Environmental Protection Authority
Te Mana Rauhī Taiao

New Zealand Government

22 October 2021

Guide to classifying hazardous substances in New Zealand

(Version 1.0)

Contents

Document control

Version	Date issued	Owner	Description
V1.0	22 Oct 2021	General Manager, HSNO	Initial release of guide to classifying hazardous substances in New Zealand

Reviewers

Position	Date	Action
Senior Communications Advisor	Sep 2021	Comms review
Senior Advisors, Hazardous Substances	Oct 2021	Peer review
Principal Scientist, Hazardous Substances	Oct 2021	Review and endorse
General Manager, HSNO	22 Oct 2021	Approve

Part 1: Introduction

This guide provides an overview of how to classify hazardous substances using New Zealand's hazard classification system. This system is implemented via the Hazardous Substances (Hazard Classification) Notice 2020, which implements elements of the seventh revised edition of the Globally Harmonized System of Classification and Labelling of Chemicals (GHS). The notice also sets out a hazard classification framework for substances that are hazardous to the terrestrial environment.

The GHS Book[1] is the definitive source of classification criteria and detailed information on test methods, mixture rules, expert judgement, and other technical considerations. This guide to New Zealand's implementation of GHS only covers the most frequently used information when classifying substances.

This guide summarises how to apply classifications to a single substance, and how to use mixture rules for classifying mixtures where formulation test data is not available. Comparisons to the previous alpha-numeric HSNO classifications are made for some classifications. Where a 1:1 correlation exists between a GHS classification and an old HSNO alpha-numeric classification, the correlation table included in Schedule 3 of the Hazardous Substances (Hazard Classification) Notice[2] can be used to assign GHS classifications.

This guide also provides details on the New Zealand-specific considerations in our implementation of GHS:

- classification categories New Zealand has not adopted
- optional classification subcategories New Zealand has not adopted
- New Zealand's additional classifications for substances that are hazardous to the terrestrial environment
- concentration cut-offs New Zealand has adopted for classification of mixtures.

New Zealand has not adopted all elements of GHS 7. The GHS system allows regulators some flexibility regarding what hazard classifications, and what concentration cut-offs are adopted. New Zealand has not adopted the following GHS classifications within its hazard classification system:

- acute toxicity Category 5 (all exposure routes)
- skin irritation Category 3
- aspiration hazard Category 2
- hazardous to the aquatic environment acute Categories 2 and 3
- hazardous to the ozone layer.

Where the GHS 7 provides optional concentration cut-off values for classification of mixtures, New Zealand has adopted the lower concentration cut-off values. These values are specified in Schedule 2 of the Hazardous Substances (Hazard Classification) Notice and are also listed in the relevant sections of this guide.

---

1 GHS (Rev.7) (2017) | UNECE.

2 Hazardous Substances (Hazard Classification) Notice: www.epa.govt.nz/industry-areas/hazardous-substances/rules-for-hazardous-substances/epa-notices-for-hazardous-substances/.

An additional non-GHS hazard class “hazardous to the terrestrial environment” has been incorporated into the New Zealand hazard classification system. It is applied only to agrichemicals or active ingredients used in the manufacture of certain agrichemicals.

The hazard class “hazardous to the terrestrial environment” comprises four hazard classifications:

- hazardous to soil organisms
- hazardous to terrestrial vertebrates
- hazardous to terrestrial invertebrates
- designed for biocidal action.

This guide outlines all of the adopted classifications and concentration cut-offs in detail in the following sections.

A full list of the classifications that form New Zealand’s classification system is provided in an appendix to this document. An abbreviated form of each classification is also provided that can be used in situations such as inventory lists.

Part 2: Physical hazards[3]

2.1 Explosives

There are seven categories of explosives: unstable explosives, and six divisions for substances, mixtures and articles that are not unstable explosives.

Explosives are classified in one of the six divisions based on Test Series 2 to 8 in Part I of the *UN Recommendations on the Transport of Dangerous Goods (UNRTDG), Manual of Tests and Criteria* (Manual of Tests and Criteria).

In addition, New Zealand has adopted the explosive compatibility groupings from the UNRTDG Model Regulations which are currently outside of the GHS. The adopted classifications, compatibility groups and types of hazards are shown in **table 1**.

Table 1: Classifications, compatibility groupings and types of hazard for explosives

Classification	Type of hazard
Unstable explosive	Substances too thermally unstable and/or too sensitive for normal handling, transport and use
1.1A, 1.1B, 1.1C, 1.1D, 1.1E, 1.1F, 1.1G, 1.1J, 1.1L	Substances and articles that have a mass explosion hazard
1.2B, 1.2C, 1.2D, 1.2E, 1.2F, 1.2G, 1.2H, 1.2J, 1.2K, 1.2L	Substances and articles that have a projection hazard but not a mass explosion hazard
1.3C, 1.3F, 1.3G, 1.3H, 1.3J, 1.3K, 1.3L	Substances and articles that have a fire hazard and either a minor blast hazard or minor projection hazard, or both, but not a mass explosion hazard
1.4B, 1.4C, 1.4D, 1.4E, 1.4F, 1.4G, 1.4S	Substances and articles that present no significant explosive hazard or that present only a small hazard in the event of ignition or initiation
1.5 D	Very insensitive substances that 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
1.6 N	Extremely insensitive articles that do not have a mass explosion hazard

[3] GHS 7 Part 2, Physical hazards: http://www.unece.org/fileadmin/DAM/trans/danger/publi/ghs/ghs_rev07/English/02e_part2.pdf

2.2 Flammable gases

A flammable gas is a gas having a flammable range with air at 20 ºC and 101.3 kPa (Standard Temperature and Pressure, STP).

Flammable gases are divided into categories 1A, 1B, or 2 based on their flammable properties as shown in **table 2**. A flammable gas Category 1A may be further categorised as a pyrophoric gas or in one of two divisions of chemically unstable gas.

Section 2.2.4 of the GHS book lays out the decision flow charts and guidance needed for this class.

Table 2: Classifications and criteria for flammable gases

Classification	Classification criteria	Comments
Flammable gas Category 1A	Gases that at STP: • are ignitable when in a mixture of 13% or less by volume in air; or • have a flammable range with air of at least 12 percentage points regardless of lower flammability limit. *Unless data shows the gas meets the criteria for Category 1B*	
Flammable gas Category 1A pyrophoric gas	Flammable gases that ignite spontaneously in air at 54 ºC or below	
Flammable gas Category 1A chemically unstable gas A	Flammable gases which are chemically unstable at STP	
Flammable gas Category 1A chemically unstable gas B	Flammable gases which are chemically unstable at a temperature greater than 20 ºC and/or a pressure greater than 101.3 kPa	
Flammable gas Category 1B	Gases which meet the flammability criteria for Category 1A, are not pyrophoric and not chemically unstable, and have either: • a lower flammability limit of more than 6% by volume in air; or • a fundamental burning velocity of less than 10 cm/s	
Flammable gas Category 2	Other gases which have a flammable range while mixed in air at STP	Methyl bromide and ammonia are both Category 2

2.3 Aerosols

An aerosol in this context:

- is a non-refillable receptacle made of metal, glass, or plastics
- contains a gas compressed, liquefied or dissolved under pressure, with or without other liquid, paste or powder ingredients; and
- is fitted with a release device allowing the contents 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.

There are three categories of aerosol based on the flammable properties of the ingredients and their heat of combustion. The classifications and criteria for aerosols are shown in **table 3**.

Aerosols should be considered for Category 1 or 2 if they contain more than 1% of ingredients that are classified as flammable gases, flammable liquids, or flammable solids, or if their heat of combustion is at least 20 kJ/g.

Table 3: Classifications and criteria for aerosols

Classification	Classification criteria
Aerosol Category 1	Aerosol with >1% flammable ingredients or a heat of combustion of at least 20 kJ/g are classified as Category 1, unless test data shows they meet the criteria of Categories 2 or 3.
Aerosol Category 2	*The criteria for differentiation between Categories 1 and 2 depend on the results of the foam test for foam aerosols, or ignition test distance and the enclosed space test for spray aerosols.*
Aerosol Category 3	Aerosols that do not meet the criteria for Category 1 or Category 2.

2.4 Oxidising gases

The oxidising power of an oxidising gas mixture can be determined by tests or calculation according to ISO 10156:2010 *Gases and gas mixtures – Determination of fire potential and oxidizing ability for the selection of cylinder valve outlets*. The classification and criteria for oxidising gases are shown in **table 4**.

Table 4: Classification and criteria for oxidising gases

Classification	Classification criteria
Oxidising gas Category 1	Any gas that contributes to the combustion of other material more than air does (generally by providing oxygen).

2.5 Gases under pressure

Gases under pressure are gases which are contained in a receptacle at a pressure of 200 kPa or more at 20 ºC, or which are liquefied, or liquefied and refrigerated. The classifications and criteria for gases under pressure are shown in **table 5**.

The gases under pressure classifications do not make a substance a hazardous substance under the HSNO Act, because “pressure” is not one of the intrinsic hazardous properties in the definition of hazardous substance under the Act.

However, gases under pressure classifications **do** apply to the physical states of gases when they are packaged (for example, in cylinders), and controls are able to be applied to gases under pressure in EPA notices regardless of whether they have intrinsic hazardous properties. There are also requirements on gases under pressure in the Health and Safety at Work (Hazardous Substances) Regulations 2017, and in some Safe Work Instruments.

Key physical property information needed for classification includes vapour pressure at 50 ºC; physical state at STP; and the critical temperature of the gas. This information will likely be available for most single chemical gases but requires complex calculation for mixtures.

Aerosols should not be classified as gases under pressure.

Table 5: Classifications and criteria for gases under pressure

Classification	Classification criteria
Compressed gas	A gas that when packaged under pressure is entirely gaseous at -50 ºC. This includes all gases with a critical temperature ≤ -50 ºC
Liquefied gas	A gas that when packaged under pressure is partially liquid at temperatures above -50 ºC. A distinction can be made between a high pressure liquefied gas (critical temperature between -50 ºC and +65 ºC) and a low pressure liquefied gas (critical temperature above +65 ºC)
Refrigerated liquefied gas	A gas that when packaged is partially liquid because of low temperature
Dissolved gas	A gas that when packaged is dissolved in a liquid phase solvent

2.6 Flammable liquids

There are four hazard categories for flammable liquid as shown in **table 6**. The key information is the flash point and the initial boiling point of the liquid. The flash point is expected to be determined by a closed-cup test method. Open-cup tests are only acceptable in special circumstances, and give different values to closed-cup tests. Suitable test methods are specified in the GHS.

Note that some specific types of flammable liquids are treated differently for some regulatory purposes for transport.

Table 6: Classifications and criteria for flammable liquids

Classification	Classification criteria
Flammable liquid Category 1	Flash point < 23 ºC and initial boiling point ≤ 35 ºC
Flammable liquid Category 2	Flash point < 23 ºC and initial boiling point > 35 ºC
Flammable liquid Category 3	Flash point ≥ 23 ºC and ≤ 60 ºC
Flammable liquid Category 4	Flash point > 60 ºC and ≤ 93 ºC

Classifying flammable liquid mixtures

General principles for determining if a mixture should be classified as a flammable liquid are as follows:

- Test data for the mixture is preferred.
- Where a mixture contains known flammable liquids in defined concentrations, the flash point can be calculated using a method outlined in the GHS, provided that the liquid phase is homogeneous and the following information is known:
  - the composition of the mixture
  - the lower explosion limit of each ingredient as well as a method for calculating the lower explosion limit of the mixture
  - the temperature dependence of saturated vapour pressure and of the activity coefficient for each ingredient

Refer to the GHS Book para 2.6.4.2.2 for further information.

2.7 Flammable solids

A flammable solid is a solid that is readily combustible or that can cause or contribute to fire through friction. Classification is determined by the tests from the Manual of Tests and Criteria, as laid out in the GHS. The classifications and categories are shown in **table 7**. Test data is required for both single chemicals and mixtures.

Table 7: Classifications and criteria for flammable solids

Classification	Classification criteria in burning rate test
Flammable solid Category 1	• Metal powders: burning time ≤ 5 minutes; or • Other substances or mixtures: the wetted zone does not stop fire; and the burning time is < 45 seconds or burning rate is > 2.2 mm/s.
Flammable solid Category 2	• Metal powders: burning time is > 5 and ≤ 10 minutes; or • Other substances or mixtures: the wetted zone stops the fire for at least 4 min; and the burning time is < 45 seconds or burning rate is > 2.2 mm/s.

2.8 Self-reactive substances and mixtures

Self-reactive substances or mixtures are thermally unstable liquids or solids liable to undergo a strongly exothermic decomposition even without oxygen or air. The definition excludes substances or mixtures classified as explosives, organic peroxides or oxidisers.

Substances or mixtures are also not classified if they have a heat of decomposition < 300 J/g, or their self-accelerating decomposition temperature (SADT) is > 75 ºC for a 50 kg package.

There are seven classification categories for self-reactive substances and mixtures as shown in **table 8**. Determination of the classification is by a series of test criteria, which apply to both substances and mixtures.

Table 8: Classifications and criteria for self-reactive substances and mixtures

Classification	Description of self-reactivity
Self-reactive substance Type A	Can detonate or deflagrate rapidly, as packaged
Self-reactive substance Type B	Has explosive properties and, as packaged, neither detonates nor deflagrates rapidly, but is liable to undergo a thermal explosion in that package
Self-reactive substance Type C	Has explosive properties where the substance or mixture as packaged cannot detonate or deflagrate rapidly or undergo a thermal explosion
Self-reactive substance Type D	In laboratory testing: • detonates partially, does not deflagrate rapidly and shows no violent effect when heated under confinement; or • does not detonate at all, deflagrates slowly and shows no violent effect when heated under confinement; or • does not detonate or deflagrate at all and shows a medium effect when heated under confinement
Self-reactive substance Type E	In laboratory testing, neither detonates nor deflagrates at all and shows low or no effect when heated under confinement
Self-reactive substance Type F	In laboratory testing, neither detonates in the cavitated state nor deflagrates at all and shows only a low or no effect when heated under confinement as well as low or no explosive power
Self-reactive substance Type G	In laboratory testing, neither detonates in the cavitated state nor deflagrates at all and shows no effect when heated under confinement nor any explosive power, provided that it is thermally stable (self-accelerating decomposition temperature is 60 – 75 ºC for a 50 kg package), and, for liquid mixtures, a diluent having a boiling point greater than or equal to 150 ºC is used for desensitisation If the mixture is not thermally stable, or a diluent with boiling point < 150 ºC is used for desensitisation, the mixture is classified as Type F instead

2.9 Pyrophoric liquids

Pyrophoric liquids are substances that, even in small quantities, are liable to ignite within five minutes after coming into contact with air. Classification is based on tests from the Manual of Tests and Criteria. The classification and criteria are shown in **table 9**.

Table 9: Classifications and criteria for pyrophoric liquids

Classification	Classification criteria
Pyrophoric liquid Category 1	Ignites within 5 minutes when added to an inert carrier and exposed to air, or ignites or chars filter paper on contact with air within 5 min

2.10 Pyrophoric solids

Pyrophoric solids are substances that, even in small quantities, are liable to ignite within five minutes after coming into contact with air. Classification is based on tests from the Manual of Tests and Criteria. The classifications and criteria are shown in **table 10**.

Table 10: Classification and criteria for pyrophoric solids

Classification	Classification criteria
Pyrophoric solid Category 1	Ignites within 5 minutes of coming into contact with air

2.11 Self-Heating substances and mixtures

A self-heating substance or mixture is a solid or liquid that:

- is not pyrophoric, in that it ignites only when in large quantities and after long periods of time; and
- is liable to self-heat by reaction with air and without energy supply

Classification is based on tests from the Manual of Tests and Criteria. The classifications and criteria are shown in **table 11**.

Table 11: Classifications and criteria for self-heating substances and mixtures

Classification	Classification criteria
Self-heating substance or mixture Category 1	A positive result is obtained in a test using a 25 mm sample cube at 140 ºC
Self-heating substance or mixture Category 2	The above test is negative and a positive result is obtained in a test using a 100 mm cube sample at 140 ºC and one of the following is true: • the substance or mixture is to be packaged in packages with a volume of more than 3 m^3; or • a positive result is obtained in a test using a 100 mm cube sample at 120 ºC and the substance or mixture is to be packaged in packages with a volume of more than 450 L; or • a positive result is obtained in a test using a 100 mm cube sample at 100 ºC.

2.12 Substances and mixtures which, in contact with water, emit flammable gases

These substances are solids or liquids which, when they come into contact with water, are liable to become spontaneously flammable or emit flammable gases in dangerous quantities. Classification is based on tests from the Manual of Tests and Criteria. Classification is not required in certain circumstances, such as if the substance/mixture is known to not react with water, or forms a stable mixture in water, or the substance /mixture does not contain metals or metalloids. The classifications and criteria are shown in **t**able 12.

Table 12: Classifications and criteria for substances which, in contact with water, emit flammable gases

Classification	Classification criteria
Substance or mixture which, in contact with water, emits flammable gas Category 1	Reacts vigorously with water at ambient temperatures and demonstrates a tendency for the gas produced to ignite spontaneously, or which reacts with water at ambient temperatures such that the rate of evolution of flammable gas is ≥ 10 L per kg of substance over any one minute
Substance or mixture which, in contact with water, emits flammable gas Category 2	Reacts readily with water at ambient temperatures such that the maximum rate of evolution of flammable gas is ≥ 20 L per kg of substance per hour, and which does not meet the criteria for Category 1
Substance or mixture which, in contact with water, emits flammable gas Category 3	Reacts slowly with water at ambient temperatures such that the maximum rate of evolution of flammable gas is > 1 L per kg of substance per hour, and which does not meet the criteria for Categories 1 and 2

2.13 Oxidising liquids

An oxidising liquid is a liquid substance or mixture which, while in itself not necessarily combustible, may, generally by yielding oxygen, cause or contribute to the combustion of other material (by oxidation). Classification is based on tests from the Manual of Tests and Criteria. The classifications and criteria are shown in **table 13**.

Among other guidance, it is not necessary to test a substance for this endpoint if it is an:

- organic substance/mixture that does not contain O, F, or Cl
- organic substance/mixture where O, F, or Cl atoms are bonded only to C or H
- inorganic substance/mixture that does not contain O or halogen (F, Cl, Br, I) atoms.

Table 13: Classifications and criteria for oxidising liquids

Classification	Classification criteria
Oxidising liquid Category 1	Any substance or mixture which, as a 1:1 mixture by mass with cellulose: • spontaneously ignites; or • has a mean pressure rise time less than that of 1:1 mixture of 50% perchloric acid and cellulose.
Oxidising liquid Category 2	Any substance or mixture which, as a 1:1 mixture by mass with cellulose, has a mean pressure rise time less than or equal to that of a 40% aqueous sodium chlorate solution and cellulose; and the criteria for Category 1 are not met.
Oxidising liquid Category 3	Any substance or mixture which, as a 1:1 mixture by mass with cellulose, has a mean pressure rise time less than or equal to that of a 1:1 mixture of 65% aqueous nitric acid and cellulose; and the criteria for Categories 1 and 2 are not met.

Guidance on classifying liquid mixtures containing oxidising components is provided in the following section.

2.14 Oxidising solids

An oxidising solid is a solid which, while in itself is not necessarily combustible, may, generally by yielding oxygen, cause or contribute to the combustion of other material (by oxidation). Classification is based on tests from the Manual of Tests and Criteria, and there are differing criteria depending on the tests used. The classifications and criteria are shown in **table 14**.

Among other guidance, it is not necessary to test a substance for this endpoint if it is an:

- organic substance/mixture that does not contain O, F, or Cl
- organic substance/mixture where O, F, or Cl atoms are bonded only to C or H
- inorganic substance/mixture that does not contain O or halogen (F, Cl, Br, I) atoms.

Table 14: Classifications and criteria for oxidising solids

Classification	Classification criteria
Oxidising solid Category 1	Any substance or mixture which, in a 4:1 or 1:1 sample-cellulose ratio (by mass): • exhibits a mean burning time less than the mean burning time of a 3:2 mixture (by mass) of potassium bromate and cellulose; or • exhibits a mean burning rate greater than the mean burning rate of a 3:1 mixture (by mass) of calcium peroxide and cellulose.
Oxidising solid Category 2	Any substance or mixture which, in a 4:1 or 1:1 sample-cellulose ratio (by mass): • exhibits a mean burning time equal to or less than the mean burning time of a 2:3 mixture (by mass) of potassium bromate and cellulose and the criteria for Category 1 are not met; or • exhibits a mean burning rate equal to or greater than the mean burning rate of a 1:1 mixture (by mass) of calcium peroxide and cellulose and the criteria for Category 1 are not met.
Oxidising solid Category 3	Any substance or mixture which, in a 4:1 or 1:1 sample-cellulose ratio (by mass): • exhibits a mean burning time equal to or less than the mean burning time of a 3:7 mixture (by mass) of potassium bromate and cellulose and the criteria for Categories 1 and 2 are not met.; or • exhibits a mean burning rate equal to or greater than the mean burning rate of a 1:2 mixture (by mass) of calcium peroxide and cellulose and the criteria for Categories 1 and 2 are not met.

Classifying mixtures with oxidising components

The order of preference for determining the oxidising classifications for a mixture is:

1. test data on the complete mixture
2. sufficient data on similar mixtures to estimate the classification using bridging principles
3. classification based on the oxidising capacity of the ingredients (with extreme caution)

If an oxidising substance is mixed with an inert material, the oxidising capability of the mixture does not linearly decrease with decreasing content of the oxidising substance. The relationship is more or less logarithmic and depends on the characteristics of the oxidising substance.

The determination of the oxidising properties of an aqueous solution of solid oxidising substances and its classification as an oxidising mixture is not necessary if the total concentration of all solid oxidisers in the aqueous solution is ≤ 20% (w/w).

Special consideration on particle size

The oxidising properties of a solid depend on its particle size. The smaller the particle size, the higher the oxidising capability of the solid. In some cases, large particles of a certain solid may be considered to be non-hazardous, while small particles of the same solid need to be classified into the hazard class of oxidising solids. Therefore, classification tests on solid substances and mixtures should be performed on the substance or mixture in its physical form 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 shall also be tested in the new form.

2.15 Organic peroxides

Organic peroxides are liquid or solid organic substances with an oxygen-oxygen bond, and may be considered derivatives of hydrogen peroxide. The term also includes mixtures containing organic peroxides. Organic peroxides are thermally unstable, and may undergo exothermic self-accelerating decomposition. Organic peroxides may also be liable to explosive decomposition, burn rapidly, be sensitive to impact or friction, or react dangerously with other substances.

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

a. not more than 1.0% available oxygen from the organic peroxides when containing not more than 1.0% hydrogen peroxide; or

b. not more than 0.5% available oxygen from the organic peroxides when containing more than 1.0% but not more than 7.0% hydrogen peroxide.

The formula for determining the available oxygen content (%) can be found in section 2.15.2.1 of the GHS.

There are seven classification categories of organic peroxides, with classification based on tests from the Manual of Tests and Criteria. The classifications and criteria are shown in **table 15**.

Table 15: Classifications and criteria for organic peroxides

Classification	Description of reactivity
Organic peroxide Type A	Can detonate or deflagrate rapidly as packaged.
Organic peroxide Type B	Has explosive properties, does not detonate or deflagrate rapidly as packaged, but is liable to undergo a thermal explosion in that package.
Organic peroxide Type C	Has explosive properties, but cannot detonate or deflagrate rapidly or undergo a thermal explosion as packaged.
Organic peroxide Type D	Any organic peroxide which in laboratory testing: • detonates partially, does not deflagrate rapidly, and shows no violent effect when heated under confinement; or • does not detonate at all, deflagrates slowly, and shows no violent effect when heated under confinement; or • does not detonate or deflagrate at all, and shows a medium effect when heated under confinement.
Organic peroxide Type E	Any organic peroxide which, in laboratory testing, neither detonates nor deflagrates at all and shows low or no effect when heated under confinement.

Classification	Description of reactivity
Organic peroxide Type F	Any organic peroxide which, in laboratory testing, neither detonates in the cavitated state nor deflagrates at all and shows only a low or no effect when heated under confinement as well as low or no explosive power.
Organic peroxide Type G	Any organic peroxide which, in laboratory testing, neither detonates in the cavitated state nor deflagrates at all and shows no effect when heated under confinement nor any explosive power, provided it is thermally stable (self-accelerating decomposition temperature is 60 ºC or higher for a 50 kg package), and, for liquid mixtures, a diluent having a boiling point ≥ 150 ºC is used for desensitisation. If the organic peroxide is not thermally stable, or a diluent with boiling point < 150 ºC is used for desensitisation, the mixture is classified as Type F instead.

Classifying mixtures of organic peroxides

Mixtures of organic peroxides may be classified as the same type of organic peroxide as that of the most dangerous ingredient. However, as two stable ingredients can form a thermally less stable mixture, the self-accelerating decomposition temperature (SADT) of the mixture shall be determined.

2.16 Corrosive to metals

Substances are classified as corrosive to metals based on tests from the Manual of Tests and Criteria. The classification and criteria are shown in **table 16**.

Table 16: Classification and criteria for substances that are corrosive to metals

Classification	Classification criteria
Corrosive to metals Category 1	Corrosion rate on either steel or aluminium surfaces exceeds 6.25 mm/year at 55ºC.

Classifying mixtures that are corrosive to metals

The order of preference for determining the metal corrosivity classifications for a mixture is:

1. test data on the complete mixture
2. sufficient data on similar mixtures to estimate the classification using bridging principles

Corrosivity of metals is so complex that the evaluation of a mixture cannot be extrapolated from similar behaviour of constituents of a mixture. However, if one significant component of a mixture is corrosive to metals the mixture is likely to be corrosive to metals as well. Testing the actual mixture is therefore highly recommended.

2.17 Desensitised explosives

Desensitised explosives are solid or liquid explosive substances or mixtures which are phlegmatised to suppress their explosive properties such that they do not mass explode, and do not burn too rapidly – therefore not being classified as explosive.

Solid desensitised explosives are explosive substances wetted with water or alcohols or diluted with other substances to form a homogenous solid with suppressed explosive properties.

Liquid desensitised explosives are explosive substances dissolved or suspended in water or other liquids, forming a homogenous liquid mixture with suppressed explosive properties.

Classification considers any desensitised explosive unless:

- it is intended to produce a practical explosive or pyrotechnic effect; or
- it has a mass explosion hazard or a corrected burning rate of > 1,200 kg/min according to the criteria in the relevant sections of the Manual of Tests and Criteria; or
- it has an exothermic decomposition energy < 300 J/g.

There are four classification categories for desensitised explosives, based on the burning rate test (external fire) from the Manual of Tests and Criteria. The classifications and criteria are shown in **table 17**.

Table 17: Classifications and criteria for desensitised explosives

Classification	Classification criteria
Desensitised explosive Category 1	Desensitised explosive with a corrected burning rate ≥ 300 kg/min but not more than 1,200 kg/min.
Desensitised explosive Category 2	Desensitised explosive with a corrected burning rate ≥ 140 kg/min but < 300 kg/min.
Desensitised explosive Category 3	Desensitised explosive with a corrected burning rate ≥ 60 kg/min but < 140 kg/min.
Desensitised explosive Category 4	Desensitised explosive with a corrected burning rate < 60 kg/min.

Part 3: Health hazards[4]

3.1 Acute toxicity

Acutely toxic substances are substances with serious adverse health effects, including lethality, after a single or short-term oral, dermal, or inhalation exposure to the substance.

In the GHS there are five categories for acute toxicity, and substances are classified for each of the oral, dermal, and inhalation exposure routes separately. The basis for classification is (approximate) LD_{50} or LC_{50} values, or acute toxicity estimates (ATE). While some *in vivo* methods determine LD_{50} / LC_{50} values directly, other newer *in vivo* methods (eg, using fewer animals) consider other indicators of acute toxicity, such as significant clinical signs of toxicity, which are used by reference to assign the hazard category.

Category 5 is not adopted in New Zealand's implementation of GHS. The adopted classifications and criteria are shown in **tables 18, 19 and 20**.

Table 18: Classifications and criteria for acute oral toxicity

Classification	Classification criteria (ATE in mg/kg bw)
Acute oral toxicity Category 1	ATE ≤ 5
Acute oral toxicity Category 2	5 < ATE ≤ 50
Acute oral toxicity Category 3	50 < ATE ≤ 300
Acute oral toxicity Category 4	300 < ATE ≤ 2000

Table 19: Classifications and criteria for acute dermal toxicity

Classification	Classification criteria (ATE in mg/kg bw)
Acute dermal toxicity Category 1	ATE ≤ 50
Acute dermal toxicity Category 2	50 < ATE ≤ 200
Acute dermal toxicity Category 3	200 < ATE ≤ 1000
Acute dermal toxicity Category 4	1000 < ATE ≤ 2000

[4] GHS 7, Part 3 Health hazards: http://www.unece.org/fileadmin/DAM/trans/danger/publi/ghs/ghs_rev07/English/03e_part3.pdf

Table 20: Classifications and criteria for acute inhalation toxicity

Classification	Classification criteria (ATE)		
	Gases (ppmV)	Vapours (mg/L)	Dusts/Mists (mg/L)
Acute inhalation toxicity Category 1	ATE ≤ 100	ATE ≤ 0.5	ATE ≤ 0.05
Acute inhalation toxicity Category 2	100 < ATE ≤ 500	0.5 < ATE ≤ 2.0	0.05 < ATE ≤ 0.5
Acute inhalation toxicity Category 3	500 < ATE ≤ 2500	2.0 < ATE ≤ 10	0.5 < ATE ≤ 1.0
Acute inhalation toxicity Category 4	2500 < ATE ≤ 20000	10 < ATE ≤ 20	1.0 < ATE ≤ 5.0

Notes for tables 18, 19 and 20

(a) The acute toxicity estimate (ATE) for the classification of a substance is derived using the LD_{50} / LC_{50} where available;

(b) The acute toxicity estimate (ATE) for a substance in a mixture is derived using:

(i) the LD_{50} / LC_{50} where available, otherwise,

(ii) the appropriate conversion value from Table 21 that relates to the results of a range test; or

(iii) the appropriate conversion value from Table 21 that relates to a classification category;

(c) Inhalation cut-off values in Table 20 are based on 4-hour testing exposures. Conversion of existing inhalation toxicity data which has been generated according to 1-hour exposures should be by dividing by a factor of 2 for gases and vapours and 4 for dusts and mists. If you have data based on a different exposure duration this should be discussed with the EPA.

Classifying mixtures for acute toxicity

The order of preference for determining classifications for a mixture is:

1. test data on the mixture as a whole
2. sufficient data on similar mixtures to estimate classification hazards using bridging principles
3. classification by mixture rules based on the acute toxicity of the ingredients.

To calculate the acute toxicity classifications of a product the LD_{50}, LC_{50} or ATE values of the ingredients should be added using the following “additivity formula”:

$T_{mix} = 100/(C_a/T_a + C_b/T_b\ldots.)$

C_a = percent of ingredient a in the product

T_a = oral LD_{50} or dermal LD_{50} or inhalation $LC_{50,}$ or ATE of ingredient a in mg/kg body weight or mg/L air or ppm air

T_{mix} = estimated LD_{50} or LC_{50} or ATE of the product

The acute toxicity classification for each route of exposure needs to be determined separately.

Where a specific LD_{50},or LC_{50} value is not available, the acute toxicity range estimate should be converted to a point estimate as described in **table 21**. The point estimate can then be used in the mixture calculation.

Table 21: **Conversion from experimentally obtained acute toxicity range values (or acute toxicity hazard categories) to acute toxicity point estimates**

Exposure routes	Classification category or experimentally obtained acute toxicity range estimate	Converted acute toxicity point estimate (refer note)
Oral (mg/kg bw)	0 < Category 1 ≤ 5	0.5
	5 < Category 2 ≤ 50	5
	50 < Category 3 ≤ 300	100
	300 < Category 4 ≤ 2,000	500
Dermal (mg/kg bw)	0 < Category 1 ≤ 50	5
	50 < Category 2 ≤ 200	50
	200 < Category 3 ≤ 1,000	300
	1,000 < Category 4 ≤ 2,000	1,100
Gases (ppmV in air)	0 < Category 1 ≤ 100	10
	100 < Category 2 ≤ 500	100
	500 < Category 3 ≤ 2,500	700
	2,500 < Category 4 ≤ 20,000	4,500
Vapours (mg/L in air)	0 < Category 1 ≤ 0.5	0.05
	0.5 < Category 2 ≤ 2.0	0.5
	2.0 < Category 3 ≤ 10.0	3.0
	10.0 < Category 4 ≤ 20.0	11.0
Dust/mist (mg/L in air)	0 < Category 1 ≤ 0.05	0.005
	0.05 < Category 2 ≤ 0.5	0.05
	0.5 < Category 3 ≤ 1.0	0.5
	1.0 < Category 4 ≤ 5.0	1.5

Note: These values are designed to be used in the calculation of the ATE for classification of a mixture based on its ingredients and do not represent test results. The values are conservatively set at the lower end of the range for Categories 1 and 2, and at a point approximately $1/10^{th}$ from the lower end of the range for Categories 3 and 4.

3.2 Skin corrosion/irritation

Skin corrosion refers to the production of irreversible damage to the skin; namely, visible necrosis through the epidermis and into the dermis occurring after exposure to a substance or mixture.

Skin irritation refers to the production of reversible damage to the skin occurring after exposure to a substance or mixture.

In GHS there are three categories for skin corrosion/irritation. In addition, there are three subcategories for skin corrosion.

New Zealand's implementation of GHS has adopted the three subcategories of skin corrosion Category 1. Skin irritation Category 3 is not adopted in New Zealand's implementation of GHS.

All the adopted classifications and criteria are shown in **table 22**.

Table 22: Classifications and criteria for skin corrosion and skin irritation

GHS Classification	Criteria
Skin corrosion Category 1A	Corrosive responses in at least one animal following exposure ≤ 3 min during an observation period ≤ 1 h.
Skin corrosion Category 1B	Corrosive responses in at least one animal following exposure > 3 min and ≤ 1 h and observations ≤ 14 days.
Skin corrosion Category 1C	Corrosive responses in at least one animal after exposures > 1 h and ≤ 4 h and observations ≤ 14 days.
Skin irritation Category 2	(1) Mean Draize score of ≥ 2.3 and ≤ 4.0 for erythema/eschar or for oedema in at least 2 of 3 tested animals from gradings at 24, 48 and 72 hours after patch removal or, if reactions are delayed, from grades on 3 consecutive days after the onset of skin reactions; or (2) Inflammation that persists to the end of the observation period normally 14 days in at least 2 animals, particularly taking into account alopecia (limited area), hyperkeratosis, hyperplasia, and scaling; or (3) In some cases where there is pronounced variability of response among animals, with very definite positive effects related to chemical exposure in a single animal but less than the criteria above.

Classifying mixtures for skin corrosion/irritation

The order of preference for determining the skin corrosion and skin irritation classifications for a mixture is:

1. test data on the complete mixture
2. sufficient data on similar mixtures to estimate the classification using bridging principles
3. classification based on the skin corrosivity or skin irritancy of the ingredients.

When considering testing of the mixture, classifiers are encouraged to use a tiered weight of evidence approach as included in the criteria for classification of substances for skin corrosion and irritation to help ensure an accurate classification, as well as to avoid unnecessary animal testing (refer to figure 3.2.1 in the GHS Book).

In the absence of any other information, a mixture is considered corrosive (Skin Category 1) if it has a pH ≤ 2 or ≥ 11.5. However, if consideration of acid/alkaline reserve suggests the mixture may not be corrosive despite the low or high pH value, this needs to be confirmed by other data, preferably by data from an appropriate validated *in vitro* test. Note it is not possible to assign the subcategories of skin corrosion Category 1A, 1B or 1C based solely on the pH value.

The concentration of ingredients of a mixture classified as skin Category 1 or 2 that would trigger classification of the mixture as hazardous to the skin (Category 1 or 2) using the additivity approach is shown in **table 23**.

Table 23: Skin corrosion and irritancy classification calculation for mixtures via additivity

Sum of ingredients classified as:	Concentration triggering classification of a mixture as:	
	Skin corrosive	**Skin irritant**
	Category 1 (see note below)	Category 2
Skin corrosive Category 1A, 1B or 1C	≥ 5%	≥ 1% but < 5%
Skin irritation Category 2		≥ 10%
(10 x Skin corrosive Category 1) + Skin irritation Category 2		≥ 10%

Note: The sum of all ingredients of a mixture classified as skin corrosive 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. Where the sum of 1A ingredients is < 5% but the sum of 1A+1B ingredients is ≥ 5%, the mixture should be classified as sub-category 1B. Similarly, where the sum of 1A + 1B ingredients is < 5% but the sum of 1A + 1B + 1C ingredients is ≥ 5% the mixture should be classified as sub-category 1C.

3.3 Serious eye damage/eye irritation

Serious eye damage refers to the tissue damage in the eye, or serious physical decay of vision, which is not fully reversible, occurring after exposure of the eye to a substance or mixture.

Eye irritation refers to the production of changes in the eye, which are fully reversible, occurring after the exposure of the eye to a substance or mixture.

In GHS there are two categories which cover serious eye damage or eye irritation. In addition, there are two subcategories for eye irritation. **The subcategories for eye irritation are not adopted in New Zealand's implementation of GHS.** All the adopted classifications and criteria are shown in **table 24**.

Table 24: Classifications and criteria for serious eye damage and eye irritation

Classification	Criteria
Serious eye damage Category 1	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 two of three tested animals, a positive response of: (i) corneal opacity ≥ 3; and/or (ii) iritis > 1.5; calculated as the mean Draize scores following grading at 24, 48 and 72 hours after instillation of the test material.
Eye irritation Category 2	Substances that produce in at least two of three 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 oedema (chemosis) ≥ 2. calculated as the mean Draize 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.

Classifying mixtures for serious eye damage/eye irritation

The order of preference for determining the serious eye damage/eye irritation classification for a mixture is:

1. test data on the complete mixture
2. sufficient data on similar mixtures to estimate the classification using bridging principles
3. classification based on the serious eye damage/eye irritancy of the ingredients.

When considering testing of the mixture, classifiers are encouraged to use a tiered weight of evidence approach as included in the criteria for classification of substances for skin corrosion and serious eye damage and eye irritation to help ensure an accurate classification, as well as to avoid unnecessary animal testing (refer to figure 3.3.1 in the GHS Book).

In the absence of any other information, a mixture is considered to cause serious eye damage if it has a pH ≤ 2 or ≥ 11.5. However, if consideration of acid/alkaline reserve suggests the mixture may not cause serious eye damage despite the low or high pH value, this needs to be confirmed by other data, preferably by data from an appropriate validated *in vitro* test.

The concentration of ingredients of a mixture classified as skin Category 1 and/or eye Category 1 or 2 that would trigger classification of the mixture as hazardous to the eye (Category 1 or 2) is shown in **table 25.**

Table 25: Serious eye damage and eye irritation classification calculation for mixtures via additivity

Sum of ingredients classified as	Concentration triggering classification of a mixture as	
	Serious eye damage	**Eye irritation**
	Category 1	Category 2
Skin corrosion Categories 1A, 1B, or 1C + serious eye damage Category 1	≥ 3%	≥ 1% but < 3%
Eye irritation Category 2		≥ 10%
10 x (Skin corrosion categories 1A, 1B, or 1C, + serious eye damage Category 1) + eye irritation Category 2		≥ 10%

Note: If an ingredient is classified as both skin Category 1A, 1B or 1C **and** eye serious eye damage Category 1, its concentration is considered only once in the calculation.

3.4 Respiratory and/or skin sensitisation

In GHS there are two categories that cover sensitisation; respiratory sensitisation and skin sensitisation. GHS also allows the allocation of sensitisers into sub-categories 1A or 1B.

Respiratory sensitisation refers to hypersensitivity of the airways occurring after inhalation of a substance or a mixture. Conclusive evidence of respiratory sensitisation in humans most commonly requires supportive epidemiological studies. The classifications and criteria are shown in **table 26.**

Skin sensitisation refers to an allergic response occurring after skin contact with a substance or a mixture. The classifications and criteria are shown in **table 27.**

Table 26: Classification and criteria for respiratory sensitisation

Classification	Criteria
Respiratory sensitisation Category 1	A substance is classified as a respiratory sensitiser: (a) if there is evidence in humans that the substance can lead to specific respiratory hypersensitivity; and/or (b) if there are positive results from an appropriate animal test (refer note).
Respiratory sensitisation Category 1A	Substances showing a high frequency of occurrence in humans; or a probability of occurrence of a high respiratory sensitisation rate in humans based on animal or other tests (refer note). Severity of reaction may also be considered.
Respiratory sensitisation Category 1B	Substances showing a low to moderate frequency of occurrence in humans; or a probability of occurrence of a low to moderate respiratory sensitisation rate in humans based on animal or other tests (refer note). Severity of reaction may also be considered.

Note: At present, recognized and validated animal models for the testing of respiratory hypersensitivity are not available. Under certain circumstances, data from animal studies may provide valuable information in a weight of evidence assessment.

Table 27: Classification and criteria for skin sensitisation

Classification	Criteria
Skin sensitisation Category 1	A substance is classified as a skin sensitiser: (a) if there is evidence in humans that the substance can lead to sensitisation by skin contact in a substantial number of persons, or (b) if there are positive results from an appropriate animal test (refer note 1).
Skin sensitisation Category 1A	Substances showing a high frequency of occurrence in humans and/or a high potency in animals can be presumed to have the potential to produce significant skin sensitisation in humans. Severity of reaction may also be considered (refer note 2).
Skin sensitisation Category 1B	Substances showing a low to moderate frequency of occurrence in humans and/or a low to moderate potency in animals can be presumed to have the potential to produce skin sensitisation in humans. Severity of reaction may also be considered (refer note 3).

Note 1. For Category 1, when an adjuvant type test method for skin sensitisation is used (e.g. Guinea Pig Maximization Test), a response of at least 30% of the animals is considered as positive. For a non-adjuvant Guinea pig test method (e.g., Buehler test), a response of at least 15% of the animals is considered as positive. For Category 1, a stimulation index of three or more is considered a positive response in the local lymph node assay. Details of test methods are provided in para 3.4.2.2.3.1 of the GHS Book. For further information contact the EPA.

Note 2. Animal test results for subcategory 1A can include data with values indicated in Table 3.4.3 in the GHS Book.

Note 3. Animal test results for subcategory 1B can include data with values indicated in Table 3.4.4 in the GHS Book.

Classifying mixtures for respiratory and skin sensitisation

The order of preference for determining the respiratory or skin sensitisation classification for a mixture is:

1. test data on the complete mixture
2. sufficient data on similar mixtures to estimate the classification using bridging principles
3. classification based on the respiratory or skin sensitisation of the ingredients.

Table 28 shows the cut-off values/concentration limits, **as adopted in New Zealand**, of ingredients of a mixture classified as a respiratory or skin sensitiser that would trigger classification of a mixture.

Table 28: Cut-off values/concentration limits for respiratory and/or skin sensitising mixtures

Ingredient classification	Mixture classification		
	Respiratory sensitiser Category 1		Skin sensitiser Category 1
	Solid/Liquid	Gas	All physical states
Respirator sensitiser Category 1	≥ 0.1%	≥ 0.1%	
Respirator sensitiser Sub-category 1A	≥ 0.1%	≥ 0.1%	
Respirator sensitiser Sub-category 1B	≥ 1.0%	≥ 0.2%	
Skin sensitiser Category 1			≥ 0.1%
Skin sensitiser Sub-category 1A			≥ 0.1%
Skin sensitiser Sub-category 1B			≥ 1.0%

Note: Sub-categories 1A and 1B, which form part of Category 1, should only be used where data are sufficient to allow the allocation of sensitisers into these sub-categories.

Respiratory and skin sensitisers with lower thresholds in classification of mixtures

Based on expert judgement, there are some hazardous substances, that when present in a mixture at levels below the normal cut-offs, will still contribute to the classification of the mixture as a sensitiser. Where this is the case, the classification information for the ingredient should indicate the revised threshold for contribution to classification of mixtures.

3.5 Germ cell mutagenicity

Germ cell mutagenicity refers to heritable gene mutations, including heritable structural and numerical chromosome aberrations in germ cells occurring after exposure to a substance or mixture.

This hazard class is primarily concerned with chemicals that may cause mutations in the germ cells of humans that can be transmitted to the progeny. However, mutagenicity/genotoxicity tests in vitro and in mammalian somatic cells in vivo are also considered in classifying substances and mixtures within this hazard class.

The classification system provides for two different categories of germ cell mutagens to accommodate the weight of evidence available. The classifications and criteria are shown in **table 29**.

Table 29: Classifications and criteria for germ cell mutagenicity

Classification	Criteria
Germ cell mutagenicity Category 1	**Substances known to induce heritable mutations in germ cells of humans:** Positive evidence from human epidemiological studies. **Substances which should be regarded as if they induce heritable mutations in the germ cells of humans:** (a) positive result(s) from in vivo heritable germ cell mutagenicity tests in mammals; or (b) positive result(s) from in vivo somatic cell mutagenicity tests in mammals, in combination with some evidence that the substance has potential to cause mutations to germ cells. This supporting evidence may, for example, be derived from mutagenicity/genotoxic tests in germ cells in vivo, or by demonstrating the ability of the substance or its metabolite(s) to interact with the genetic material of germ cells; or (c) positive results from tests showing mutagenic effects in the germ cells of humans, without demonstration of transmission to progeny; for example, an increase in the frequency of aneuploidy in sperm cells of exposed people.
Germ cell mutagenicity Category 2	**Substances which cause concern for humans owing to the possibility that they may induce heritable mutations in the germ cells of humans:** Positive evidence obtained from experiments in mammals and/or in some cases from in vitro experiments, obtained from: (a) somatic cell mutagenicity tests in vivo, in mammals; or (b) other in vivo somatic cell genotoxicity tests which are supported by positive results from in vitro mutagenicity assays. **Note**: Substances which are positive in in vitro mammalian mutagenicity assays, and which also show structure activity relationship to known germ cell mutagens, should be considered for classification as Category 2 mutagens.

Classifying mixtures for germ cell mutagenicity

The order of preference for determining the germ cell mutagenicity classification for a mixture is:

1. test data on the complete mixture
2. sufficient data on similar mixtures to estimate the classification using bridging principles
3. classification based on the germ cell mutagenicity of the ingredients.

Table 30 shows the cut-off values/concentration limits, **as adopted in New Zealand**, of ingredients of a mixture classified as a germ cell mutagen that would trigger classification of a mixture.

Table 30: Cut-off values/concentration limits for mutagenic mixtures

Ingredient classification	Mixture classification	
	Category 1 mutagen	Category 2 mutagen
Category 1 mutagen	≥ 0.1%	
Category 2 mutagen		≥ 1.0%

3.6 Carcinogenicity

Carcinogenicity refers to the induction of cancer or an increase in the incidence of cancer occurring after exposure to a substance or mixture. Substances and mixtures which have induced benign and malignant tumours in well performed experimental studies on animals are considered also to be presumed or suspected human carcinogens unless there is strong evidence that the mechanism of tumour formation is not relevant for humans.

Classification of a substance or mixture as posing a carcinogenic hazard is based on its inherent properties and does not provide information on the level of the human cancer risk which the use of the substance or mixture may represent.

For the purpose of classification for carcinogenicity, substances are allocated to one of two categories based on strength of evidence and additional considerations (weight of evidence). In certain instances, route specific classification may be warranted. The classifications and criteria are shown in **table 31**.

Table 31: Classifications and criteria for carcinogenicity

Classification	Criteria
Carcinogenicity Category 1	**Known to have carcinogenic potential for humans; the placing of a substance is largely based on human evidence.** **Presumed to have carcinogenic potential for humans; the placing of a substance is largely based on animal evidence:** Based on strength of evidence together with additional considerations, such evidence may be derived from human studies that establish a causal relationship between human exposure to a substance and the development of cancer (known human carcinogen). Alternatively, evidence may be derived from animal experiments for which there is sufficient evidence to demonstrate animal carcinogenicity (presumed human carcinogen). In addition, on a case by case basis, scientific judgement may warrant a decision of presumed human carcinogenicity derived from studies showing limited evidence of carcinogenicity in humans together with limited evidence of carcinogenicity in experimental animals.
Carcinogenicity Category 2	**Suspected human carcinogens:** The placing of a substance in Category 2 is done on the basis of evidence obtained from human and/or animal studies, but which is not sufficiently convincing to place the substance in Category 1. Based on strength of evidence together with additional considerations, such evidence may be from either limited evidence of carcinogenicity in human studies or from limited evidence of carcinogenicity in animal studies.

Classifying mixtures for carcinogenicity

The order of preference for determining the carcinogenicity classification for a mixture is:

1. test data on the complete mixture
2. sufficient data on similar mixtures to estimate the classification using bridging principles
3. classification based on the carcinogenicity of the ingredients.

Table 32 shows the cut-off values/concentration limits, **as adopted in New Zealand**, of ingredients of a mixture classified as a carcinogen that would trigger classification of a mixture.

Table 32: Cut-off values/concentration limits for carcinogenic mixtures

Ingredient classification	Mixture classification	
	Carcinogenicity Category 1	Carcinogenicity Category 2
Carcinogenicity Category 1	≥ 0.1%	
Carcinogenicity Category 2		≥ 0.1%

3.7 Reproductive toxicity

Reproductive toxicity refers to adverse effects on sexual function and fertility in adult males and females, as well as developmental toxicity in the offspring, occurring after exposure to a substance or mixture.

In this classification system, reproductive toxicity is subdivided under two main headings:

a. adverse effects on sexual function and fertility
b. adverse effects on development of the offspring.

The classifications and criteria are shown in **table 33**.

In the evaluation of toxic effects on the developing offspring, it is important to consider the possible influence of maternal toxicity.

Some reproductive toxic effects cannot be clearly assigned to either impairment of sexual function and fertility or to developmental toxicity. Nonetheless, substances and mixtures with these effects would be classified as reproductive toxicants with a general hazard statement.

Adverse effects on or via lactation are also included in reproductive toxicity, but for classification purposes, such effects are treated separately. This is because it is desirable to be able to classify chemicals specifically for an adverse effect on lactation so that a specific hazard warning about this effect can be provided for lactating mothers.

Table 33: Classifications and criteria for reproductive toxicants and effects on or via lactation

Classification	Criteria
Reproductive toxicity Category 1	**Known or presumed human reproductive toxicant** This category includes substances which are known to have produced an adverse effect on sexual function and fertility or on development in humans or for which there is evidence from animal studies, possibly supplemented with other information, to provide a strong presumption that the substance has the capacity to interfere with reproduction in humans.
Reproductive toxicity Category 2	**Suspected human reproductive toxicant** This category includes substances for which there is some evidence from humans or experimental animals, possibly supplemented with other information, of an adverse effect on sexual function and fertility, or on development, in the absence of other toxic effects, or if occurring together with other toxic effects the adverse effect on reproduction is considered not to be a secondary non-specific consequence of the other toxic effects, and where the evidence is not sufficiently convincing to place the substance in Category 1. For instance, deficiencies in the study may make the quality of evidence less convincing, and in view of this Category 2 could be the more appropriate classification.
Effects on or via lactation	**Effects on or via lactation** are allocated to a separate single category. It is appreciated that for many substances there is no information on the potential to cause adverse effects on the offspring via lactation. However, substances which are absorbed by women and have been shown to interfere with lactation, or which may be present (including metabolites) in breast milk in amounts sufficient to cause concern for the health of a breastfed child, should be classified to indicate this property hazardous to breastfed babies. This classification can be assigned on the basis of: (a) absorption, metabolism, distribution and excretion studies that would indicate the likelihood the substance would be present in potentially toxic levels in breast milk; and/or (b) results of one or two generation studies in animals which provide clear evidence of adverse effect in the offspring due to transfer in the milk or adverse effect on the quality of the milk; and/or (c) human evidence indicating a hazard to babies during the lactation period.

Classifying mixtures for reproductive toxicity

The order of preference for determining the reproductive toxicant classification for a mixture is:

1. test data on the complete mixture;
2. sufficient data on similar mixtures to estimate the classification using bridging principles: and
3. classification based on the hazards of the ingredients.

Table 34 shows the cut-off values/concentration limits, **as adopted in New Zealand**, of ingredients of a mixture classified as a reproductive toxicant or has effects on or via lactation that would trigger classification of a mixture.

Table 34: Cut-off values/concentration limits for mixtures that are reproductive toxicants or have other effects on or via lactation

Ingredient classification	Mixture classification		
	Reproductive toxicity Category 1	Reproductive toxicity Category 2	Effects on or via lactation
Reproductive toxicity Category 1	≥ 0.1%		
Reproductive toxicity Category 2		≥ 0.1%	
Effects on or via lactation			≥ 0.1%

3.8 Specific target organ toxicity – single exposure

Specific target organ toxicity – single exposure refers to specific, non-lethal toxic effects on target organs occurring after a single exposure to a substance or mixture. All significant health effects that can impair function, both reversible and irreversible, immediate or delayed, where those effects are not covered separately in the GHS, are included. The classifications and criteria are included in **table 35.**

Classification depends upon the availability of reliable evidence that a single exposure to the substance or mixture has produced a consistent and identifiable toxic effect in humans, or, in experimental animals, toxicologically significant changes which have affected the function or morphology of a tissue/organ, or has produced serious changes to the biochemistry or haematology of the organism and these changes are relevant for human health. It is recognized that human data will be the primary source of evidence for this hazard class.

Specific target organ toxicity can occur by any route that is relevant for humans; ie, principally oral, dermal or inhalation.

Specific target organ toxicity following a repeated exposure is classified separately in the GHS as described in specific target organ toxicity – repeated exposure. A substance can be classified for both single exposure and repeated exposure.

Substances are classified in Category 1 or 2, depending upon the nature and severity of the effect(s) observed. Category 3 is applied instead to substances where there are target organ effects which may not meet the criteria to be classified in Categories 1 or 2. These are effects which adversely alter human function for a short duration after exposure and from which humans may recover in a reasonable period without leaving significant alteration of structure or function.

Table 35: Classifications and criteria for specific target organ toxicity – single exposure

Classification	Criteria
Specific target organ toxicity – single exposure Category 1	**Substances that have produced significant toxicity in humans, or that, on the basis of evidence from studies in experimental animals can be presumed to have the potential to produce significant toxicity in humans following single exposure** Placing a substance in Category 1 is done on the basis of: (a) reliable and good quality evidence from human cases or epidemiological studies; or (b) observations from appropriate studies in experimental animals in which significant and/or severe toxic effects of relevance to human health were produced at generally low exposure concentrations.
Specific target organ toxicity – single exposure Category 2	**Substances that, on the basis of evidence from studies in experimental animals can be presumed to have the potential to be harmful to human health following single exposure** Placing a substance in Category 2 is done on the basis of observations from appropriate studies in experimental animals in which significant toxic effects, of relevance to human health, were produced at generally moderate exposure concentrations. In exceptional cases, human evidence can also be used to place a substance in Category 2.
Specific target organ toxicity – single exposure Category 3	**Transient target organ effects** There are target organ effects for which a substance/mixture may not meet the criteria to be classified in Categories 1 or 2 indicated above. These are effects which adversely alter human function for a short duration after exposure and from which humans may recover in a reasonable period without leaving significant alteration of structure or function. This category only includes narcotic effects and respiratory tract irritation.

For these categories, the specific target organ/system that has been primarily affected by the classified substance may be identified, or the substance may be identified as a general toxicant. Attempts should be made to determine the primary target organ/system of toxicity and classify for that purpose; for example, hepatotoxicants, neurotoxicants. One should carefully evaluate the data and, where possible, not include secondary effects; for example, a hepatotoxicant can produce secondary effects in the nervous or gastro-intestinal systems.

In order to help reach a decision about whether a substance should be classified or not, and to what degree it would be classified (Category 1 vs. Category 2), dose/concentration “guidance values” are provided for consideration of the dose/concentration which has been shown to produce significant health effects. The principal argument for proposing such guidance values is that all chemicals are potentially toxic and there has to be a reasonable dose/concentration above which a degree of toxic effect is acknowledged.

Thus, in animal studies, when significant toxic effects are observed, that would indicate classification, consideration of the dose/concentration at which these effects were seen, in relation to the suggested guidance values, can provide useful information to help assess the need to classify.

The guidance value ranges proposed for single-dose exposure which has produced a significant non-lethal toxic effect are those applicable to acute toxicity testing, as indicated in **table 36**.

Table 36: Guidance value ranges for single-dose exposures

Guidance value ranges for:				
Route of exposure	**Units**	**Category 1**	**Category 2**	**Category 3**
Oral (rat)	mg/kg body weight	C ≤ 300	2000 ≥ C > 300	Guidance values do not apply (refer note)
Dermal (rat or rabbit)	mg/kg body weight	C ≤ 1,000	2,000 ≥ C > 1000	
Inhalation (rat) gas	ppmV/4h	C ≤ 2,500	20,000 ≥ C > 2,500	
Inhalation (rat) vapour	mg/litre/4h/d	C ≤ 10	20 ≥ C > 10	
Inhalation (rat) dust/mist/fume	mg/litre/4h/d	C ≤ 1.0	5.0 ≥ C > 1.0	

Note: Guidance values are not provided since this classification is primarily based on human data. Animal data may be included in the weight of evidence evaluation.

Classifying mixtures for specific target organ toxicity – single exposure

The order of preference for determining the specific target organ toxicant (single exposure) classification for a mixture is:

1. test data on the complete mixture
2. sufficient data on similar mixtures to estimate the classification using bridging principles
3. classification based on the hazards of the ingredients.

Table 37 shows the cut-off values/concentration limits, **as adopted in New Zealand**, of ingredients of a mixture classified as a specific target organ toxicant (single exposure) that would trigger classification of a mixture.

Table 37: Cut-off values/concentration limits for mixtures that specific target organ toxicants via single exposure

Ingredient classification	Mixture classification	
	Category 1 STOT	Category 2 STOT
Category 1 - Specific target organ toxicity	≥ 10%	1.0 ≤ ingredient < 10%
Category 2 - Specific target organ toxicity		≥ 1%

Care should be exercised when extrapolating the toxicity of a mixture that contains Category 3 ingredient(s). A cut-off value/concentration limit of 20% has been suggested; however, it should be recognised that this cut-off value concentration limit may be higher or less depending on the Category 3 ingredient(s) and that some effects such as respiratory tract irritation may not occur below a certain concentration while other effects such as narcotic effects may occur below this 20% value. Expert judgment should be exercised. When determining classifications for these hazards, the contribution of each ingredient should be considered additive, unless there is evidence that the effects are not additive.

3.9 Specific target organ toxicity – repeated exposure

Specific target organ toxicity-repeated exposure refers to specific toxic effects on target organs occurring after repeated exposure to a substance or mixture. All significant health effects that can impair function, both reversible and irreversible, immediate and/or delayed are included.

Classification identifies the substance or mixture as being a specific target organ toxicant and, as such, it may present a potential for adverse health effects in people who are exposed to it.

Classification depends upon the availability of reliable evidence that a repeated exposure to the substance or mixture has produced a consistent and identifiable toxic effect in humans, or, in experimental animals, toxicologically significant changes which have affected the function or morphology of a tissue/organ, or has produced serious changes to the biochemistry or haematology of the organism and these changes are relevant for human health. It is recognized that human data will be the primary source of evidence for this hazard class.

Specific target organ toxicity can occur by any route relevant for humans, ie, principally oral, dermal or inhalation.

Non-lethal toxic effects observed after a single-event exposure are classified in the GHS as described in “specific target organ toxicity – single exposure” and are therefore excluded from this class.

Substances are classified as specific target organ toxicant by expert judgement on the basis of the weight of all evidence available, including the use of recommended guidance values which take into account the duration of exposure and the dose/concentration which produced the effect(s), and are placed in one of two categories, depending upon the nature and severity of the effect(s) observed. The classifications and criteria are shown in **table 38**.

Table 38: Classification and criteria for specific target organ toxicity – repeated exposure

Classification	Criteria
Specific target organ toxicity – repeated exposure Category 1	**Substances that have produced significant toxicity in humans, or that, on the basis of evidence from studies in experimental animals can be presumed to have the potential <u>to produce significant toxicity in humans</u> following repeated exposure** Placing a substance in Category 1 is done on the basis of: (a) reliable and good quality evidence from human cases or epidemiological studies; or, (b) observations from appropriate studies in experimental animals in which significant and/or severe toxic effects, of relevance to human health, were produced at generally low exposure concentrations.

Classification	Criteria
Specific target organ toxicity – repeated exposure Category 2	**Substances that, on the basis of evidence from studies in experimental animals can be presumed to have the potential to be harmful to human health following repeated exposure** Placing a substance in Category 2 is done on the basis of observations from appropriate studies in experimental animals in which significant toxic effects, of relevance to human health, were produced at generally moderate exposure concentrations. In exceptional cases human evidence can also be used to place a substance in Category 2.

For both categories the specific target organ/system that has been primarily affected by the classified substance may be identified, or the substance may be identified as a general toxicant. Attempts should be made to determine the primary target organ/system of toxicity and classify for that purpose, e.g., hepatotoxicants, neurotoxicants. One should carefully evaluate the data and, where possible, not include secondary effects; for example, a hepatotoxicant can produce secondary effects in the nervous or gastro-intestinal systems.

In order to help reach a decision about whether a substance should be classified or not, and to what degree it would be classified (Category 1 vs. Category 2), dose/concentration "guidance values" are provided in **table 39** for consideration of the dose/concentration which has been shown to produce significant health effects.

The guidance values proposed refer basically to effects seen in a standard 90-day toxicity study conducted in rats. They can be used as a basis to extrapolate equivalent guidance values for toxicity studies of greater or lesser duration, using dose/exposure time extrapolation similar to Haber's rule for inhalation, which states essentially that the effective dose is directly proportional to the exposure concentration and the duration of exposure. The assessment shall be done on a case-by-case basis; for a 28-day study the guidance values below would be increased by a factor of three.

Table 39: Guidance value ranges for repeat-dose exposures

		Guidance values (dose/concentration)	
Route of exposure	**Units**	**Category 1**	**Category 2**
Oral (rat)	mg/kg body weight/d	≤ 10	10 < C ≤ 100
Dermal (rat or rabbit)	mg/kg body weight/d	≤ 20	20 < C ≤ 200
Inhalation (rat) gas	ppmV/6h/d	≤ 50	50 < C ≤ 250
Inhalation (rat) vapour	mg/litre/6h/d	≤ 0.2	0.2 < C ≤ 1.0
Inhalation (rat) dust/mist/fume	mg/litre/6h/d	≤ 0.02	0.02 < C ≤ 0.2

Classifying mixtures for specific target organ toxicity – repeated exposure

The order of preference for determining the specific target organ toxicant (repeated exposure) classification for a mixture is:

1. test data on the complete mixture
2. sufficient data on similar mixtures to estimate the classification using bridging principles
3. classification based on the hazards of the ingredients.

Table 40 shows the cut-off values/concentration limits, **as adopted in New Zealand**, of ingredients of a mixture classified as a specific target organ toxicant (repeated exposure) that would trigger classification of a mixture.

Table 40: Cut-off values/concentration limits for mixtures that specific target organ toxicants via repeated exposure

Ingredient classification	Mixture classification	
	Category 1 STOT	Category 2 STOT
Category 1 - Specific target organ toxicity	≥ 10%	1.0 ≤ ingredient < 10%
Category 2 - Specific target organ toxicity		≥ 1%

3.10 Aspiration hazard

Aspiration means the entry of a liquid or solid chemical directly through the oral or nasal cavity, or indirectly from vomiting, into the trachea and lower respiratory system.

Aspiration hazard refers to severe acute effects such as chemical pneumonia, pulmonary injury or death occurring after aspiration of a substance or mixture.

The GHS has two categories for aspiration hazard – Category 1 and Category 2.

Category 2 is not adopted in New Zealand's implementation of GHS. The classification criteria for Category 1 are shown in **table 41**.

Table 41: Classification and criteria for aspiration hazard Category 1

Classification	Criteria
Aspiration hazard Category 1: chemicals known to cause human aspiration toxicity hazards or to be regarded as if they cause human aspiration toxicity hazard	A substance is classified in Category 1: (a) based on reliable and good quality human evidence; or (b) if it is a hydrocarbon and has a kinematic viscosity ≤ 20.5 mm^2/s, measured at 40° C.

Classifying mixtures for aspiration hazard

The order of preference for determining the aspiration hazard classification for a mixture is:

1. reliable and good quality human evidence on the complete mixture
2. sufficient data on similar mixtures to estimate the classification using bridging principles
3. classification based on the hazards of the ingredients.

A mixture is classified as aspiration hazard Category 1 when the sum of the concentrations of Category 1 ingredients is ≥ 10%, and the mixture has a kinematic viscosity ≤ 20.5 mm^2/s, measured at 40 °C.

In the case of a mixture which separates into two or more distinct layers, the entire mixture is classified as Category 1 if in any distinct layer the sum of the concentrations of Category 1 ingredients is ≥ 10%, and it has a kinematic viscosity ≤ 20.5 mm^2/s, measured at 40 °C.

Part 4: Environmental hazards[5]

4.1 Hazardous to the aquatic environment

GHS has four basic elements which are used to characterise substances which are hazardous to the aquatic environment:

a. acute aquatic toxicity
b. chronic aquatic toxicity
c. potential for or actual bioaccumulation
d. degradation (biotic or abiotic) for organic chemicals.

Acute aquatic toxicity means the intrinsic property of a substance to be injurious to an organism in a short-term aquatic exposure to that substance.

Chronic aquatic toxicity means the intrinsic property of a substance to cause adverse effects to aquatic organisms during aquatic exposures which are determined in relation to the life-cycle of the organism.

Bioaccumulation means the net result of uptake, transformation and elimination of a substance in an organism due to waterborne exposure.

Degradation means the decomposition of organic molecules to smaller molecules and eventually to carbon dioxide, water and salts.

In GHS there are seven classification categories for substances that are hazardous to the aquatic environment. These categories include acute and chronic effects.

Hazardous to the aquatic environment acute Category 2 and acute Category 3 are not adopted in New Zealand's implementation of GHS. The adopted classifications and criteria are listed in **table 42** and **table 43**.

Table 42: Classification and criteria for hazardous to the aquatic environment acute effects

Classification	Criteria
Hazardous to the aquatic environment acute Category 1	LC_{50} or EC_{50} ≤ 1.00 mg/L

[5] GHS 7, Part 4 Environmental hazards:
http://www.unece.org/fileadmin/DAM/trans/danger/publi/ghs/ghs_rev07/English/04e_part4.pdf

Table 43: Classification and criteria for hazardous to the aquatic environment chronic effects

Classification	Criteria		
	Adequate chronic toxicity data available		Adequate chronic toxicity data not available **and** the substance is not rapidly degradable and/or the experimentally determined BCF is ≥ 500 (or, in absence of BCF, log K_{ow} ≥ 4)
	Non-rapidly degradable substances	Rapidly degradable substances	
Hazardous to the aquatic environment chronic Category 1	NOEC or EC_x ≤ 0.1 mg/L	NOEC or EC_x ≤ 0.01 mg/L	LC_{50} or EC_{50} ≤ 1.00 mg/L
Hazardous to the aquatic environment chronic Category 2	0.1 mg/L < NOEC or EC_x ≤ 1 mg/L	0.01 mg/L < NOEC or EC_x ≤ 0.1 mg/L	1.00 mg/L < LC_{50} or EC_{50} ≤ 10.0 mg/L
Hazardous to the aquatic environment chronic Category 3		0.1 mg/L < NOEC or EC_x ≤ 1 mg/L	10.0 < mg/L LC_{50} or EC_{50} ≤ 100 mg/L
Hazardous to the aquatic environment chronic Category 4	No acute toxicity and lack of rapid degradability and BCF ≥ 500 or, if absent log Kow ≥ 4, unless NOECs > 1 mg/L		

Acute toxicity is based on LC_{50} or EC_{50} values in mg/L for fish, crustacea and/or algae or other aquatic plants (or QSAR estimation if no experimental data).

Substances are classified in the various chronic categories unless there are adequate chronic toxicity data for all three trophic levels above the water solubility or above 1 mg/L.

Chronic toxicity bands are based on NOEC values in mg/L for fish or crustacea or other recognised measures for chronic toxicity.

The system also introduces a “safety net” classification (referred to as hazardous to the aquatic environment chronic Category 4) for use when the data available do not allow classification under the formal criteria but there are nevertheless some grounds for concern. For example, for poorly soluble substances for which no acute toxicity has been demonstrated at the solubility limit, that are both not rapidly degradable and have a potential to bioaccumulate, this category should apply unless it can be demonstrated that the substance does not require classification for aquatic long-term (chronic) hazards in another category.

Further detail on classifying substances for aquatic toxicity is provided in Chapter 4.1 and Annex 9 of the GHS Book.

Classifying mixtures for aquatic toxicity

The order of preference for determining the aquatic toxicity classifications for a mixture is:

1. test data on the mixture
2. sufficient data on similar mixtures to estimate classification hazards using bridging principles
3. classification by summation mixture rules based on the hazards of the ingredients.

In the absence of test data for the mixture and where sufficient data on similar mixtures is not available, then mixture rules based on the hazards of the ingredients may be used (refer to section 4.1.3 of the GHS Book).

When calculating the overall classification of a mixture using the summation mixture rules, a multiplying factor is applied to very ecotoxic ingredients of the mixture. The hazard thresholds and multiplying factors are shown in **table 44**.

Table 44: Hazard thresholds and multiplying factors for highly toxic ingredients of mixtures

Acute Toxicity	Multiplying factor	Chronic Toxicity	Multiplying factor (M)	
LC_{50}/EC_{50} value (mg/L)		**NOEC value (mg/L)**	**Non-rapidly degradable**	**Rapidly degradable**
0.1 < LC_{50} or EC_{50} ≤ 1	1	0.01 < NOEC ≤ 0.1	1	
0.01 < LC_{50} or EC_{50} ≤ 0.1	10	0.001 < NOEC ≤ 0.01	10	1
0.001 < LC_{50} or EC_{50} ≤ 0.01	100	0.0001 < NOEC ≤ 0.001	100	10
0.0001 < LC_{50} or EC_{50} ≤ 0.001	1,000	0.00001 < NOEC ≤ 0.0001	1,000	100
0.00001 < LC_{50} or EC_{50} ≤ 0.0001	10,000	0.000001 < NOEC ≤ 0.00001	10,000	1,000
Continue in factor 10 intervals		Continue in factor 10 intervals		

To calculate the acute and chronic aquatic toxicity classifications of a mixture, the individual classifications of the ingredients should be added using the 'summation formula' as shown in **table 45** and **table 46**.

Table 45: Classification of a mixture for short-term (acute) aquatic hazards based on summation of the concentrations of classified ingredients

Sum of ingredients classified as	Cut-off	Mixture classified as
Acute 1 x M	≥ 25%	Acute 1

Table 46: Classification of a mixture for long-term (chronic) aquatic hazards based on summation of the concentrations of classified ingredients

Sum of ingredients classified as	Cut-off	Mixture classified as
Chronic 1 x M	≥ 25%	Chronic 1
(M x 10 x Chronic 1) + Chronic 2	≥ 25%	Chronic 2
(M x 100 x Chronic 1) + (10 x Chronic 2) + Chronic 3	≥ 25%	Chronic 3
Chronic 1 + Chronic 2 + Chronic 3 + Chronic 4	≥ 25%	Chronic 4

4.2 Hazardous to the terrestrial environment

New Zealand has adopted four classifications for substances that are hazardous to the terrestrial environment. These classifications are not part of the GHS.

The threshold values for these classifications are derived from the previous thresholds for the 9.2, 9.3, and 9.4 alphanumeric HSNO classifications. The classifications and criteria for substances which are hazardous to the terrestrial environment are shown in **table 47**.

Table 47: Classifications and criteria for substances which are hazardous to the terrestrial environment

Classification	Classification criteria	Note
Hazardous to soil organisms	• Plant or soil invertebrate EC_{50} ≤ 100 mg/kg dry weight of soil over 14-day exposure period; or • Data indicates a 25% reduction in microbial respiration or microbial nitrification at ≤ 100 mg/kg dry weight of soil after a 28-day exposure period	These three classifications apply to agrichemicals, and to active ingredients used in the manufacture of an agrichemical that is a pesticide or veterinary medicine. Examples of agrichemicals include: commercial pesticides, veterinary medicines, pesticide adjuvants, fertilisers, plant growth regulators, fumigants, domestic pesticides, vertebrate toxic agents; and Agrichemicals do not include: timber treatment chemicals, antisapstain chemicals or antifouling paints.
Hazardous to terrestrial vertebrates	• Acute avian or mammalian oral or dermal LD_{50} ≤ 2000 mg/kg bw; or • Acute avian or mammalian LC_{50} of ≤ 5,000 ppm in the diet; or • Chronic avian or mammalian MATC[6] of ≤ 100 ppm in the diet	
Hazardous to terrestrial invertebrates	Acute oral or contact LD_{50} ≤ 25 µg per terrestrial invertebrate	

[6] MATC means the maximum acceptable toxicant concentration, being the geometric mean of the NOEC and LOEC where the NOEC and LOEC are derived from the same study.

Classification	Classification criteria	Note
Designed for biocidal action	Any substance designed for biocidal action (where biocidal action means causing mortality, inhibited growth, or inhibited reproduction in an organism), except where: • The substance is classified as hazardous to the aquatic environment; or • The substance is hazardous to soil organisms, hazardous to terrestrial vertebrates, or hazardous to terrestrial invertebrates; or • The substance is designed for biocidal action against: ○ an internal organism in humans or in other vertebrates; ○ a virus; ○ a protozoan; or ○ a bacterium.	Designed for biocidal action is applied to agrichemicals, but not to active ingredients.

Terrestrial ecotoxicity classification of mixtures

The order of preference for determining the terrestrial ecotoxicity classifications for a mixture is:

1. test data on the mixture
2. sufficient data on similar mixtures to estimate classification hazards using bridging principles
3. classification by summation mixture rules based on the hazards of the ingredients.

Hazardous to the soil environment

A mixture is classified hazardous to the soil environment if the sum of the following ≥ 25%

$$\sum (M \times 100 \times \%\ \text{component A}) + \sum 10 \times \%\ \text{component B} + \sum \%\ \text{component C} \geq 25\%$$

How to identify component type

Component type	Acute EC_{50}
Component A	≤1 mg/kg
Component B	>1 and ≤ 10 mg/kg
Component C	>10 and ≤ 100 mg/kg

Table of multiplication (M) factors – relevant only for component A

EC_{50} (mg/kg dry weight soil)	Multiplying factor (M)
$0.1 < EC_{50}$	No multiplying factor
$0.01 < EC_{50} \leq 0.1$	10
$0.001 < EC_{50} \leq 0.01$	100
$0.0001 < EC_{50} \leq 0.001$	1,000
$0.00001 < EC_{50} \leq 0.0001$	10,000
Continue in factor 10 intervals	Continue in factor 10 intervals

Hazardous to terrestrial vertebrates

A mixture is classified hazardous to terrestrial vertebrates if the sum of the following ≥ 25%:

$$\sum (M \times 100 \times \% \text{ component A}) + \sum 10 \times \% \text{ component B} + \sum \% \text{ component C} \geq 25\%$$

How to identify component type

Component type	Acute LD_{50} (mg/kg bw – oral / dermal)	LC_{50} (ppm) – diet
Component A	≤ 50	≤ 500
Component B	$50 < LD_{50} \leq 500$	$500 < LD_{50} \leq 1,000$
Component C	$500 < LD_{50} \leq 2,000$	$1,000 < LD_{50} \leq 5,000$

Table of multiplication (M) factors – relevant only for component A

Acute LD_{50} (mg/kg bw – oral / dermal)	LC_{50} (ppm) - diet	Multiplying factor (M)
$5 < LD_{50}$	$50 < LC_{50}$	No multiplying factor
$0.5 < LD_{50} \leq 5$	$5 < LC_{50} \leq 50$	10
$0.05 < LD_{50} \leq 0.5$	$0.5 < LC_{50} \leq 5$	100
$0.005 < LD_{50} \leq 0.05$	$0.05 < LC_{50} \leq 0.5$	1,000
$0.0005 < LD_{50} \leq 0.005$	$0.005 < LC_{50} \leq 0.05$	10,000
Continue in factor 10 intervals	Continue in factor 10 intervals	Continue in factor 10 intervals

Hazardous to terrestrial invertebrates

A mixture is classified hazardous to terrestrial invertebrates if the sum of the following ≥ 25%:

$$\sum (M \times 100 \times \%\ \text{component A}) + \sum 10 \times \%\ \text{component B} + \sum \%\ \text{component C} \geq 25\%$$

How to identify component type

Component type	Acute LD_{50}
Component A	< 2 µg/terrestrial invertebrate
Component B	2 ≤ LD_{50} < 11 µg/terrestrial invertebrate
Component C	11 ≤ LD_{50} < 25 µg/terrestrial invertebrate

Table of multiplication (M) factors – relevant only for component A

LD_{50} (µg/ terrestrial invertebrate)	Multiplying factor (M)
0.2 < LD_{50}	No multiplying factor
0.02 < LD_{50} ≤ 0.2	10
0.002 < LD_{50} ≤ 0.02	100
0.0002 < LD_{50} ≤ 0.002	1,000
0.00002 < LD_{50} ≤ 0.0002	10,000
Continue in factor 10 intervals	Continue in factor 10 intervals

Appendix: Hazard classifications

Physical hazards

Hazard class	Hazard classification	NZ abbreviation
Explosives (class 1)	unstable explosive	Unst. Expl.
	1.1 (A, B, C, D, E, F, G, J, L)	1.1 (A, B, C, D, E, F, G, J, L)
	1.2 (B, C, D, E, F, G, H, J, K, L)	1.2 (B, C, D, E, F, G, H, J, K, L)
	1.3 (C, F, G, H, J, K, L)	1.3 (C, F, G, H, J, K, L)
	1.4 (B, C, D, E, F, G, S)	1.4 (B, C, D, E, F, G, S)
	1.5 (D)	1.5 (D)
	1.6 (N)	1.6 (N)
Flammable gases	flammable gas Category 1A	Flam. Gas 1A
	flammable gas Category 1A pyrophoric gas	Flam. Gas 1A, Pyr. Gas
	flammable gas Category 1A chemically unstable gas A	Flam. Gas 1A, Chem. Unst. Gas A
	flammable gas Category 1A chemically unstable gas B	Flam. Gas 1A, Chem. Unst. Gas B
	flammable gas Category 1B	Flam. Gas 1B
	flammable gas Category 2	Flam. Gas 2
Aerosols	aerosol Category 1	Aerosol 1
	aerosol Category 2	Aerosol 2
	aerosol Category 3	Aerosol 3
Oxidising gases	oxidising gases Category 1	Oxid. Gas 1
Gases under pressure	compressed gas	Compressed gas
	liquefied gas	Liquefied gas
	refrigerated liquefied gas	Refrigerated liquefied gas
	dissolved gas	Dissolved gas
Flammable liquids	flammable liquids Category 1	Flam. Liquid 1
	flammable liquids Category 2	Flam. Liquid 2
	flammable liquids Category 3	Flam. Liquid 3
	flammable liquids Category 4	Flam. Liquid 4

Hazard class	Hazard classification	NZ abbreviation
Flammable solids	flammable solids Category 1	Flam. Solid 1
	flammable solids Category 2	Flam. Solid 2
Self-reactive substances and mixtures	self-reactive substances and mixtures Type A	Self React. Type A
	self-reactive substances and mixtures Type B	Self React. Type B
	self-reactive substances and mixtures Type C	Self React. Type C
	self-reactive substances and mixtures Type D	Self React. Type D
	self-reactive substances and mixtures Type E	Self React. Type E
	self-reactive substances and mixtures Type F	Self React. Type F
	self-reactive substances and mixtures Type G	Self React. Type G
Pyrophoric liquids	pyrophoric liquids Category 1	Pyr. Liquid 1
Pyrophoric solids	pyrophoric solids Category 1	Pyr. Solid 1
Self-heating substances and mixtures	self-heating substances and mixtures Category 1	Self Heat. 1
	self-heating substances and mixtures Category 2	Self Heat. 2
Substances and mixtures which, in contact with water, emit flammable gases	substances and mixtures which, in contact with water, emit flammable gases Category 1	Water React. Flam. Gas 1
	substances and mixtures which, in contact with water, emit flammable gases Category 2	Water React. Flam. Gas 2
	substances and mixtures which, in contact with water, emit flammable gases Category 3	Water React. Flam. Gas 3
Oxidising liquids	oxidising liquids Category 1	Oxid. Liquid 1
	oxidising liquids Category 2	Oxid. Liquid 2
	oxidising liquids Category 3	Oxid. Liquid 3
Oxidising solids	oxidising solids Category 1	Oxid. Solid 1
	oxidising solids Category 2	Oxid. Solid 2
	oxidising solids Category 3	Oxid. Solid 3
Organic peroxides	organic peroxide Type A	Org. Perox. Type A
	organic peroxide Type B	Org. Perox. Type B

Hazard class	Hazard classification	NZ abbreviation
	organic peroxide Type C	Org. Perox. Type C
	organic peroxide Type D	Org. Perox. Type D
	organic peroxide Type E	Org. Perox. Type E
	organic peroxide Type F	Org. Perox. Type F
	organic peroxide Type G	Org. Perox. Type G
Corrosive to metals	corrosive to metals Category 1	Met. Corr. 1
Desensitised explosives	desensitised explosive Category 1	Des. Expl. 1
	desensitised explosive Category 2	Des. Expl. 2
	desensitised explosive Category 3	Des. Expl. 3
	desensitised explosive Category 4	Des. Expl. 4

Health hazards

Hazard class	Hazard classification	NZ abbreviation
Acute toxicity	acute oral toxicity Category 1	Acute Tox. 1 (oral)
	acute dermal toxicity Category 1	Acute Tox. 1 (dermal)
	acute inhalation toxicity Category 1	Acute Tox. 1 (inhalation)
	acute oral toxicity Category 2	Acute Tox. 2 (oral)
	acute dermal toxicity Category 2	Acute Tox. 2 (dermal)
	acute inhalation toxicity Category 2	Acute Tox. 2 (inhalation)
	acute oral toxicity Category 3	Acute Tox. 3 (oral)
	acute dermal toxicity Category 3	Acute Tox. 3 (dermal)
	acute inhalation toxicity Category 3	Acute Tox. 3 (inhalation)
	acute oral toxicity Category 4	Acute Tox. 4 (oral)
	acute dermal toxicity Category 4	Acute Tox. 4 (dermal)
	acute inhalation toxicity Category 4	Acute Tox. 4 (inhalation)

Hazard class	Hazard classification	NZ abbreviation
Skin corrosion /irritation	skin corrosion Category 1A	Skin Corr. 1A
	skin corrosion Category 1B	Skin Corr. 1B
	skin corrosion Category 1C	Skin Corr. 1C
	skin irritation Category 2	Skin Irrit. 2
Serious eye damage/eye irritation	serious eye damage Category 1	Eye Damage 1
	eye irritation Category 2	Eye Irrit. 2
Respiratory or skin sensitisation	respiratory sensitisation Category 1 respiratory sensitisation Sub-category 1A respiratory sensitisation Sub-category 1B	Resp. Sens. 1 Resp. Sens. 1A Resp. Sens. 1B
	skin sensitisation Category 1 skin sensitisation Sub-category 1A skin sensitisation Sub-category 1B	Skin Sens. 1 Skin Sens. 1A Skin Sens. 1B
Germ cell mutagenicity	germ cell mutagenicity Category 1	Muta. 1
	germ cell mutagenicity Category 2	Muta. 2
Carcinogenicity	carcinogenicity Category 1	Carc. 1
	carcinogenicity Category 2	Carc. 2
Reproductive toxicity	reproductive toxicity Category 1	Repr. 1
	reproductive toxicity Category 2	Repr. 2
	effects on or via lactation	Effect on or via lactation.
Specific target organ toxicity – single exposure	specific target organ toxicity – single exposure Category 1	STOT Single Exp. 1
	specific target organ toxicity – single exposure Category 2	STOT Single Exp. 2
	specific target organ toxicity – single exposure Category 3	STOT Single Exp. 3
Specific target organ toxicity – repeated exposure	specific target organ toxicity – repeated exposure Category 1	STOT Rep. Exp. 1
	specific target organ toxicity – repeated exposure Category 2	STOT Rep. Exp. 2
Aspiration hazard	aspiration hazard Category 1	Asp. Tox. 1

Environmental hazards

Hazard class	Hazard classification	NZ abbreviation
Hazardous to the aquatic environment	hazardous to the aquatic environment acute Category 1	Aquatic Acute 1
	hazardous to the aquatic environment chronic Category 1	Aquatic Chronic 1
	hazardous to the aquatic environment chronic Category 2	Aquatic Chronic 2
	hazardous to the aquatic environment chronic Category 3	Aquatic Chronic 3
	hazardous to the aquatic environment chronic Category 4	Aquatic Chronic 4
Hazardous to the terrestrial environment	hazardous to soil organisms	Haz. soil org.
	hazardous to terrestrial vertebrates	Haz. terrestrial vert.
	hazardous to terrestrial invertebrates	Haz. terrestrial invert.
	designed for biocidal action	Des. biocidal action