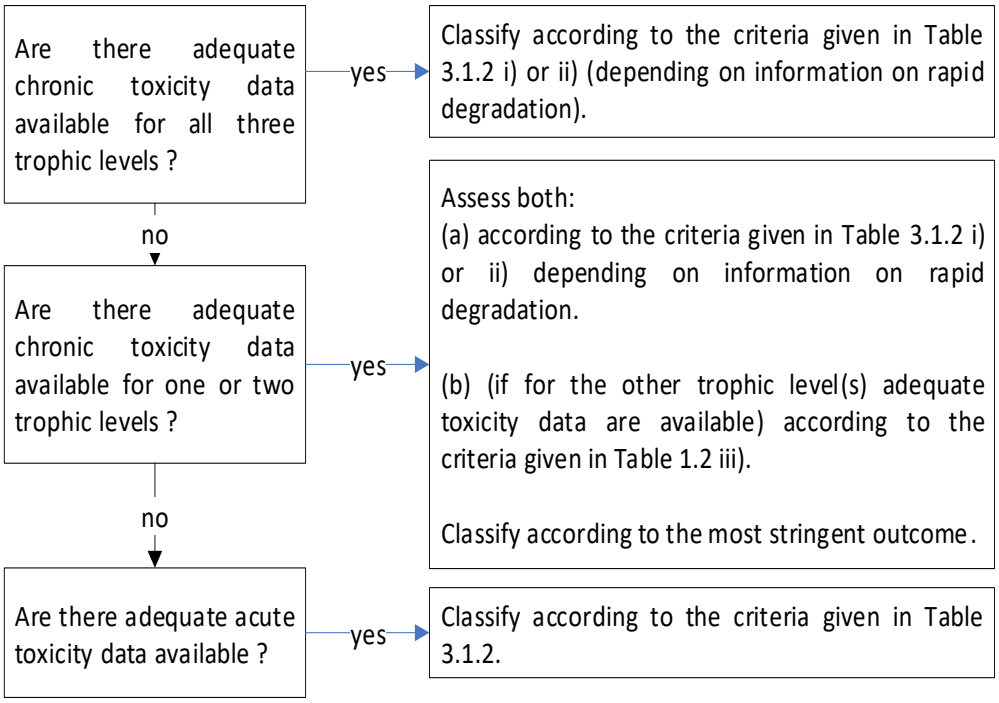
2) Where data on rapid degradability (either determined experimentally or evaluated) is not available, the substance/mixture should be considered as not rapidly degradable.

Chronic category 4, type "*Safety net*":

A fourth chronic category - the "Safety net category" - can be used when the data available do not allow classification under formal criteria but there are nevertheless some grounds for concern.

In addition, poorly soluble substances and mixtures for which no acute toxicity is recorded at levels up to the water solubility, and which are not rapidly degradable and have a log $K_{ow} \geq 4$, indicating a potential to bioaccumulate, will be classified in this category unless other specific evidence exists showing classification to be unnecessary. Such evidences include an experimentally determined BCF < 500, or a chronic toxicity NOECs > 1 mg/L, or evidence of rapid degradation in the environment.

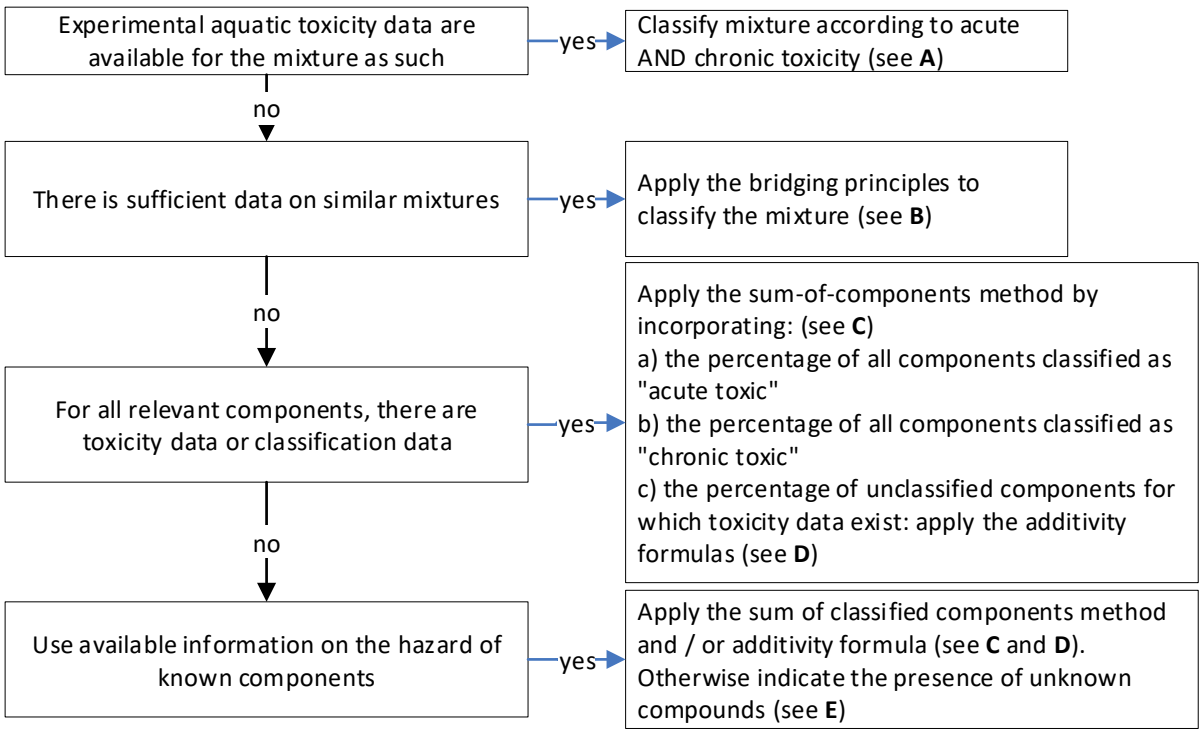
Figure 3.1.1: Sequential approach for the classification of a substance or a mixture in chronic toxicity categories.



Classification of mixtures:

For the classification of mixtures, the same categories are used (acute toxicity 1 to 3 and chronic toxicity 1 to 4). Again, the classification follows a sequential approach and depends on the type of information available for the mixture in itself and for its individual components (figure 3.1.2). The final classification must be made according to the most stringent result.

Figure 3.1.2: Sequential approach applied to the classification of mixtures for short and long-term hazards.



A-1) Acute toxicity:

- If there is adequate experimental data on the acute toxicity (LC_{50} or EC_{50}) of the tested mixture as such indicating $L(E)C_{50} \leq 100$ mg/L, it can be classified in Acute categories 1, 2 or 3 according to table 3.1.1.
- If appropriate experimental data is available on the acute toxicity (LC_{50} or EC_{50}) of the tested mixture as such indicating $L(E)C_{50} > 100$ mg/L, or at a concentration greater than the solubility in water, it is not necessary to classify such mixture in an acute toxicity category.

A-2) Chronic toxicity:

- If there is adequate experimental data on the chronic toxicity (ECx or NOEC) of the mixture as such indicating ECx or NOEC ≤ 1 mg/L, it may be classified in Chronic categories 1, 2 or 3 according to table 3.1.2 i) and ii) depending on whether the mixture is rapidly degradable or not.
- If there is adequate experimental data on the chronic toxicity (ECx or NOEC) of the mixture as such indicating ECx or NOEC > 1 mg/L, or at a concentration greater than the solubility in water, then it is not necessary to classify this mixture in a chronic toxicity category.

If there are nevertheless reasons for concern, classify this mixture in the chronic category 4 ("Safety net" category).

B) Bridging principles:

If the toxicity of the mixture towards the aquatic environment has not been experimentally tested, but there is sufficient data available on similar mixtures, the bridging principles must apply. See explanatory paragraph on the bridging principles (page 36).

C-1) Summation method – Acute categories 1 to 3 (if data is available for each component of the mixture).

The determination of acute toxicity categories 1, 2 and 3 for mixtures results from the sum of the concentrations of its classified components and is done according to an additive approach summarized in table 3.1.3 where the percentage of components classified as "acute toxic" is introduced directly into the summation equation.

- If the sum of the concentrations (in %) of the individual components classified as acute category 1 multiplied by the corresponding M factor exceeds 25 %, the mixture must be classified as acute 1.
- Otherwise, we examine whether the mixture enters the category acute 2 according to the formula in the following line, and so on for acute category 3.

Table 3.1.3: Classification of a mixture for short-term (acute) hazards based on the summation of the concentration of classified ingredients.

Sum of the concentrations (in %) of the ingredients classified as:		**Mixture classified as:**
Acute 1 x M[1]	≥ 25 %	**Acute 1**
(Acute 1 x M x 10) + Acute 2	≥ 25 %	**Acute 2**
(Acute 1 x M x 100) + (Acute 2 x 10) + Acute 3	≥ 25 %	**Acute 3**

1) The M factor is explained in Table 3.1.5.

C-2) Summation method – Chronic categories 1 to 4 (if data is available for each component of the mixture).

The determination of chronic toxicity categories 1, 2, 3 and 4 for mixtures results from the sum of the concentrations of its classified components and is done according to an additive approach summarized in table 3.1.4 where the percentage of components classified as "chronic toxic" is introduced directly into the summation equation.

- If the sum of the concentrations (in %) of the individual components classified as chronic category 1 multiplied by the corresponding M factor exceeds 25 %, the mixture must be classified as chronic 1.
- Otherwise, we examine if the mixture enters the category chronic 2 according to the formula in the following line, and so on for categories 3 and 4.

Table 3.1.4: Classification of a mixture for long-term (chronic) hazards based on the summation of the concentration of classified ingredients.

Sum of the concentrations (in %) of the ingredients classified as:		Mixture classified as:
Chronic 1 x M[1]	≥ 25 %	**Chronic 1**
(Chronic 1 x M x 10) + Chronic 2	≥ 25 %	**Chronic 2**
(Chronic 1 x M x 100) + (Chronic 2 x 10) + Chronic 3	≥ 25 %	**Chronic 3**
Chronic 1 + Chronic 2 + Chronic 3 + Chronic 4	≥ 25 %	**Chronic 4**

1) M factor is explained in table 3.1.5.

D) Where classification data are NOT available for each of the components of the mixture, but the toxicity data are available.

The mixtures may contain both classified components (acute categories 1 to 3 and/or chronic categories 1 to 4) and non-classified components, but for which there are experimental data of appropriate toxicity (L(E)C_{50} values).

If these toxicity values are available, the overall toxicity of the non-classified components can be extrapolated using the additivity formulas (see D-1 and D-2 below). These mixture's fractions can then be assigned a hazard category (using tables 3.1.1 and 3.1.2 (i) (ii) and (iii)) which can then be used when applying the summation method (see C-1 and C-2).

D-1) When data on acute toxicity are available.

$$\frac{\sum C_i}{C(E)L_{50m}} = \sum_n \frac{C_i}{C(E)L_{50i}}$$

C_i	Concentration of component *i* (weight %)
$C(E)L_{50i}$	LC_{50} or $EC_{50}$for component *I* (mg/L)
n	Number of components *I* (running from 1 to n)
$L(E)C_{50m}$	$L(E)C_{50}$ of the part of the mixture with test data

D-2) When data on chronic toxicity are available.

$$\frac{\sum Ci + \sum Cj}{EqCSEO_m} = \sum_n \frac{Ci}{CSEOi} + \sum_n \frac{Cj}{0{,}1 \times CSEOj}$$

C_i	Concentration of component *i* (weight %), for rapidly degradable components
C_j	Concentration of component *j* (weight %), for non-rapidly degradable components
$NOEC_{i.or\ j}$	*No Observed Effect Concentration* for rapidly degradable components (*i)* and for non-rapidly degradable components (*j)* in mg/L
n	Number of components *I* and *j* (running from 1 to n)
$EqNOEC_m$	Equivalent NOEC of the part of the mixture with test data

Table 3.1.5: Multiplying factor (M factor) for highly toxic ingredients of mixtures.

Acute toxicity	**M factor**	**Chronic toxicity**	**M factor**	
L(E)C_{50} (mg/l)		**NOEC (mg/l)**	**Components NRD[1]**	**Components RD[2]**
0.1< L(E)C_{50} ≤1	1	0.01< NOEC ≤0.1	1	/
0.01< L(E)C_{50} ≤0.1	10	0.001< NOEC ≤0.01	10	1
0.001< L(E)C_{50} ≤0.01	100	0.0001< NOEC ≤0.001	100	10
0.0001< L(E)C_{50} ≤0.001	1'000	0.00001< NOEC ≤0.0001	1'000	100
0.00001< L(E)C_{50} ≤0.0001	10'000	0.000001< NOEC ≤0.00001	10'000	1'000
(continues in factor 10 intervals)				

1) Non-rapidly degradable
2) Rapidly degradable

When no useful data on the degradability are available – either experimentally determined or estimated data – the substance should be regarded as non-rapidly degradable.

E)

In the event that no useable information on acute and/or chronic aquatic toxicity is available for one or more relevant ingredients, it is concluded that the mixture cannot be attributed (a) definitive category(ies). In this situation the mixture should be classified based on the known ingredients only, with the additional statement that "x % of the mixture consists of ingredient(s) of unknown hazards to the aquatic environment". The competent authority can decide to specify that the additional statement is communicated on the label or on the SDS or both, or to leave the choice of where to place the statement to the manufacturer/supplier.

ENVIRONMENTAL HAZARDS

The labelling elements are:

Acute toxicity (short term)

Pictogram		/	
Hazard categories	**Cat. 1**	**Cat. 2***	**Cat. 3***
Signal words	***Warning***	/	
Hazard statements	**H400:** Very toxic to aquatic life.	**H401:** Toxic to aquatic life.	**H402:** Harmful to aquatic life.

Chronic toxicity (long term)

Pictogram			/	
Hazard categories	**Cat. 1**	**Cat. 2**	**Cat. 3***	**Cat. 4***
Signal words	***Warning***	/		
Hazard statements	**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.

*not included in the CLP.

The precautionary statements are:

Acute toxicity (short term)

Hazard categories		**Cat.1**	**Cat.2***	**Cat.3***
Precautionary statements	*Prevention*	**P273:** Avoid release in the environment.		
	Response	**P391:** Collect spillage.	/	
	Storage	/		
	Waste	**P501:** Dispose of contents/container to …[1]		

Chronic toxicity (long term)

Hazard categories		**Cat.1**	**Cat.2**	**Cat.3***	**Cat.4***
Precautionary statements	*Prevention*	**P273:** Avoid release in the environment.			
	Response	**P391:** Collect spillage.		/	
	Storage	/			
	Waste	**P501:** Dispose of contents/container to …[1]			

*not included in CLP.

1) *in accordance with local/regional/national/international regulation.* They are supplied by the manufacturer / supplier and indicated on the container, on the SDS or both.

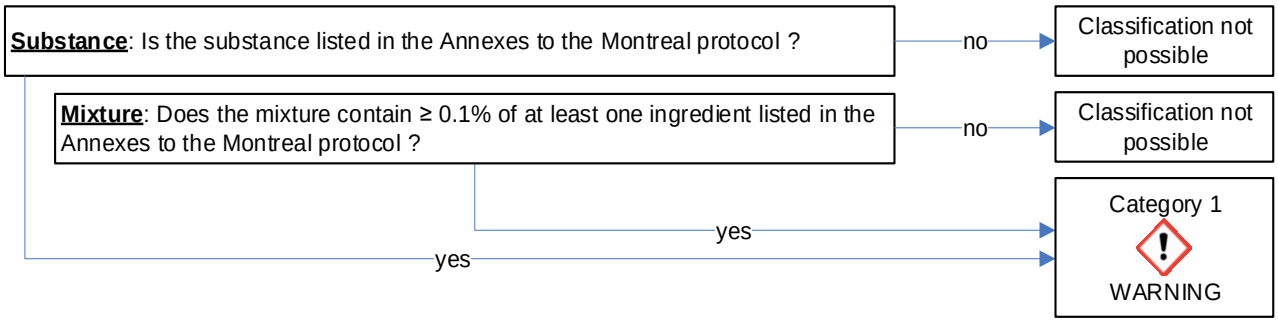
3.2. Hazardous for the ozone layer

The *Ozone Depleting Potential* (ODP) is an integrative quantity, distinct for each halocarbon source species, that represent the extent of ozone depletion in the stratosphere expected from the halocarbon on a mass-for-mass basis relative to CFC-11 (trichlorofluoromethane).

The *Montreal Protocol* on substances that deplete the ozone layers list all known substances with an ODP.

A substance or a mixture must be classified in the single category of this hazard class according to figure 3.2.1.

Figure 3.2.1: Decision diagram for substances hazardous to the ozone layer.



The labelling elements are:

Pictogram	
Hazard category	**Hazardous to the ozone layer**
Signal words	***Warning***
Hazard statements	**H420:** Harms public health and the environment by destroying the ozone in the upper atmosphere.

The precautionary statements are:

Hazard category		**Cat.1**
Precautionary statements	*Prevention*	/
	Response	/
	Storage	/
	Waste	**P502:** Refer to the manufacturer or supplier for information on recovery or recycling.

Complementary information

Acronyms

/	No data or Not applicable
ATE	Acute Toxicity Estimate
BCF	Bioconcentration factor
C or conc.	Concentration
Cat.	Categories
EC	European Commission
CLP	Classification, Labelling and Packaging – European adaptation of the Globally Harmonized System of Classification and Labelling of Chemicals
C&L Inventory	C&L inventory is a database containing information on the classification and labeling of notified substances and products given by the producers. It also contains the names of harmonized substances translated into all the languages of the European Union.
ECHA	European Chemicals Agency
GHS	Globally Harmonized System of Classification and Labelling of Chemicals
FP	Flash Point
ISO	International Organization for Standardization
K_{oe}	Octanol/water coefficient – used a potential for bioaccumulation factor
LFL	Lower Flammable Limit (or Lower Explosive Limit)
UFL	Upper Flammable Limit (or Upper Explosive Limit)
M factor	Multiplying factor (page 63)
NOEC	No Obeserved Effect Concentration
OECD	Organization for Economic Co-operation and Development
ODP	Ozone Depleting Potential
REACH	Registration, Evaluation, Authorization and Restriction of Chemicals https://echa.europa.eu/fr/regulations/reach/understanding-reach
RTMD	*Regulations for the Transport of Dangerous Materials*
SDS	Safety Data Sheet
SE/RE	Single exposure / Repeated exposure
STOT	Specific Target Organ Toxicity
SUVA	Schweizerische Unfallversicherungsanstalt (main Swiss insurance).

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.