Republic of South Africa

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SANS 10228 (2012) (English): The identification and classification of dangerous goods for transport by road and rail modes

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SOUTH AFRICAN NATIONAL STANDARD

The identification and classification of dangerous goods for transport

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Table of changes		
Change No.	**Date**	**Scope**

Acknowledgement

The SABS Standards Division wishes to acknowledge the valuable assistance derived from publications of the United Nations.

Foreword

This South African standard was approved by National Committee, SABS 1060B, *National committee for dangerous goods standards – Classification and information,* in accordance with procedures of the SABS Standards Division, in compliance with annex 3 of the WTO/TBT agreement.

This document was published in January 2010.

This document supersedes SANS 10228:2006 (edition 4).

Owing to the fact that information in respect of names and addresses of competent authorities and certification authorities dealing with dangerous goods is subject to change, details of the competent authorities and certification authorities are given in a general advice sheet provided with this standard. This advice sheet will be updated every six months and it is the responsibility of the competent authority/certification authority to notify the SABS Standards Division of any changes. The advice sheet will be available, free of charge, from the SABS Standards Sales Office.

Users of this South African National Standard are advised that a supplement to this standard will be published in the near future detailing relevant information as contained in the 16th revised edition of the United Nations *Recommendations on the transport of dangerous goods. Model Regulations*. The revised edition will come into effect on 1 January 2011. The information to be contained in the supplement is relevant to industry especially to companies in the export and import of chemicals.

The supplement will be available from the SABS Standards Sales Office once published and all purchasers of this standard will be advised by the SABS Standards Division when the supplement is available.

In 7.4 reference is made to the “relevant competent authority”. In South Africa it is the Chief Inspector of Explosives of the South African Police Service in terms of the Explosives Act, 2003 (Act No. 15 of 2003).

Annexes A to F form an integral part of this document. Annex G is for information only.

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The identification and classification of dangerous goods for transport

1 Scope

This standard covers the identification of dangerous goods that are capable of posing a significant risk to health and safety or to property and the environment. Dangerous goods are classified in nine classes and three packing groups in accordance with the United Nations' *Recommendations on the Transport of Dangerous Goods. Model Regulations*. The nine classes relate to the type of hazard whereas the three packing groups relate to the degree of danger posed within the class.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. Information on currently valid national and international standards can be obtained from the SABS Standards Division.

2.1 Standards

ASTM D 93, *Standard test methods for flash point by Pensky-Martens closed-cup tester.*

ASTM D 240, *Standard test method for heat of combustion of liquid hydrocarbon fuels by bomb calorimeter.*

ASTM D 4359, *Standard test method for determining whether a material is a liquid or a solid.*

ASTM G 31, *Standard practice for laboratory immersion corrosion testing of metals.*

ISO 780, *Packaging – Pictorial marking for handling of goods*.

ISO 1523, *Determination of flash point – Closed cup equilibrium method*.

ISO 2431, *Paints and varnishes – Determination of flow time by use of flow cups*.

ISO 2592, *Determination of flash and fire points – Cleveland open cup method.*

ISO 2719, *Determination of flash point – Pensky-Martens closed cup method.*

ISO 3711, *Lead chromate pigments and lead chromate-molybdate pigments – Specifications and methods of test.*

ISO 8115, *Cotton bales – Dimensions and density*.

ISO 9038, *Test for sustained combustibility of liquids*.

ISO 10156, *Gases and gas mixtures – Determination of fire potential and oxidizing ability for the selection of cylinder valve outlets.*

ISO 10156-2, *Gas cylinders – Gases and gas mixtures – Part 2: Determination of oxidizing ability of toxic and corrosive gases and gas mixtures.*

ISO 13736, *Determination of flash point – Abel closed-cup method*.

ISO 13943, *Fire safety – Vocabulary – Part 86.1*: *Affective heat of combustion*.

ISO 13943, *Fire safety – Vocabulary – Part 86.2*: *Gross heat of combustion*.

ISO 13943, *Fire safety – Vocabulary – Part 86.3*: *Net heat of combustion*.

NFPA 30B, *Manufacture and storage of aerosol products*.

SANS 1431, *Weldable structural steels.*

SANS 1518, *Transport of dangerous goods – Design, construction, testing, approval and maintenance of road vehicles and portable tanks.*

SANS 10229-1, *Transport of dangerous goods – Packaging and large packaging for road and rail transport – Part 1: Packaging.*

SANS 10229-2, *Transport of dangerous goods – Packaging and large packaging for road and rail transport – Part 2: Large packaging.*

SANS 10232-1 (SABS 0232-1), *Transport of dangerous goods – Emergency information systems – Part 1: Emergency information system for road transport*.

SANS 10233 (SABS 0233), *Transport of dangerous goods – Intermediate bulk containers for road and rail transport.*

2.2 Other publications

Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989).

International Atomic Energy Agency (IAEA). *Regulations for the safe transport of radioactive material. Safery standards series No. TS-R-1*. IAEA. Vienna, 2005

NOTE Explanatiory material on the 2005 edition of TS-R-1 can be found in the *Advisory material for the IAEA Regulations for the transport of radioactive material. Safety standards series No. TS-G-1.1 (Rev. 1)*. IAEA. Vienna, 2007

International Civil Aviation Organization. *Technical instructions for the safe transport of dangerous goods by air*. Montreal, Quebec: ICAO, 2005-2006.

International Maritime Organization. *International convention for safe containers.* Edition 3. London: IMO, 1996.

International Maritime Organization. *International convention for the prevention of pollution from ships,1973 as modified by the protocol of 1978* (MARPOL 73/78).

International Programme on Chemical Safety (IPCS). *WHO recommended classification of pesticides by hazard and guidelines to classification* .World Health Organization. Geneva, 2005

OECD Test Guideline 107, *Partition coefficient (n-octanol/water): Shake flask method – Guidelines for testing of chemicals*. Paris, France.

OECD Test Guideline 117, *Partition coefficient (n-octanol/water) — High performance liquid chromatography (HPLC) method.* Paris, France.

OECD Test Guideline 201, *Fresh water alga and cyanobacteria, growth inhibition test*. Paris, France.

OECD Test Guideline 202, *Daphnia sp. Acute immobilisation test.* Paris, France.

OECD Test Guideline 203, *Fish, acute toxicity test.* Paris, France.

OECD Test Guideline 404, *Acute dermal irritation/corrosion.* Paris, France.

United Nations. *Recommendations on the transport of dangerous goods; Manual of tests and criteria – Part I: Classification procedures, test methods and criteria relating to explosives of class 1.* 4th rev. ed. New York and Geneva: UN, 2003.

United Nations. Recommendations on the transport of dangerous goods; *Manual of tests and criteria – Part II: Classification procedures, test methods and criteria relating to self-reactive substances of division 4.1 and organic peroxides of division 5.2*. 4th rev. ed. New York and Geneva: UN, 2003.

United Nations. *Recommendations on the transport of dangerous goods; Manual of tests and criteria – Part III: Classification procedures, test methods and criteria relating to class 3, class 4, division 5.1 and class 9.* 4th rev. ed. New York and Geneva: UN, 2003.

NOTE The United Nations' *Recommendations on the transport of dangerous goods; Manual of tests and criteria,* will be referred to as the United Nations' *Manual of tests and criteria* in the text of this standard.

World Health Organization. *WHO Laboratory Biosafety Manual*. Third edition. Geneva, 2004.

3 Definitions and abbreviations

For the purposes of this standard, the following definitions and abbreviations apply.

3.1 Definitions

3.1.1
A_1 and A_2
values for individual radionuclides (see D.1) that are basic activity values used for characterizing radioactive material to be transported, and for specifying activity limits

3.1.2
abiotic
incompatible with life

3.1.3
activity
amount of a radionuclide in a particular energy state at a given time

NOTE It is quantified as the expected number of spontaneous nuclear transitions from that energy state in a unit time.

3.1.4
activity concentration
activity of one mass unit or volumetric unit of radioactive material, expressed in becquerels per kilogram or becquerels per cubic metre respectively, or their fractions, or their multiples

3.1.5
acute aquatic toxicity
intrinsic property of a substance to be injurious to an organism in a short-term exposure to that substance

3.1.6
ambient temperature
temperature of 23 °C ± 2 °C

3.1.7
availability
extent to which a substance becomes a soluble or disaggregate species

3.1.8
bioaccumulation
net result of uptake, transformation and elimination of a substance in an organism due to all routes of exposure (air, water, sediment/soil and food)

3.1.9
bioavailability
extent to which a substance is taken up by an organism and distributed to an area within the organism

3.1.10
bioconcentration factor
BCF
ratio of a test substance concentrating in a test organism to the concentration in the test water at equilibrium

3.1.11
biotic
relating to life or to living things

3.1.12
bulk container
containment system (including any liner or coating) intended for the transport of solid substances that are in direct contact with the containment system

NOTE Packagings (see SANS 10229-1), intermediate bulk containers (IBCs) (see SANS 10233), large packagings (see SANS 10229-2) and portable tanks (see SANS 1518) are not included.

3.1.13
bulk container for gases
container, for example a portable tank, of capacity exceeding 450 L

3.1.14
bulk transport equipment
multimodal tank container (ISO tank container), or a specially designed multimodal freight container, or a portable tank, or an intermediate bulk container, or a road or rail tank vehicle, or a road or rail vehicle specially built for the transport of a specific dangerous commodity

3.1.15
chronic aquatic toxicity
potential or actual properties of a substance to cause adverse effects to aquatic organisms during exposures that are determined in relation to the life-cycle of the organism

3.1.16
combustible
solid that is relatively difficult to ignite and that burns relatively slowly, and a liquid that sustains combustion for more than 15 s at 60,5 °C ± 1,0 °C

3.1.17
competent authority
national body or authority designated, or otherwise recognized, for the control or regulation of a particular aspect of the transport of dangerous goods

NOTE See the advice sheet provided with this standard for contact information.

3.1.18
critical temperature
temperature above at which a substance cannot exist in the liquid state

3.1.19
dangerous goods
goods that are capable of posing a significant risk to health and safety or to property or the environment during transport and that are listed in B.2 and annex C

NOTE For the purposes of this standard, "dangerous substances" and "dangerous goods" are synonymous.

3.1.20
degradation
decomposition of organic molecules to smaller molecules and eventually to carbon dioxide, water and salts

3.1.21
diluent, type A
organic liquid that is compatible with an organic peroxide and a self-reactive substance, and that has a boiling point of not less than 150 °C

3.1.22
diluent, type B
organic liquid that is compatible with an organic peroxide and that has a boiling point of less than 150 °C but not less than 60 °C, and a flash point of not less than 5 °C

3.1.23
EC_{50}
concentration of a substance, in milligram per litre of water, that causes the maximum response to 50 % of a population of daphnia (water flea)

3.1.24
fire point
lowest temperature at which a specimen sustains burning for 5 s

3.1.25
fuel cell
electrochemical device that converts the chemical energy of a fuel to electrical energy, heat and reaction products

2.1.26
fuel cell cartridge
article that stores fuel for discharge into the fuel cell through a valve that controls the discharge of fuel into the fuel cell

3.1.27
gas
state of matter that is characterized by very low density and viscosity (relative to liquids and solids), comparatively great expansion and contraction with changes in pressure and temperature, the ability to diffuse into other gases, and the ability to occupy with almost complete uniformity the whole of any container

3.1.28
genetically modified micro-organisms
GMMOs
micro-organisms in which the genetic material has been purposely altered through genetic engineering in a way that does not occur naturally

3.1.29
genetically modified organisms
GMOs
organisms in which the genetic material has been purposely altered through genetic engineering in a way that does not occur naturally

3.1.30
LC_{50}
concentration of a substance in air or in water which causes the death of 50 % of a group of test animals

3.1.31
liquid
substance that has a vapour pressure not exceeding 300 kPa at 50 °C and that has a melting point or an initial melting point of not higher than 20 °C at a pressure of 101,3 kPa

NOTE A viscous substance for which a specific melting point cannot be determined should be tested in accordance with ASTM D 4359.

3.1.32
no observed effect concentration
NOEC
test concentration immediately below the lowest tested concentration with statistically significant adverse effect

NOTE The NOEC has no statistically significant adverse effect compared to the control.

3.1.33
octanol-water partition coefficient (log K_{ow})
measure of the transfer of a substance from the aquatic environment to an organism, for example fish, and the potential bioaccumulation of the substance at equilibrium concentration

NOTE The partition coefficient is the quotient of octanol to water and is given in the form of its logarithm to base ten.

3.1.34
packing group

group symbol that indicates the degree of danger/hazard of the primary property of a specific substance in accordance with internationally recognized classifications (see clause 1)

3.1.35
paste

soft, viscous mass of solids dispersed in a liquid

NOTE A paste can be classified either as a liquid or as a solid, depending on the results obtained when it is tested in accordance with ASTM D 4359.

3.1.36
proper shipping name

description used for dangerous goods in transport documentation, in the marking of packages, and in the placarding of containers and vehicles to ensure that goods can be readily identified during transport

NOTE 1 In the case of spillage and leakage, the proper shipping name is instrumental in determining what response actions, emergency equipment or antidotes, are necessary.

NOTE 2 The proper shipping name is shown in capital letters in B.2 and in annex C.

NOTE 3 If more than one distinct entry is given under a single UN number (see 3.1.38), as indicated by the conjunction "or" or by punctuation, the more appropriate of the names is to be used.

NOTE 4 If several names are in use for the same substance, one or more of these names can be used as the proper shipping name; the rest, being synonyms, are given in lower case for reference purposes only.

NOTE 5 Technical names and trade names can be utilized on documents and packages in addition to the proper shipping name.

3.1.37
rated capacity

output of a fuel cell cartridge (see 3.1.24) that can continue indefinitely in conformity with a criterion, for example heating.

3.1.38
solid

powders, flakes, granules and kibbles, and also pastes and viscous substances that conform to the test for solids in accordance with ASTM D 4359

3.1.39
specific activity

activity of one mass unit of radioactive material, expressed in becquerels per kilogram, or its fractions, or its multiples

3.1.40
total activity

activity of the radionuclide material contained in a consignment, expressed in the basic unit of becquerel (Bq)

3.1.41
United Nations (UN) number

serial number that consists of four digits and that is assigned to dangerous goods by the United Nations' Committee of Experts on the Transport of Dangerous Goods

3.1.42
waste, chemical
unusable product from chemical and metal processing operations, that, if improperly disposed of, contains dangerous or polluting materials that pose a threat to humans or animals or the environment

3.2 Abbreviations

3.2.1 BCF	bioconcentration factor
3.2.2 BOD	biochemical oxygen demand
3.2.3 Bq	becquerel
3.2.4 COD	chemical oxygen demand
3.2.5 GCPF	Global Crop Protection Federation
3.2.6 GLP	good laboratory practices
3.2.7 N.O.S.	not otherwise specified
3.2.8 OECD	Organization for Economic Co-operation and Development
3.2.9 SADT	self-accelerating decomposition temperature
3.2.9 sv	Sievert
3.2.10 UN	United Nations
3.2.12 WHO	World Health Organization
3.2.13 †	add the technical name of the product in parentheses after the proper shipping name

4 Dangerous goods listing

4.1 Annex B

4.1.1 B.1 gives the relevant special provisions relating to individual articles or substances, with reference to SANS 10229-1.

4.1.2 B.2 consists of a numerical list of dangerous goods and gives, in tabulated form, the information required for their identification and classification, i.e. the UN number, the name and description, the class or division, the packing group, the subsidiary risk, references to appropriate packing instructions given in SANS 10229-1, SANS 10229-2, SANS 10233 and SANS 1518, and special provisions, and limited quantity requirements and excepted quantity requirements of SANS 10229-1.

4.2 Annex C

This annex consists of an alphabetical list of dangerous goods and gives, in tabulated form, the proper shipping name and the UN number.

4.3 Annex D

4.3.1 D.1 consists of an alphabetical list of basic radionuclide values for individual radionuclides and gives, in tabulated form, the radionuclide, the A_1 and A_2 values, the activity concentrations for exempt material and exempt consignments, and remarks.

4.3.2 D.2 consists of notes to annex D.

4.4 Annex E

4.4.1 E.1 consists of an alphabetical list of pesticides (technical) and gives, in tabulated form, the active ingredient, the toxicity (LD_{50}), the route of administration and remarks.

4.4.2 E.2 consists of notes to annex E.

4.5 Annex F

This annex consists of a list of generic or N.O.S. proper shipping names and gives, in tabulated form, the class or division, the subsidiary risk and the UN number.

4.6 Annex G

This annex consists of a glossary of terms for explosives.

5 Classification system, packing group allocation and subsidiary risk

5.1 Classification system

5.1.1 Class 1: explosives

This class is subdivided into six divisions (see 7.2).

5.1.2 Class 2: gases

This class is subdivided as follows:

a) **division 2.1**: flammable gases;

b) **division 2.2**: non-flammable, non-toxic gases; and

c) **division 2.3**: toxic gases.

5.1.3 Class 3: flammable liquids

This class comprises liquids capable of being ignited.

5.1.4 Class 4: flammable solids; substances liable to spontaneous combustion; substances that, on contact with water, emit flammable gases

This class is subdivided as follows:

a) **division 4.1**: flammable solids, self-reactive substances and solid desensitized explosives;

b) **division 4.2**: substances liable to spontaneous combustion; and

c) **division 4.3**: substances that, on contact with water, emit flammable gases.

5.1.5 Class 5: oxidizing substances and organic peroxides

This class is subdivided as follows:

a) **division 5.1**: oxidizing substances; and

b) **division 5.2**: organic peroxides.

5.1.6 Class 6: toxic and infectious substances

This class is subdivided as follows:

a) **division 6.1**: toxic substances; and

b) **division 6.2**: infectious substances.

5.1.7 Class 7: radioactive material

This class comprises materials that spontaneously emit ionizing radiation.

5.1.8 Class 8: corrosives

This class comprises substances that, by chemical action, cause damage to living tissue, to commonly used metals, or to other cargo.

5.1.9 Class 9: miscellaneous dangerous substances and goods

This class comprises any substance not covered by the other classes, but that has been or could be shown by experience to be of such a dangerous character that the provisions of this class should apply to it.

5.2 Packing group allocation

5.2.1 General

For packing purposes, certain substances listed in this standard are assigned to three packing groups in accordance with their degree of danger.

NOTE Dangerous goods of classes 1, 2 and 7, and divisions 5.2 and 6.2 and self-reactive substances of division 4.1 are excluded from the packing group allocation.

5.2.2 Packing groups

The packing groups have the following meaning:

a) **packing group I**: substances that present a high danger;

b) **packing group II**: substances that present a medium danger; and

c) **packing group III**: substances that present a low danger.

5.3 Subsidiary risk

Where applicable, the subsidiary danger risk of a substance is also identified in terms of the classification system.

6 Special requirements for certain dangerous goods

6.1 This standard does not apply to the transport of:

a) dangerous goods that are required for the propulsion of the means of transport or the operation of its specialized equipment during transport, for example refrigeration units, or that are required in accordance with the operating requirements, for example fire extinguishers; and

b) dangerous goods that are transported as packed for retail sale by private individuals for their own use.

6.2 In accordance with the Universal Postal Union Convention, dangerous goods as defined in this standard, with the exception of those listed below, are not permitted in mail transported internationally. The following dangerous goods are acceptable in international mail subject to the provisions of the national postal authority:

a) infectious substances assigned to category B (UN 3373) and solid carbon dioxide (dry ice) when used as a refrigerant for infectious substances of UN 3373; and

b) adioactive material in an excepted package (see SANS 10229-1), the total activity of which does not exceed one tenth of that listed in table 1.

NOTE The Acts of the Universal Postal Union do not apply to the domestic transport of dangerous goods by mail.

6.3 Any substance or article that is liable to react in one of the following ways under normal conditions of transport in the condition it is presented for transport, is forbidden from transport unless otherwise provided by this standard:

- explode;
- react dangerously;
- produce a flame or dangerous evolution of heat; or
- emit toxic, corrosive or flammable gases or vapours.

Table 1 — Activity limits for excepted packages

1	2	3	4
Physical state of contents	**Instruments or article**		**Material limits** [a,b]
	Item limits [a,b]	**Package limits** [a,b]	
Solids			
Special form	$10^{-2} A_1$	A_1	$10^{-3} A_1$
Other form	$10^{-2} A_2$	A_2	$10^{-3} A_2$
Liquids	$10^{-3} A_2$	$10^{-1} A_2$	$10^{-4} A_2$
Gases			
Tritium	$2 \times 10^{-2} A_3$	$2 \times 10^{-1} A_3$	$2 \times 10^{-2} A_3$
Special form	$10^{-3} A_1$	$10^{-2} A_1$	$10^{-3} A_1$
Other forms	$10^{-3} A_2$	$10^{-2} A_2$	$10^{-3} A_2$

[a] See 13.3.2 for mixtures of radionuclides.
[b] See D.1 for the basic radionuclide values.

7 Class 1: Explosives

7.1 General

7.1.1 Introductory notes

7.1.1.1 Class 1 is a restricted class, i.e. only those explosive substances and articles that are listed in B.2 shall be accepted for transport. However, the competent authority retains the right by mutual agreement to approve transport of explosive substances and articles for special purposes under special conditions. Therefore, entries have been included in B.2 for "Substances, explosive, N.O.S." and "Articles, explosive, N.O.S." These entries shall be used only when no other method of operation is possible.

7.1.1.2 A number of explosive substances and articles are described in annex G because an explosive term might not be well-known or might be at variance with its usage for regulatory purposes.

7.1.1.3 Class 1 is unique in that the type of packaging (see SANS 10229-1) frequently has a decisive effect on the hazard and therefore on the assignment to a particular division (see 7.2).

7.1.1.4 General entries such as “Explosives, blasting Type A” are used to allow for the transport of new explosive substances.

7.1.2 Explosive substances and articles

7.1.2.1 An explosive substance is a solid substance or a liquid substance, or a mixture of substances, that is in itself capable, by chemical reaction, of producing gas at such a temperature, pressure and speed as to cause damage to the surroundings.

NOTE The following explosive substances are excluded from class 1:

a) those that are too dangerous to transport;

b) those of which the predominant hazard is appropriate to another class; and

c) those that are in themselves not explosives but that can form an explosive atmosphere of gas, vapour or dust.

7.1.2.2 An explosive article is an article that contains one or more explosive substances or an article that is manufactured with a view to producing a practical explosive.

NOTE Devices that contain explosive substances in such quantity or of such character that their inadvertent or accidental ignition or initiation during transport does not cause any external effect to the device, either by projection, fire, smoke, heat or loud noise, are excluded from class 1.

7.1.2.3 Class 1 includes substances and articles not mentioned in 7.1.2.1 and 7.1.2.2 that are manufactured to produce an effect by heat, light, sound, gas or smoke, or a combination of these, as the result of non-detonative self-sustaining exothermic chemical reactions (pyrotechnic effect).

7.2 Divisions of class 1

7.2.1 Division 1.1

This division consists of substances and articles that present a mass explosion hazard.

NOTE A mass explosion is one that affects virtually the entire consignment of explosives almost instantaneously.

7.2.2 Division 1.2

This division consists of substances and articles that present a projection hazard, but not a mass explosion hazard.

7.2.3 Division 1.3

This division consists of substances and articles that, in the event of ignition or initiation during transport

a) give rise to considerable radiant heat, or

b) burn one after the other, producing a minor blast or a minor projection effect (or both).

7.2.4 Division 1.4

This division consists of substances and articles that

a) present no significant hazard, and

b) present only a small hazard in the event of ignition or initiation during transport. The effects are largely confined within the package and no projection of fragments of appreciable size or range is to be expected. An external fire will not cause virtually instantaneous explosion of almost the entire contents of the package.

NOTE Substances and articles in this division that are so packaged or so designed that any hazardous effects arising from accidental functioning are confined to the package (unless the package has been degraded by fire, in which case all blast or projection effects are limited to the extent that they do not significantly hinder fire-fighting or other emergency response efforts in the immediate vicinity of the package), are placed in compatibility group S (see 7.3).

7.2.5 Division 1.5

This division consists of 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 of transport. As a minimum requirement, they shall not explode in the external fire test (see test series 6(c) in part I of the United Nations' *Manual of tests and criteria*).

NOTE The probability of transition from burning to detonation is greater when large quantities are transported.

7.2.6 Division 1.6

This division consists of extremely insensitive articles that do not have a mass explosion hazard and the probability of accidental initiation or propagation is negligible.

NOTE The risk of explosion is limited to a single article.

7.3 Compatibility groups

Substances and articles of class 1 are considered to be "compatible" if they can be safely stored together or transported together without significantly increasing either the probability of an accident or, for a given quantity, the magnitude of the effects of such an accident. In accordance with this criterion, goods listed in this class have been divided into a number of compatibility groups, each denoted by a letter from A to N (excluding I and M) and S. Table 2 gives the possible hazard divisions associated with each compatibility group and the consequential classification code. Table 3 gives the scheme of classification and the combination of hazard division with compatibility group.

7.4 Competent authority for the classification of explosives

The classification of all explosive articles and substances, together with their compatibility group allocation, shall be approved by the relevant competent authority (see the foreword).

Table 2 — Classification codes

1	2	3
Article or substance to be classified	**Compatibility group**[a]	**Classification code**
Primary explosive substance	A	1.1A
Article that contains a primary explosive substance and does not contain two or more independent safety features. Some articles, such as detonators for blasting, detonator assemblies for blasting and primers, cap-type, are included, even though they do not contain primary explosives	B	1.1B; 1.2B; 1.4B
Propellant explosive substance or other deflagrating explosive substance or article that contains a propellant explosive substance	C	1.1C; 1.2C; 1.3C; 1.4C
Secondary detonating explosive substance or black powder or article that contains a secondary detonating explosive substance, in each case without means of initiation, and without a propelling charge, or article that contains a primary explosive substance and two or more effective protective features	D	1.1D; 1.2D; 1.4D; 1.5 D
Article that contains a secondary detonating explosive substance, without means of initiation, with a propelling charge (other than one containing a flammable liquid or gel or hypergolic liquids)	E	1.1E; 1.2E; 1.4E
Pyrotechnic substance, or article that contains a pyrotechnic substance, or article that contains both an explosive substance and an illuminating, incendiary, tear-producing or smoke-producing substance (other than a water-activated article or one that contains white phosphorus, phosphides, a pyrophoric substance, a flammable liquid or gel, or hypergolic liquids)	G	1.1G; 1.2G; 1.3G; 1.4G
Article that contains both an explosive substance and white phosphorus	H	1.2H; 1.3H
Article that contains both an explosive substance and a flammable liquid or gel	J	1.1J; 1.2J; 1.3J
Article that contains both an explosive substance and a toxic chemical agent	K	1.2K; 1.3K
Explosive article or substance that contains an explosive substance and presents a special risk (for example owing to water activation or the presence of hypergolic liquids, phosphides or a pyrophoric substance) and of which each type needs to be isolated	L	1.1L; 1.2L; 1.3L
Article that contains an extremely insensitive detonating substance	N	1.6N
Article or substance so packed or so designed that any hazardous effects arising from accidental functioning are confined within the package, unless the package has been degraded by fire, in which case all blast or projection effects are limited to the extent that they do not significantly hinder or prohibit fire-fighting or other emergency response efforts in the immediate vicinity of the package	S	1.4S
[a] The definitions of the compatibility groups are intended to be mutually exclusive, except for a substance or article that qualifies for compatibility group S. Since the criterion of compatibility group S is an empirical one, assignment to this group is necessarily linked to the tests for assignment to division 1.4 as given in test series 6 in part I of the United Nations' *Manual of tests and criteria*.		

Table 3 — Scheme of classification of explosives, combination of hazard division with compatibility group

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Hazard division	**Compatibility group**													
	A	B	C	D	E	F	G	H	J	K	L	N	S	A-S Σ
1.1	1.1A	1.1B	1.1C	1.1D	1.1E	1.1F	1.1G		1.1J		1.1L			9
1.2		1.2B	1.2C	1.2D	1.2E	1.2F	1.2G	1.2H	1.2J	1.2K	1.2L			10
1.3			1.3C			1.3F	1.3G	1.3H	1.3J	1.3K	1.3L			7
1.4		1.4B	1.4C	1.4D	1.4E	1.4F	1.4G						1.4S	7
1.5				1.5D										1
1.6												1.6N		1
1.1-1.6 Σ	1	3	4	4	3	4	4	2	3	2	3	1	1	35

7.5 Classification of explosives

7.5.1 General

7.5.1.1 Any substance or article that has, or is suspected of having, explosives characteristics shall be considered for classification in class 1. Substances classified as explosives of class 1 shall be assigned to the appropriate division and compatibility group (see 7.2 and 7.3).

7.5.1.2 A substance or an article that is not listed by its proper shipping name in B.2 and in annex C shall not be offered for transport as an explosive of class 1 unless it has been subjected to the classification procedure prescribed in this clause. The classification procedure shall also be undertaken before a new product is offered for transport.

A new product considered for classification in class 1 is

a) a substance, or a combination of substances, or a mixture of explosive substances that is considered to be significantly different from other combinations or mixtures already classified, or

b) a new design of article, or an article that contains a new explosive substance, or a new combination or mixture of explosive substances, or

c) a new design of packaging for an explosive substance or article that includes a new type of inner packaging.

It is important to realize that a relatively minor change in an inner or outer packaging can be critical and can convert a lesser risk into a mass explosion risk.

7.5.1.3 The manufacturer or other applicant requesting classification of an explosive product shall provide adequate information regarding the names and characteristics of all the explosive substances present in the product, and shall provide the results of all relevant tests that have been done.

NOTE It is assumed that all the explosive substances in a new article have been properly tested and that they carry competent authority approval.

7.5.1.4 Verification of the classification shall be undertaken if the explosive substance or article, or its packaging, is degraded and if the degradation might affect the behaviour of the substance or item in the tests.

7.5.1.5 A report on the series of tests that have been performed shall be drawn up in accordance with the requirements of the competent authority. Such a report shall contain at least the following information:

a) the composition of the substance or the structure of the article;

b) the quantity of substance or the number of articles used per test;

c) the type and construction of the packaging;

d) the test assembly, including the nature, quantity and arrangement of the means of initiation or ignition used;

e) the course of the test, including the time elapsing until the occurrence of the first noteworthy reaction of the substance or article, the duration and characteristics of the reaction, and whether the reaction was complete;

f) the effect of the reaction on the immediate surroundings, up to 25 m from the site of the test;

g) the effect of the reaction on the surroundings further than 25 m from the site of the test; and

h) the atmospheric conditions during the test.

7.5.2 Procedure

Figure 1 indicates the general scheme for the classification of a substance or an article that is to be considered for inclusion in class 1. The assessment is done in two stages:

a) Ascertain the potential of a substance or an article to explode and whether its stability and sensitivity, both chemical and physical, are shown to be acceptable.

In order to assist the competent authority with the assessment, the test data shall be analysed systematically with respect to the appropriate test criteria by using the flow chart of figure 10.2 in part I of the United Nations' *Manual of tests and criteria*; and

b) If the substance or article is acceptable for class 1, assign the correct hazard division in accordance with figure 10.3 in part I of the United Nations' *Manual of tests and criteria*.

NOTE 1 The tests for acceptance and the further tests to determine the correct division in class 1 are grouped into seven series as listed in part I of the United Nations' *Manual of tests and criteria.* The numbering of these series relates to the sequence of assessing results rather than the order in which the tests are conducted.

NOTE 2 The scheme of assessment given in flowchart 1 is only designed for the classification of

a) packed explosive substances and articles, and

b) individual unpacked explosive articles.

NOTE 3 Transport in freight containers, road vehicles and rail wagons could require special tests which take into consideration the quantity (self-confinement), the kind of substance and the container used for the substance. Such tests can be specified by the competent authority (see the foreword).

7.5.3 Acceptance criteria

7.5.3.1 The results from preliminary tests and those from test series 1 to 4 in part I of the United Nations' *Manual of tests and criteria*, are used to determine whether or not the product is acceptable for class 1. If the substance is manufactured with a view to producing a practical explosive or pyrotechnic effect (see 7.1.2.3), it is unnecessary to conduct tests series 1 and 2. If an article, a packaged article or a packaged substance is rejected by test series 3 or 4 (or both), it could be practicable to redesign the article or the packaging to render it acceptable.

7.5.3.2 The competent authority may exclude an article or a substance from class 1 by virtue of test results and the class 1 definition.

7.5.3.3 An explosive substance that has been diluted to exclude it from class 1 by test series 6 in part I of the United Nations' *Manual of tests and criteria*, is referred to as a "desensitized explosive" (see 9.2, 10.1.2.6 and 10.1.3). Such a substance shall be classified as a desensitized explosive with an indication of the highest concentration of explosive allowed to exclude it from class 1 and, if applicable, the concentration below which it is no longer deemed as dangerous goods.

7.5.3.4 A new solid desensitized explosive shall be classified in division 4.1, and a new liquid desensitized explosive shall be classified in class 3. When a desensitized explosive complies with the criteria or definition for another class or division, the corresponding subsidiary risk(s) shall be assigned to it.

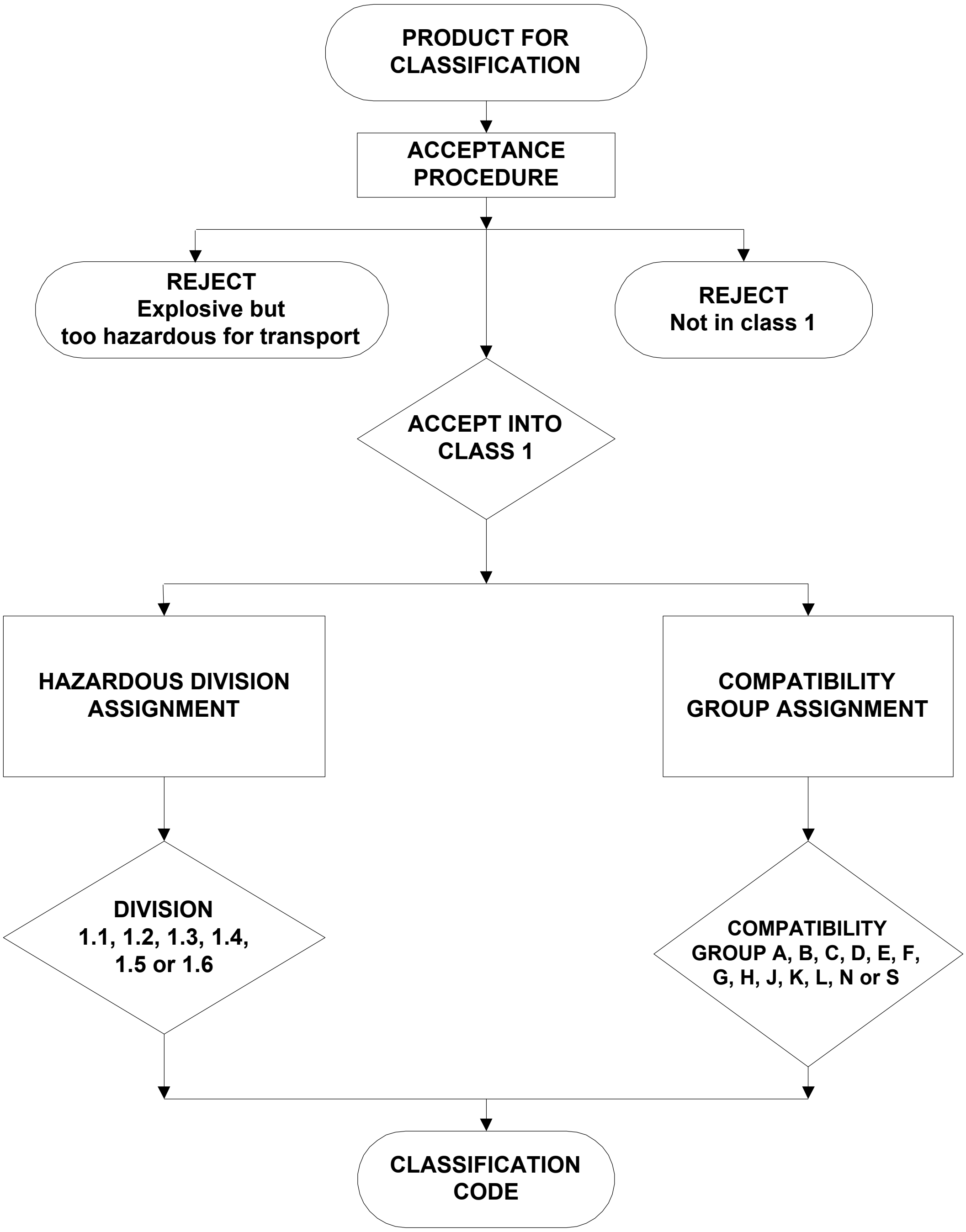

Figure 1 — Scheme of procedure for the classification of an explosive substance or article

7.5.3.5 Some explosive devices could function during transport. Theoretical analysis, test data or other evidence of safety shall be provided to the competent authority to show that such an event is very unlikely or that the consequences would not be significant. The assessment shall take the following into account:

a) vibration related to the proposed mode(s) of transport;

b) static electricity;

c) electromagnetic radiation at all relevant frequencies up to a maximum intensity of 100 W/m^2;

d) adverse climatic conditions; and

e) compatibility with glues, paints and packaging materials with which the explosive substances might come into contact.

7.5.3.6 All articles that contain primary explosive substances shall be assessed to evaluate the risk and consequences of accidental functioning during transport. The reliability of fuzes shall be assessed by taking the number of independent safety features into account.

7.5.3.7 All explosive articles and packaged explosive substances shall be assessed to ensure that they have been designed in a good workmanlike manner, for example, that there is no possibility of the formation of voids or thin films of an explosive substance, and that there is no possibility of grinding or nipping of explosive substances between hard surfaces.

7.5.4 Assignment to hazard divisions

7.5.4.1 An explosive substance or article shall be assigned to the hazard division which corresponds to the tests to which the substance or article, as offered for transport, has been subjected. Other test results, and data assembled from accidents which have occurred, can also be taken into account.

7.5.4.2 The following test series in part I of the United Nations' *Manual of tests and criteria* are used to determine the hazard division:

a) **test series 5**: whether a substance can be assigned to division 1.5;

b) **test series 6**: whether a substance or article can be assigned to divisions 1.1, 1.2, 1.3 and 1.4; and

c) **test series 7**: whether an article can be assigned to division 1.6.

NOTE In the case of compatibility group S, the tests may be waived by the competent authority, if classification by analogy is possible by using the test results of a comparable article.

7.5.5 Exclusion from class 1

7.5.5.1 The competent authority may exclude a substance or an article from class 1 by virtue of test results and the class 1 definition.

7.5.5.2 Where a substance, provisionally classified as an explosive, is excluded from class 1 by virtue of test results of series 6 of part 1 of the United Nations' *Manual of tests and criteria* on a specific type and size of package such a substance (when complying with the classification criteria or definition of another class or division), shall be classified in that class or division with a special provision restricting it to the type and size of the package tested.

7.5.5.3 An explosive substance that has been diluted to exclude it from class 1 by test series 6, is referred to as a “desensitized explosive” (see 9.2, 10.1.2.6 and 10.1.3). Such a substance shall be classified as a desensitized explosive with an indication of the highest concentration of explosive allowed to exclude it from class 1 and, if applicable, the concentration below which it is no longer deemed as dangerous goods.

7.5.5.4 A new solid desensitized explosive shall be classified in division 4.1 and a new liquid desensitized explosive shall be classified in class 3. When a desensitized explosive complies with the criteria or definition of another class or division, the corresponding subsidiary risk(s) shall be assigned to it.

7.5.6 Fireworks

7.5.6.1 Fireworks shall be assigned to divisions 1.1, 1.2, 1.3, and 1.4 on the basis of test data derived from test series 6 in part I of the United Nations' *Manual of tests and criteria*. However, since the range of fireworks is very extensive and the availability of test facilities might be limited, assignment to hazard divisions could also be made in accordance with 7.5.6.2.

7.5.6.2 Assignment of fireworks to UN Nos 0333, 0334, 0335 or 0336 may be made on the basis of analogy, without the need for test series 6 testing, in accordance with the default fireworks classification (see table 3) and with the agreement of the competent authority. Items not specified in table 3 shall be classified on the basis of test data derived from test series 6.

7.5.6.3 Where fireworks of more than one division of class 1 are packed in the same package they shall be classified on the basis of the highest hazard division unless test data derived from test series 6 indicate otherwise.

7.5.6.4 The default classification shown in table 4 applies only to articles packed in fibreboard boxes (4G) (see SANS 10229-1).

Table 4 — Default fireworks classification

1	2	3	4	5
Type	**Synonyms**	**Definition**	**Specification**[a, b, c]	**Classification**
Shell, spherical or cylindrical	Spherical display shell: aerial shell, colour shell, dye shell, multi-break shell, multi-effect shell, nautical shell, parachute shell, smoke shell, star shell; report shell: maroon, salute, sound shell, thunderclap, aerial shell kit	Device with or without propellant charge, with delay fuse and bursting charge, pyrotechnic unit(s) or loose pyrotechnic composition and designed to be projected from a mortar	All report shells	1.1G
			Colour shell: ≥ 180 mm	1.1G
			Colour shell: < 180 mm with > 25 % flash composition, as loose powder or report effects (or both)	1.1G
			Colour shell: < 180 mm with ≤ 25 % flash composition, as loose powder or report effects (or both)	1.3G
			Colour shell: ≤ 50 mm, or ≤ 60 g pyrotechnic composition, with ≤ 2 % flash composition as loose powder and/or report effects	1.4G
	Peanut shell	Device with two or more spherical aerial shells in a common wrapper propelled by the same propellant charge with separate external delay fuses	The most hazardous spherical aerial shell determines the classification	
	Preloaded mortar, shell in mortar	Assembly comprising a spherical or cylindrical shell inside a mortar from which the shell is designed to be projected	All report shells	1.1G
			Colour shell: ≥ 180 mm	1.1G
			Colour shell: >25 % flash composition as loose powder or report effects (or both)	1.1G
			Colour shell: > 50 mm and < 180 mm	1.2G
			Colour shell: ≤ 50 mm, or ≤ 60 g pyrotechnic composition, with ≤ 25 % flash composition as loose powder or report effects (or both)	1.3G

Table 4 *(continued)*

1	2	3	4	5
Type	**Synonyms**	**Definition**	**Specification**[a, b, c]	**Classification**
Shell, spherical or cylindrical (continued)	Shell of shells (spherical) (Reference to percentages for shell of shells is to the gross mass of the fireworks article)	Device without propellant charge, with delay fuse and bursting charge, containing report shells and inert materials and designed to be projected from a mortar	> 120 mm	1.1G
		Device without propellant charge, with delay fuse and bursting charge, containing report shells ≤ 25 g flash composition per report unit, with ≤ 33 % flash composition and ≥ 60 % inert materials and designed to be projected from a mortar	≤ 120 mm	1.3G
		Device without propellant charge, with delay fuse and bursting charge, containing colour shells or pyrotechnic units (or both) and designed to be projected from a mortar	> 300 mm	1.1G
		Device without propellant charge, with delay fuse and bursting charge, containing colour shells ≤ 70 mm or pyrotechnic units (or both) with ≤ 25 % flash composition and ≤ 60 % pyrotechnic composition and designed to be projected from a mortar	> 200 mm and ≤ 300 mm	1.3G
		Device with propellant charge, with delay fuse and bursting charge, containing colour shells ≤ 70 mm or pyrotechnic units (or both), with ≤ 25 % flash composition and ≤ 60 % pyrotechnic composition and designed to be projected from a mortar	≤ 200 mm	1.3G

Table 4 *(continued)*

1	2	3	4	5
Type	**Synonyms**	**Definition**	**Specification**[a, b, c]	**Classification**
Battery/ combination	Barrage, bombardos, cakes, finale box, flowerbed, hybrid, multiple tubes, shell cakes, banger batteries, flash banger batteries	Assembly including several elements either containing the same type or several types each corresponding to one of the types of fireworks listed in this table, with one or two points of ignition	The most hazardous firework determines the classification	
Roman candle	Exhibition candle, candle, bombettes	Tube containing a series of pyrotechnic units consisting of alternate pyrotechnic composition, propellant charge, and transmitting fuse	≥ 50 mm inner diameter, containing flash composition, or < 50 mm with > 25 % flash composition	1.1G
			≥ 50 mm inner diameter, containing no flash composition	1.2G
			< 50 mm inner diameter and ≤ 25 % flash composition	1.3G
			≤ 30 mm inner diameter, each pyrotechnic unit ≤ 25 g and ≤ 5 % flash composition	1.4G
Shot tube	Single shot Roman candle, small preloaded mortar	Tube containing a pyrotechnic unit consisting of pyrotechnic composition, propellant charge with or without transmitting fuse	≤ 30 mm inner diameter and pyrotechnic unit > 25 g, or > 5 % and ≤ 25 % flash composition	1.3G
			≤ 30 mm inner diameter, pyrotechnic unit ≤ 25 g and ≤ 5 % flash composition	1.4G
Rocket	Avalanche rocket, signal rocket, whistling rocket, bottle rocket, sky rocket, missile type rocket, table rocket	Tube containing pyrotechnic composition or pyrotechnic units (or both), with stick(s) or other means for stabilization of flight, and designed to be propelled into the air	Flash composition effects only	1.1G
			Flash composition > 25 % of the pyrotechnic composition	1.1G
			> 20 g pyrotechnic composition and flash composition ≤ 25 %	1.3G

Table 4 *(continued)*

1	2	3	4	5
Type	**Synonyms**	**Definition**	**Specification**[a, b, c]	**Classification**
Rocket *(continued)*	Avalanche rocket, signal rocket, whistling rocket, bottle rocket, sky rocket, missile type rocket, table rocket	Tube containing pyrotechnic composition or pyrotechnic units (or both), with stick(s) or other means for stabilization of flight, and designed to be propelled into the air	≤ 20 g pyrotechnic composition, black powder bursting charge and ≤ 0,13 g flash composition per report and ≤ 1 g in total	1.4G
Mine	Pot-a-feu, ground mine, bag mine, cylinder mine	Tube containing propellant charge and pyrotechnic units and designed to be placed on the ground or to be fixed in the ground. The principal effect is ejection of all the pyrotechnic units in a single burst producing a widely dispersed visual or aural effect (or both); in the air; or	> 25 % flash composition, as loose powder or report effects (or both)	1.1G
			≥ 180 mm and ≤ 25 % flash composition, as loose powder or report effects (or both)	1.1G
			< 180 mm and ≤ 25 % flash composition, as loose powder or report effects (or both)	1.3G
		Cloth or paper bag or cloth or paper cylinder containing propellant charge and pyrotechnic units, designed to be placed in a mortar and to function as a mine	≤ 150g pyrotechnic composition, containing ≤ 5 % flash composition as loose powder or report effects (or both). Each pyrotechnic unit ≤ 25 g, each report effect < 2 g; each whistle, if any, ≤ 3 g	1.4G
Fountain	Volcanos, gerbs, showers, lances, Bengal fire, flitter sparkle, cylindrical fountains, cone fountains, illuminating torch	Non-metallic case containing pressed or consolidated sparks and flame producing pyrotechnic composition	≥ 1 kg pyrotechnic composition	1.3G
			< 1 kg pyrotechnic composition	1.4G
Sparkler	Handheld sparklers, non-handheld sparklers, wire sparklers	Rigid wire partially coated (along one end) with slow burning pyrotechnic composition with or without an ignition tip	Perchlorate based sparklers: > 5 g per item or > 10 items per pack	1.3G
			Perchlorate based sparklers: ≤ 5 g per item and ≤ 10 items per pack; nitrate based sparklers: ≤ 30 g per item	1.4G
Bengal stick	Dipped stick	Non-metallic stick partially coated (along one end) with slow-burning pyrotechnic composition and designed to be held in the hand	Perchlorate based items: > 5 g per item or > 10 items per pack	1.3 G
			Perchlorate based items: ≤ 5 g per item and ≤ 10 items per pack; nitrate based items: ≤ 30 g per item	1.4G

Table 4 (*continued*)

1	2	3	4	5
Type	**Synonyms**	**Definition**	**Specification**[a, b, c]	**Classification**
Low hazard fireworks and novelties	Table bombs, throwdowns, crackling granules, smokes, fog, snakes, glow worm, serpents, snaps, party poppers	Device designed to produce very limited visible or audible effect (or both) which contains small amounts of pyrotechnic or explosive composition (or both)	Throwdowns and snaps may contain up to 1,6 mg of silver fulminate; snaps and party poppers may contain up to 16 mg of potassium chlorate or red phosphorous (or both); other articles may contain up to 5 g of pyrotechnic composition, but no flash composition	1.4G
Spinner	Aerial spinner, helicopter, chaser, ground spinner	Nnon-metallic tube or tubes containing gas- or spark-producing pyrotechnic composition, with or without noise producing composition, with or without aerofoils attached	Pyrotechnic composition per item > 20 g, containing ≤ 3 % flash composition as report effects, or whistle composition ≤ 5 g	1.3G
			Pyrotechnic composition per item ≤ 20 g, containing ≤ 3 % flash composition as report effects, or whistle composition ≤ 5 g	1.4G
Wheels	Catherine wheels, Saxon	Assembly including drivers containing pyrotechnic composition and provided with a means of attaching it to a support so that it can rotate	≥ 1 kg total pyrotechnic composition, no report effect, each whistle (if any) ≤ 25 g and ≤ 50 g whistle composition per wheel	1.3G
			< 1 kg total pyrotechnic composition, no report effect, each whistle (if any) ≤ 5 g and ≤ 10 g whistle composition per wheel	1.4G
Aerial wheel	Flying Saxon, UFO's, rising crown	Tubes containing propellant charges and spark, flame or noise producing pyrotechnic compositions (or any combination of these), the tubes being fixed to a supporting ring	> 200 g total pyrotechnic composition or > 60 g pyrotechnic composition per driver, ≤ 3 % flash composition as report effects, each whistle (if any) ≤ 25 g and ≤ 50 g whistle composition per wheel	1.3G
			≤ 200 g total pyrotechnic composition and ≤ 60 g pyrotechnic composition per driver, ≤ 3 % flash composition as report effects, each whistle (if any) ≤ 5 g and ≤ 10 g whistle composition per wheel	1.4G

Table 4 (*concluded*)

1	2	3	4	5
Type	**Synonyms**	**Definition**	**Specification**[a, b, c]	**Classification**
Selection pack	Display selection box, display selection pack, garden selection box, indoor selection box; assortment	A pack of more than one type each corresponding to one of the types of fireworks listed in this table	The most hazardous firework type determines the classification	
Firecracker	Celebration cracker, celebration roll, string cracker	Assembly of tubes (paper or cardboard) linked by a pyrotechnic fuse, each tube intended to produce an aural effect	Each tube ≤ 140 mg of flash composition or ≤ 1 g black powder	1.4G
Banger	Salute, flash banger, lady cracker	Non-metallic tube containing report composition intended to produce an aural effect	> 2 g flash composition per item	1.1G
			≤ 2 g flash composition per item and ≤ 10 g per inner packaging	1.3G
			≤ 1 g flash composition per item and ≤ 10 g per inner packaging or ≤ 10 g black powder per item	1.4G

[a] "Percentage" refers to the mass of all pyrotechnic compositions, for example rocket motors, lighting charge, bursting charge and effect charge unless otherwise stated.

[b] "Flash composition" refers to pyrotechnic compositions in powder form or as pyrotechnic units, as presented in fireworks, that are used to produce an aural report effect, or used as a bursting charge or a lifting charge. When tested in accordance with Part I, Section 12, Test Series 2(c)(i) of the Unitred Nations' *Manal of tests and criteria*, the pressure rise from 690 kPa to 2070 kPa should be less than 0,8 ms for 0,5 g of pyrotechnic composition.

[c] Dimensions in millimetre refer to the

- diameter of a spherical shell or a peanut shell,
- the length of a cylinder shell,
- inside diameter of the tube comprising, or containing, firework in the case of a shell in mortar, Roman candle, shot tube firework or mine, and
- inside diameter of the motar intended to contain the mine in case of a mine bag or a cylinder mine.

8 Class 2: Gases

8.1 General

8.1.1 Permanent gas

A permanent gas is a gas that, at a temperature of 50 °C, has a vapour pressure exceeding 300 kPa or is completely gaseous at a temperature of 20 °C and at a standard pressure of 101,3 kPa.

NOTE Carbonated beverages are not subject to the requirements of this standard.

8.1.2 Compressed gas

A compressed gas is a gas that, when packaged under pressure for transport, is entirely gaseous at a temperature of −50 °C. A gas with a critical temperature of less than, or equal to, –50 °C is regarded as a compressed gas.

8.1.3 Liquefied gas

A liquefied gas is a gas that, when packaged under pressure for transport, can become partially liquid at a temperature above −50 °C. A distinction is made between

a) high pressure liquefied gas: a gas with a critical temperature between −50 °C and +65 °C, and

b) low pressure liquefied gas: a gas with a critical temperature above +65 °C.

8.1.4 Refrigerated liquefied gas

A refrigerated liquefied gas is a gas that, when packaged under pressure for transport, is partially liquid due to its low temperature, for example liquid nitrogen and liquid oxygen.

8.1.5 Dissolved gas

A dissolved gas is a gas that, when packaged under pressure for transport, is dissolved in a liquid phase solvent.

8.1.6 Aerosol dispenser

An aerosol dispenser is a non-refillable receptacle made of metal, glass or plastics, that contains a gas that is compressed, liquefied or dissolved under pressure, with or without a liquid, paste or powder, and that is fitted with a release device to allow the contents to be ejected as solid or liquid particles in suspension in a gas, or as a foam, a paste or a powder, or in a liquid state, or in a gaseous state.

The flammability of an aerosol shall be determined in accordance with A.2.1.

8.2 Divisions of class 2

8.2.1 General

Substances of Class 2 are assigned to one of three divisions based on the primary hazard of the gas during transport.

8.2.2 Division 2.1: Flammable gases

8.2.2.1 Flammable gases are gases that, at a temperature of 20 °C and at a standard pressure of 101,3 kPa

a) are ignitable when in a mixture of 13 % or less (by volume) with air, or

b) have a flammable range with air of at least 12 percentage points, regardless of the lower flammable limit. Flammability shall be determined by tests or by calculation in accordance with ISO 10156. Where insufficient data are available for the calculation in accordance with ISO 10156, tests by a comparable internationally recognized method may be used.

8.2.3 Division 2.2: Non-flammable, non-toxic gases

Non-flammable, non-toxic gases are gases that are transported at a pressure of at least 280 kPa at a temperature of 20 °C, or as refrigerated liquids, and that

a) are asphyxiant (gases that dilute or replace the oxygen in the atmosphere), or

b) are oxidizing (gases that can, generally by providing oxygen, cause or contribute to the combustion of other material to a greater extent than air does). The oxidizing ability of a gas shall be determined by tests or by calculation in accordance with ISO 10156 and ISO 10156-2, or

c) do not fall under division 2.1 or division 2.3.

8.2.4 Division 2.3: Toxic gases

Toxic gases are gases that

a) are known to be so toxic or corrosive to humans that they pose a health hazard, or

b) are presumed to be toxic or corrosive to humans because they have an inhalation toxicity (LC_{50}) value equal to or less than 5 000 mL/m^3 when tested in accordance with A.6.

NOTE Gases that meet the above criteria owing to their corrosiveness are classified as toxic with a subsidiary corrosive risk.

8.3 Warning notes about gases

Although some gases are chemically and physiologically inert, these gases, and other gases accepted as non-toxic under normal circumstances, will nevertheless be suffocating in high concentrations.

Many gases can have a marked narcotic effect at comparatively low concentrations, or can emit highly toxic vapours or fumes when involved in a fire. All gases that are heavier than air present a potential danger if allowed to accumulate.

8.4 Classification of gas mixtures

8.4.1 General

Gas mixtures (including vapours of substances from other classes) are classified in at least one of the three divisions in accordance with the principles discussed in 8.4.2 to 8.4.5 (inclusive).

8.4.2 Flammability

The flammability of a gas mixture is determined in accordance with ISO 10156. Where insufficient data are available for the calculation in accordance with ISO 10156, tests by a comparable internationally recognized method may be used.

8.4.3 Toxicity

The toxicity of a gas mixture is determined in accordance with 12.1.2.4 or is calculated by means of the following formula:

$$LC_{50} = \frac{1}{\sum_{i=1}^{n} \frac{f_i}{T_i}}$$

where

LC_{50} is the acute inhalation toxicity, in milligrams per litre for dust or mist, and in millilitres per cubic metre for vapours;

n is the number of toxic gases in the gas mixture;

f_i is the mole fraction of the i^{th} toxic component substance of the mixture;

T_i is the toxicity index of the i^{th} toxic component substance of the mixture (T_i equals the LC_{50} value when available).

NOTE When the LC_{50} values are unknown, the toxicity index is determined by

a) using the lowest LC_{50} value of substances with similar physiological and chemical effects, or

b) testing, if this is the only practical possibility.

8.4.4 Corrosiveness

Corrosiveness as a subsidiary risk of a gas mixture is applicable when the mixture is known to be destructive to the human skin, eyes or mucous membranes, or when the calculated LC_{50} value is less than or equal to 5 000 mL/m^3 when the following formula is applied:

$$LC_{50} = \frac{1}{\sum_{i=1}^{n} \frac{f_{ci}}{T_{ci}}}$$

where

LC_{50} is the acute inhalation toxicity, in milligrams per litre for dust and mist, and in millilitres per cubic metre for vapours;

n is the number of toxic gases in the gas mixture;

f_{ci} is the mole fraction of the i^{th} corrosive component substance of the mixture;

T_{ci} is the toxicity index of the i^{th} corrosive component substance of the mixture (T_{ci} equals the LC_{50} value when available).

8.4.5 Oxidizing ability

The oxidizing ability of a gas mixture is determined by tests or by the calculation in accordance with ISO 10156 and ISO 10156-2.

8.5 Hazard precedence for gases

Gases and gas mixtures that present hazards associated with more than one division of class 2 take the following precedence:

a) hazards associated with division 2.3 take precedence over divisions 2.1 and 2.2; and

b) hazards associated with division 2.1 take precedence over hazards associated with division 2.2.

9 Class 3: Flammable liquids

9.1 General

9.1.1 Class 3 includes the following substances:

a) flammable liquids (see 9.1.2 and 9.1.3); and

b) liquid desensitized explosives (see 9.2).

9.1.2 Flammable liquids are liquids, or mixtures of liquids, that might contain solids in solution or in suspension (for example paints, varnishes and lacquers, but not substances that, on account of their other dangerous characteristics, have been included in other classes), that give off a flammable vapour at or below 60 °C, closed-cup test (which corresponds to 65,6 °C, open-cup test). This class also includes:

a) liquids offered for transport at temperatures at or above their flash point; and

b) substances that are transported, or offered for transport, at elevated temperatures in a liquid state and which give off a flammable vapour at a temperature at or below the maximum transport temperature.

9.1.3 A non-toxic, non-corrosive liquid that complies with the requirements of 9.1.2, that has a closed-cup flash point exceeding 35 °C and that does not sustain combustion, need not be considered as flammable if

a) it has passed the combustibility test (see A.3.4), or

b) the (fire) point exceeds 100 °C when tested in accordance with ISO 2592, or

c) it is a water miscible solution with a water content exceeding 90 % (by mass).

However, such a substance shall be classified as a product of class 3 if it is intended for transport at an elevated temperature equal to or higher than its flash point.

NOTE 1 The flash point of a liquid can be altered by the presence of impurities. Therefore, chemically pure liquids that are not regarded as flammable liquids of class 3, may be classified under this class if they are commercial products.

NOTE 2 Substances listed by name in this class are regarded as chemically pure.

9.1.4 Substances classified as flammable liquids due to their being transported, or offered for transport at elevated temperatures, are included in packing group III.

9.2 Liquid desensitized explosives

A liquid desensitized explosive is an explosive substance that is dissolved or suspended in water or in another liquid substance, to form a homogeneous liquid mixture to suppress its explosive properties (see 7.5.5.3). Entries in B.2 and in annex C for liquid desensitized explosives are UN 1204, UN 2059, UN 3064, UN 3343, UN 3357 and UN 3379.

9.3 Packing groups based on flammability (see table 5)

9.3.1 General

9.3.1.1 The criteria given in table 4 are used to determine the packing group of a liquid that presents a risk owing to its flammability.

9.3.1.2 If a liquid has an additional risk(s) to flammability, the packing group determined from table 4 and the packing group based on the severity of the additional risk(s) shall be considered. The classification and packing group of such a substance shall be allocated in accordance with table 18, provided that the substance is not listed in B.2 and in annex C.

9.3.1.3 The flash point data in this standard are generally based on closed-cup methods. Where it is customary for flash points to be determined by the open-cup method, the temperatures determined by that method would have to be reduced for comparison with those in this standard (see 9.1.2).

Table 5 — Packing groups based on flammability

1	2	3
Packing group	**Closed-cup flash point** °C	**Initial boiling point** °C
I	–	≤ 5
II	< 23	> 35
III	≥ 23 and ≤ 60	> 35

9.4 Viscous flammable liquids

9.4.1 Paints, varnishes, enamels, lacquers, adhesives, polishes and other viscous flammable substances of class 3 that have a closed-cup flash point of less than 23 °C can be assigned to packing group III on the basis of

a) the viscosity expressed as the flow time, in seconds, exceeding the limits given in table 6,

b) the closed-cup flash point (see A.3.1), and

c) a solvent separation test (see A.3.3).

9.4.2 Viscous flammable liquids that have a closed-cup flash point of less than 23 °C are assigned to packing group III, provided that

a) less than 3 % of the clear solvent layer separates in the solvent separation test (see 9.5(c)), and

b) the mixture or any separated solvent does not comply with the criteria of division 6.1 (see 12.1) or class 8 (see clause 14).

9.4.3 Viscous substances that

a) have a flash point equal to or exceeding 23 °C and less than or equal to 60 °C,

b) are not toxic, corrosive, or hazardous to the environment,

c) contain not more than 20 % nitrocellulose, provided that the nitrocellulose contains not more than 12,6 % nitrogen (by dry mass), and

d) are packed in receptacles of capacity less than 450 L, are not subject to the requirements of this standard if

1) the solvent separation test (see A.3.3) shows that the height of the separated layer of solvent is less than 3 % of the total height, and

2) the viscosity of the substance (see A.3.2) is such that it has a flow time (6 mm cup) equal to or exceeding

i) 60 s, or

ii) 40 s, if the substance contains not more than 60 % of class 3 substances.

Table 6 — Criteria for viscous flammable substances

1	2	3
Flow time t (s)		**Closed-cup flash point** °C
4 mm cup	**6 mm cup**	
$20 < t \le 60$	—	> 17
$60 < t \le 100$	—	> 10
—	$20 < t \le 32$	> 5
—	$32 < t \le 44$	> −1
—	$44 < t \le 100$	> −5
—	$100 < t$	≤ −5

9.5 Test methods for flammable liquids

The testing of flammable liquids for classification purposes shall be in accordance with the test methods given in A.3 for

a) flash point A.3.1,

b) viscosity A.3.2,

c) solvent separation A.3.3, and

d) combustibility A.3.4.

10 Class 4: Flammable solids; substances liable to spontaneous combustion; substances that, on contact with water, emit flammable gases

10.1 Division 4.1: Flammable solids, self-reactive substances and solid desensitized explosives

10.1.1 Flammable solids

10.1.1.1 General

10.1.1.1.1 Flammable solids are readily combustible and can cause, or contribute to, fire through friction.

10.1.1.1.2 Readily combustible solids are powdered, granular, or pasty substances that can easily be ignited on brief contact with an ignition source, such as a burning match, and the flames of which spread rapidly. When heated or when on fire, some of these substances can emit toxic combustion products.

10.1.1.1.3 Metal powders are especially dangerous because extinguishing the fire of burning metal powders with normal extinguishing agents such as carbon dioxide or water can increase the fire hazard.

10.1.1.2 Classification of flammable solids

10.1.1.2.1 Powdered, granular or pasty substances shall be classified in division 4.1 when the time of burning of one or more of the tests performed in accordance with A.4.1.2, is less than 45 s or the rate of burning exceeds 2,2 mm/s.

10.1.1.2.2 Powders of metals or metal alloys shall be classified in division 4.1 when they can be ignited and the reaction spreads over the entire length of the sample in 10 min or less (see A.4.1.2).

10.1.1.2.3 Solids that can cause fire through friction shall be classified in division 4.1 by analogy with existing entries, for example matches, until definitive criteria are established.

10.1.1.3 Assignment of packing groups to flammable solids

10.1.1.3.1 General

The packing groups for flammable solids are assigned on the basis of the results obtained in the preliminary screening test (see A.4.1.1) and the burning rate test (see A.4.1.2). The packing group of a solid that can cause fire through friction shall be assigned by analogy with an existing entry, or in accordance with an appropriate special provision.

10.1.1.3.2 Packing group II

Packing group II is assigned to

a) readily combustible solids (other than metal powder) if the burning time is less than 45 s and the flame passes the wetted zone; and

b) metal powders or metal alloys if the zone of reaction spreads over the entire length of the specimen in 5 min or less.

10.1.1.3.3 Packing group III

Packing group III is assigned to

a) readily combustible solids (other than metal powders) if the burning time is less than 45 s and the wetted zone stops the flame propagation for at least 4 min, and

b) metal powders or metal alloys if the reaction spreads over the whole length of the specimen in more than 5 min but in less than 10 min.

10.1.2 Self-reactive substances

10.1.2.1 General

10.1.2.1.1 Self-reactive substances of division 4.1 are thermally unstable substances that are liable to undergo a strong exothermic decomposition, even without the participation of oxygen or air. The following substances are not considered to be self-reactive substances of division 4.1:

a) explosives of class 1;

b) oxidizing substances of division 5.1 (see also 10.1.2.1.3);

c) organic peroxides of division 5.2;

d) substances of which the heat of decomposition is less than 300 J/g; and

e) substances of which the self-accelerating decomposition temperature (SADT) exceeds 75 °C for a 50 kg package.

NOTE The heat of decomposition can be determined by means of any internationally recognized method, for example differential scanning calorimetry or adiabatic calorimetry.

10.1.2.1.2 A substance that shows the properties of a self-reactive substance shall be classified in division 4.1 even if it gives a positive result according to 10.2.3 for inclusion in division 4.2.

10.1.2.1.3 A mixture of oxidizing substances of division 5.1 that contains 5,0 % or more of combustible organic susbances and does not meet the criteria given in 10.1.2.1.1(a), (c), (d) or (e), shall be subjected to the self-reactive substance classification procedure (see 10.1.2.3).

10.1.2.2 Properties of self-reactive substances

10.1.2.2.1 The decomposition of self-reactive substances can be initiated by friction, impact or heat, or by contact with catalytic impurities, for example acids, heavy metal compounds and heavy metal bases.

10.1.2.2.2 The rate of decomposition increases with temperature and varies with the substance. Decomposition, particularly if no ignition occurs, can result in the evolution of toxic gases or vapours. In the case of certain self-reactive substances, the temperature has to be controlled. Some self-reactive substances can decompose explosively, particularly if confined; this characteristic can be modified by the addition of diluents (see 10.1.2.6) or by the use of appropriate packaging.

10.1.2.2.3 Some self-reactive substances burn vigorously. Self-reactive substances include some of the following types of compounds:

a) aliphatic azo compounds (-C-N=N-C-);

b) organic azides (-C-N_3);

c) diazonium salts (-$CN_2^+Z^-$);

d) N-nitroso compounds (-N-N=O); and

e) aromatic sulfohydrazides (-SO_2-NH-NH_2).

10.1.2.2.4 Substances of other reactive groups and some mixtures of substances can have properties similar to those of self-reactive substances.

10.1.2.3 Classification of self-reactive substances

10.1.2.3.1 Self-reactive substances are classified into seven types according to the degree of danger they present (see 10.1.2.4). The types of self-reactive substances range from type A (shall not be accepted for transport in the packaging in which they are tested) to type G, which is not subject to the provisions for self-reactive substances of division 4.1. The classification of types B to F is directly related to the maximum quantity allowed in one packaging.

10.1.2.3.2 Self-reactive substances permitted for transport in packaging are listed in table 6 (see also SANS 10229-1), those permitted for transport in IBCs are listed in packing instruction IBC520 (see SANS 10233) and those permitted for transport in portable tanks are listed in tank instruction T23 (see SANS 1518). For each permitted substance listed in table 6, the appropriate generic entry (UN 3221 to UN 3240) is given in B.2.

10.1.2.3.3 The classification given in table 7 is based on the pure substance except where a concentration of less than 100 % is specified. For other concentrations, the substance shall be classified differently in accordance with the procedures given in 10.1.2.4 and 10.1.2.5.

10.1.2.3.4 Classification of self-reactive substances not listed in table 7, packing instruction IBC520 or tank instruction T23 (see B.2) and assignment to a generic entry shall be made by the relevant competent authority of the country of origin on the basis of a test report. Principles applying to the classification of such substances are provided in 10.1.2.4. The applicable classification procedures, test methods and criteria, and an example of a suitable test report, are given in Part II of the United Nations' *Manual of Tests and Criteria*. The statement of approval by the competent authority shall contain the classification and the relevant transport conditions.

10.1.2.3.5 Activators, such as zinc compounds, may be added to some self-reactive substances to change their reactivity. Depending on both the type and the concentration of the activator, this could result in a decrease in thermal stability and a change in explosive properties. If either of these properties is altered, the new formulation shall be assessed in accordance with the classification criteria of this standard.

10.1.2.3.6 Samples of self-reactive substances or formulations of self-reactive substances not listed in table 6, for which a complete set of test results is not available and that are to be transported for further testing or evaluation, may be assigned to one of the appropriate entries for self-reactive substances type C provided the following conditions are met:

a) the available data indicate that the sample would be no more dangerous than self-reactive substances type B;

b) the sample is packaged in accordance with packing method OP2 (see packing instruction P520 in SANS 10229-1) and the quantity per transport unit is limited to 10 kg; and

c) the available data indicate that the control temperature, if any, is sufficiently low to prevent any dangerous decomposition and sufficiently high to prevent any dangerous phase separation.

Table 7 — Currently assigned self-reactive substances in packaging

1	2	3	4	5	6	7
Self-reactive substance	**Concen-tration** %, by mass	**Packing method** (see SANS 10229-1)	**Control tempera-ture** °C	**Emergency tempera-ture** °C	**UN generic entry**	**Remarks**
Acetone-pyrogallol copolymer 2-Diazo-1-naphthol-5-sulfonate	100	OP8			3228	
Azodicarbonamide formulation type B, temperature controlled	< 100	OP5			3232	1, 2
Azodicarbonamide formulation type C	< 100	OP6			3224	3
Azodicarbonamide formulation type C, temperature controlled	< 100	OP6			3234	4
Azodicarbonamide formulation type D	< 100	OP7			3226	5
Azodicarbonamide formulation type D, temperature controlled	< 100	OP7			3236	6
2,2' -Azodi(2,4-dimethyl-4-methoxyvaleronitrile)	100	OP7	-5	+5	3236	
2,2' -Azodi(2,4-dimethyl-valeronitrile)	100	OP7	+10	+15	3236	
2,2' -Azodi(ethyl-2-methylpropionate)	100	OP7	+20	+25	3235	
1,1-Azodi(hexahydrobenzonitrile)	100	OP7			3226	
2,2'-Azodi(isobutyronitrile)	100	OP6	+40	+45	3234	
2,2'-Azodi(isobutyronitrile) as a water based paste	≤ 50	OP6			3224	
2,2'-Azodi(2-methylbutyronitrile)	100	OP7	+35	+40	3236	
Benzene-1,3-disulphonyl hydrazide, as a paste	52	OP7			3226	
Benzenesulphonyl hydrazide	100	OP7			3226	
4-(Benzyl(ethyl)amino)-3-ethoxy-benzenediazonium zinc chloride	100	OP7			3226	
4-(Benzyl(methyl)amino)-3-ethoxy-benzenediazonium zinc chloride	100	OP7	+40	+45	3236	
3-Chloro-4-diethylaminobenzene-diazonium zinc chloride	100	OP7			3226	
2-Diazo-1-naphthol-4-sulfonyl-chloride	100	OP5			3222	2
2-Diazo-1-naphthol-5-sufonyl-chloride	100	OP5			3222	2
2-Diazo-1-naphthol sulfonic acid ester mixture, type D	<100	OP7			3226	9
2,5-Diethoxy-4-morpholino-benzenediazonium zinc chloride	67–100	OP7	+35	+40	3236	

Table 7 (*continued*)

1	2	3	4	5	6	7
Self-reactive substance	**Concen-tration** %, by mass	**Packing method** (see SANS 10229-1)	**Control tempera-ture** °C	**Emergency tempera-ture** °C	**UN generic entry**	**Remarks**
2,5-Diethoxy-4-morpholino-benzenediazonium zinc chloride	66	OP7	+40	+45	3236	
2,5-Diethoxy-4-morpholino-benzenediazonium tetrafluoroborate	100	OP7	+30	+35	3236	
2,5-Diethoxy-4-(4-morpholinyl)-benzenediazonium sulfate	100	OP7			3226	
2,5-Diethoxy-4-(phenylsulfonyl)-benzenediazonium zinc chloride	67	OP7	+40	+45	3236	
Diethyleneglycol bis (allyl carbonate) *and* Di-isopropylperoxy-dicarbonate	≥ 88 *and* ≤ 12	OP8	−10	0	3237	
2,5-Dimethoxy-4-(4-methyl-phenylsulphonyl)benzene-diazonium zinc chloride	79	OP7	+40	+45	3236	
4-(Dimethylamino)-benzene-diazonium trichlorozincate (-1)	100	OP8			3228	
4-Dimethylamino-6-(2-dimethyl-aminoethoxy) toluene-2-diazonium zinc chloride	100	OP7	+40	+45	3236	
N,N'-Dinitroso-N,N'-dimethyl terephthalamide, as a paste	72	OP6			3224	
N,N'-Dinitrosopentamethylene-tetramine	82	OP6			3224	
Diphenyloxide-4,4'-disulfonyl-hydrazide	100	OP7			3226	7
4-Dipropylaminobenzene-diazonium zinc chloride	100	OP7			3226	
2-(N,N-ethoxycarbonyl-phenylamino)-3-methoxy-4-(N-methyl-N-cyclohexylamino benzenediazonium zinc chloride	63 — 92	OP7	+40	+45	3236	
2-(N,N-Ethoxycarbonyl-phenylamino)-3-methoxy-4-(N-methyl-N- cyclohexylamino) benzenediazonium zinc chloride	62	OP7	+35	+40	3236	
N-Formyl-2-(nitromethylene) -1,3-perhydrothiazine	100	OP7	+45	+50	3236	
2-(2-Hydroxyethoxy)-1-(pyrrolidin-1-yl)benzene-4- diazonium zinc chloride	100	OP7	+45	+50	3236	

Table 7 *(concluded)*

1	2	3	4	5	6	7
Self-reactive substance	**Concentration** %, by mass	**Packing method** (see SANS 10229-1)	**Control temperature** °C	**Emergency temperature** °C	**UN generic entry**	**Remarks**
3-(2-Hydroxyethoxy)-4-(pyrrolidin-1-yl)benzene diazonium zinc chloride	100	OP7	+40	+45	3236	
2-(N,N-Methylaminoethyl-carbonyl)-4-(3,4-dimethyl-phenylsulphonyl)benzene-diazonium hydrogen Sulfate	96	OP7	+45	+50	3236	
4-Methylbenzenesulfonyl-hydrazide	100	OP7			3226	
3-Methyl-4-(pyrrolidin-1-yl) benzenediazonium tetrafluoro-borate	95	OP6	+45	+50	3234	
4-Nitrosophenol	100	OP7	+35	+40	3236	
Self-reactive liquid, sample		OP2			3223	8
Self-reactive liquid, sample, temperature controlled		OP2			3233	8
Self-reactive solid, sample		OP2			3224	8
Self-reactive solid, sample, temperature controlled		OP2			3234	8
Sodium 2-diazo-1-naphthol-4-sulfonate	100	OP7			3226	
Sodium 2-diazo-1-naphthol-5-sulfonate	100	OP7			3226	
Tetramine palladium (II) nitrate	100	OP6	+30	+35	3234	

Remarks

1 Azodicarbonamide formulations that fulfil the criteria of 10.1.2.4.3. The control and emergency temperatures shall be determined by the procedure given in 10.1.2.5.

2 "EXPLOSIVE" subsidiary risk label is required (see SANS 10229-1).

3 Azodicarbonamide formulations that fulfil the criteria of 10.1.2.4.4.

4 Azodicarbonamide formulations that fulfil the criteria of 10.1.2.4.4. The control and emergency temperatures shall be determined by the procedure given in 10.1.2.5.

5 Azodicarbonamide formulations that fulfil the criteria of 10.1.2.4.5.

6 Azodicarbonamide formulations that fulfil the criteria of 10.1.2.4.5. The control and emergency temperatures shall be determined by the procedure given in 10.1.2.5.

7 With a compatible diluent having a boiling point of not less than 150 °C.

8 See 10.1.2.6.

9 This entry applies to mixtures of esters of 2-diazo-1-naphthol-4-sulfonic acid and 2-diazo-1-naphthol-5-sulfonic acid meeting the criteria of 10.1.2.4.5.

10.1.2.4 Types of self-reactive substances

10.1.2.4.1 General

Self-reactive substances are classified in seven types, in accordance with the degree of danger that they present.

10.1.2.4.2 Type A

A type A substance is any substance that can detonate or deflagrate rapidly when packaged for transport. Type A substances are prohibited from transport under the provisions of division 4.1 in such packaging.

10.1.2.4.3 Type B

A type B substance is any substance that has explosive properties and that, when packaged for transport, neither detonates nor deflagrates rapidly, but is liable to undergo a thermal explosion in the package. Type B substances shall also bear an "Explosive" risk label.

Such a substance can be packaged in amounts of up to 25 kg, unless the maximum quantity has to be limited to a lower amount to preclude detonation or rapid deflagration of the package.

10.1.2.4.4 Type C

A type C substance is any substance that has explosive properties but that cannot detonate or deflagrate rapidly or undergo a thermal explosion when packaged for transport in packages with a capacity not exceeding 50 kg. Type C substances may be transported without an "Explosive" risk label.

10.1.2.4.5 Type D

A type D substance is any substance that, during laboratory testing and when packaged for transport

a) detonates partially, does not deflagrate rapidly and shows no violent effect when heated under confinement, or

b) does not detonate at all, deflagrates slowly and shows no violent effect when heated under confinement, or

c) does not detonate or deflagrate at all and shows a medium effect when heated under confinement.

Such a substance can be transported in packages with a capacity not exceeding 50 kg net mass.

10.1.2.4.6 Type E

A type E substance is any substance that, during laboratory testing, neither detonates nor deflagrates and shows little or no effect when heated under confinement.

Such a substance can be transported in packages with a capacity not exceeding 400 kg or 450 L.

10.1.2.4.7 Type F

A type F substance is any substance that, during laboratory testing, neither detonates in the cavitated state nor deflagrates, shows little or no effect when heated under confinement, and shows low or no explosive power. These substances may be transported in intermediate bulk containers (IBCs) that comply with SANS 10233 or tanks that comply with SANS 1518.

10.1.2.4.8 Type G

A type G substance is any substance that, during laboratory testing, neither detonates in the cavitated state nor deflagrates, and shows no effect when heated under confinement and shows no explosive power. These substances may be exempted from classification as a self-reactive substance of division 4.1, provided that

a) the formulation is thermally stable (self-accelerating decomposition temperature of 60 °C to 75 °C for a 50 kg package), and

b) any diluent complies with the requirement given in 10.1.2.6.

NOTE If the formulation is not thermally stable or a diluent other than type A (see 3.1.19) is used for desensitization, the formulation should be classified as "Self-reactive liquid (or solid), type F".

10.1.2.5 Temperature control requirements for self-reactive substances

Self-reactive substances shall be subject to temperature control in transport if their self-accelerating decomposition temperature (SADT) is less than or equal to 55 °C. The test methods for determining the SADT are given in section 28, part II of the United Nations' *Manual of tests and criteria.*

10.1.2.6 Desensitization of self-reactive substances

10.1.2.6.1 In order to ensure safety during transport, handling and storage, self-reactive substances can be desensitized by the use of a diluent. When a diluent is used (see 10.1.2.6.3 and 10.1.2.6.4), the self-reactive substance shall be tested with the diluent present, in the concentration and form to be used during transport, handling and storage.

10.1.2.6.2 A diluent which can allow a self-reactive substance to concentrate to a dangerous extent in the event of leakage from a package, shall not be used.

10.1.2.6.3 The diluent shall be compatible with the self-reactive substance. Compatible diluents are those solids or liquids which have no detrimental influence on the thermal stability and hazard type of the self-reactive substance.

10.1.2.6.4 A liquid diluent in a liquid formulation that requires temperature control shall have a boiling point of at least 60 °C and a closed-cup flash point of not less than 5 °C. The boiling point of the liquid diluent shall be at least 50 °C higher than the control temperature of the self-reactive substance.

10.1.3 Solid desensitized explosives

10.1.3.1 Solid desensitized explosives are explosive substances that are wetted with water, or alcohols, or diluted with other substances, to form a homogeneous solid mixture to suppress their explosive properties.

Solid desensitized explosives in B.2 and annex C are: UN 1310; UN 1320; UN 1321; UN 1322; UN 1336; UN 1337; UN 1344; UN 1347; UN 1348; UN 1349; UN 1354; UN 1355; UN 1356; UN 1357; UN 1517; UN 1571; UN 2555; UN 2556; UN 2557; UN 2852; UN 2907; UN 3317; UN 3319; UN 3344; UN 3364; UN 3365; UN 3366; UN 3367; UN 3368; UN 3369; UN 3370, UN 3376, UN 3380 and UN 3474.

10.1.3.2 Substances assigned to division 4.1 include

a) substances that have been provisionally accepted as explosives of class 1 in accordance with test series 1 and 2 in part I of the United Nations' *Manual of tests and criteria,* but have been exempted from class 1 by test series 6 in part I of the United Nations' *Manual of tests and criteria,*

b) substances that are not self-reactive substances of division 4.1, or

c) substances of class 5, for example UN 2956, UN 3241, UN 3242 and UN 3251.

10.2 Division 4.2: Substances liable to spontaneous combustion

10.2.1 General

Substances of division 4.2 are liable to spontaneous heating under normal conditions, or to heating when they come into contact with air, and are then liable to catch fire. Some of these substances can emit toxic gases when they are involved in a fire. Pyrophoric substances and self-heating substances are included in division 4.2.

10.2.2 Pyrophoric substances

10.2.2.1 Properties

Pyrophoric substances, including mixtures and solutions, are substances that, even in small quantities, ignite within 5 min of their coming into contact with air. These substances are the division 4.2 substances most liable to spontaneous combustion and shall be assigned to packing group I.

10.2.2.2 Test methods for pyrophoric substances

For classification purposes, pyrophoric substances shall be tested in accordance with the test methods given in A.4.2.1.

10.2.3 Self-heating substances

10.2.3.1 Properties

10.2.3.1.1 Self-heating substances are substances, other than pyrophoric substances, that on contact with air and without energy supply, are liable to self-heating. These substances will ignite only in large amounts (several kilograms) and after a long time (hours or days).

10.2.3.1.2 Self-heating of substances is caused by reaction of the substance with oxygen in the air and when the heat that develops is not conducted away rapidly enough to the surroundings. Spontaneous combustion occurs when the rate of heat production exceeds the rate of heat loss and the auto-ignition temperature is reached. Some substances can emit toxic gases when they are involved in a fire.

10.2.3.2 Classification of self-heating substances

10.2.3.2.1 A substance shall be classified as a self-heating substance of division 4.2 when the substance is tested in accordance with the test method given in A.4.2.2 and

a) a positive result is obtained in a test using a 25 mm specimen cube at 140 °C,

b) a positive result is obtained in a test using a 100 mm specimen cube at 140 °C and a negative result is obtained when using a 100 mm specimen cube at a temperature of 120 °C, and the substance is to be transported in packages with a capacity not exceeding 3 m^3,

c) a positive result is obtained in a test using a 100 mm specimen cube at 140 °C and a negative result is obtained when using a 100 mm specimen cube at 100 °C, and the substance is to be transported in packages with a capacity exceeding 450 L, and

d) a positive result is obtained in a test using a 100 mm specimen cube at 140 °C and a positive result is obtained with a 100 mm specimen cube at 100 °C.

NOTE With the exception of type G, self-reactive substances that also give positive results for self-heating properties, are classified in division 4.1 and not in division 4.2.

10.2.3.2.2 A substance shall not be classified as a self-heating substance of division 4.2 if

a) a negative result is obtained in a test when using a 100 mm specimen cube at 140 °C,

b) a positive result is obtained in a test when using a 100 mm specimen cube at 140 °C and a negative result is obtained when using a 25 mm specimen cube at 140 °C, and with the additional test at 120 °C, provided that the substance is to be transported in packages with a capacity not exceeding 3 m^3, and

c) a positive result is obtained in a test when using a 100 mm specimen cube at 140 °C and a negative result is obtained when using a 25 mm specimen cube at 140 °C, and with the additional test at 100 °C, provided that the substance is to be transported in packages with a capacity not exceeding 450 L.

10.2.3.3 Assignment of packing groups

10.2.3.3.1 Packing group I

Packling group I is assigned to all pyrophoric substances in liquid and solid form (see also 10.2.2).

10.2.3.3.2 Packing group II

Packing group II is assigned to a self-heating substance if a positive result is obtained in a test using a 25 mm specimen cube at 140 °C.

10.2.3.3.3 Packing group III

Packing group III is assigned to a self-heating substance if

a) a positive result is obtained in a test using a 100 mm specimen cube at 140 °C and a negative result is obtained using a 25 mm specimen cube at 140 °C, and the substance is to be transported in packages with a capacity exceeding 3 m^3,

b) a positive result is obtained in a test using a 100 mm specimen cube at 140 °C and a negative result is obtained when using a 25 mm specimen cube at 140 °C, a positive result is obtained in the additional test using a 100 mm specimen cube at 120 °C, and the substance is to be transported in packages with a capacity exceeding 450 L, and

c) a positive result is obtained in a test using a 100 mm specimen cube at 140 °C and a negative result is obtained using a 25 mm specimen cube at 140 °C, and a positive result is obtained using a 100 mm specimen cube at 100 °C.

10.3 Division 4.3: Substances that, on contact with water, emit flammable gases

10.3.1 General

Certain substances, on contact with water, emit flammable gases that can form explosive mixtures with air. Such gas mixtures are easily ignited by all ordinary sources of ignition, for example naked flames, sparkling hand tools or unprotected light bulbs. The resulting blast wave and flames can endanger people and the environment.

NOTE Where the term "water-reactive" is used in this standard, it refers to substances that, on contact with water, emit flammable gases.

10.3.2 Classification of water-reactive substances

A substance shall be classified as a water-reactive substance of division 4.3 when the substance is tested in accordance with the test methods given in A.4.3 and the following results are obtained:

a) spontaneous ignition takes place at any step of the test procedure; or

b) there is an evolution of flammable gas at a rate exceeding 1 L/kg of the substance per hour.

10.3.3 Assignment of packing groups

10.3.3.1 Packing group I

Packing group I is assigned to a substance that reacts

a) violently with water at ambient temperature, with a general tendency for the gas evolved to ignite spontaneously, or

b) readily with water at ambient temperature at such a rate that the evolution of flammable gas is equal to or exceeds 10 L/kg of the substance in any 1 min.

10.3.3.2 Packing group II

Packing group II is assigned to a substance that

a) reacts readily with water at ambient temperature at such a rate that the evolution of flammable gas is equal to or exceeds 20 L/kg of the substance under test per hour, and

b) does not meet the criteria for packing group I.

10.3.3.3 Packing group III

Packing group III is assigned to a substance that

a) reacts slowly with water at ambient temperature at such a rate that the evolution of flammable gas is equal to or exceeds 1 L/kg of the substance under test per hour, and

b) does not meet the criteria for packing groups I or II.

10.4 Organometallic substances

Depending on their properties, organometallic substances can be classified in division 4.2 or division 4.3, as appropriate, in accordance with the scheme given in figure 2.

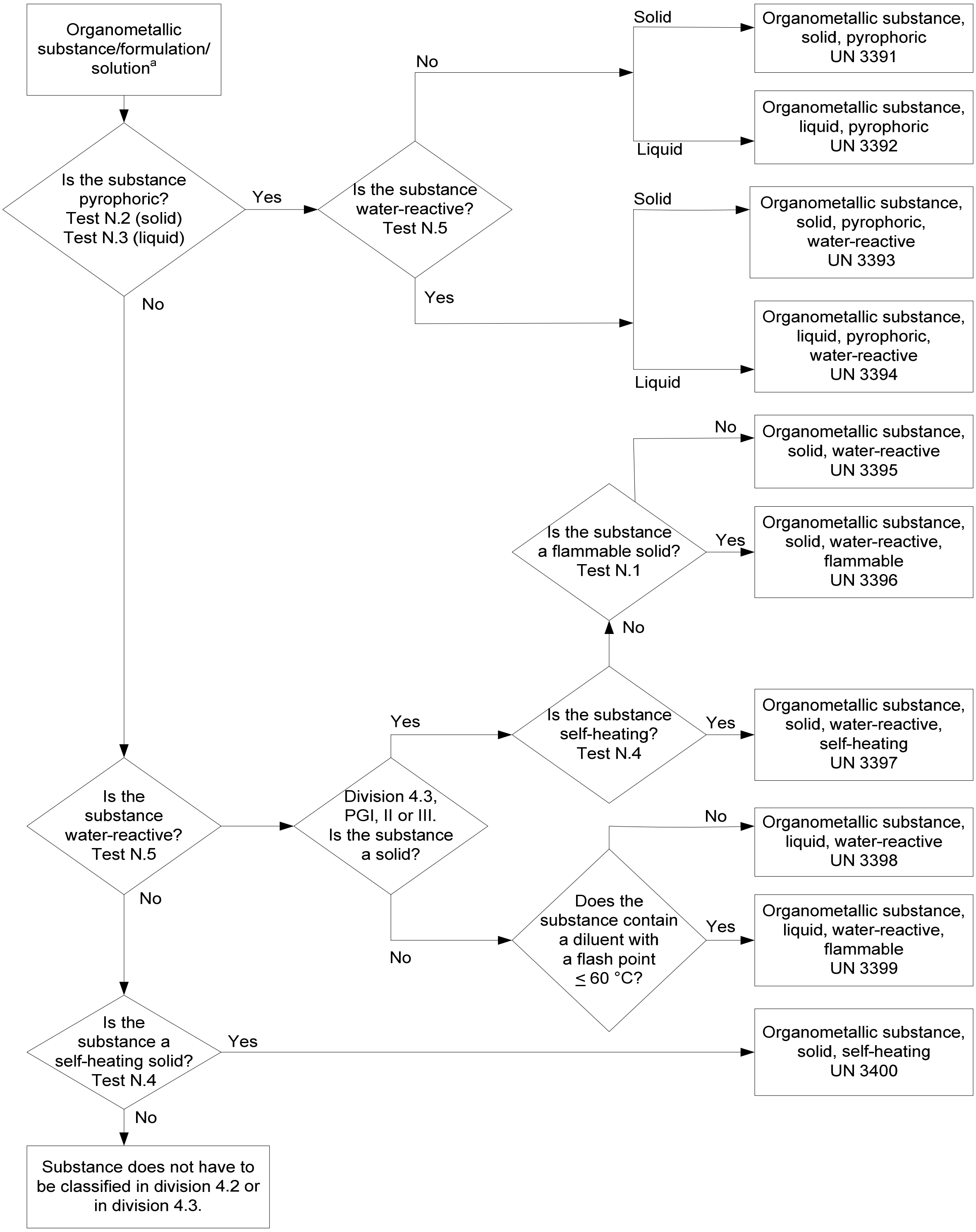

Figure 2 — Classification scheme for organometallic substances[b]

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[a] If applicable and testing is relevant, taking into account reactivity properties, division 6.1 and class 8 properties should be considered according to the precedence of hazard table 19.

[b] Test methods N.1 to N.5 can be found in part III, section 33 of the UN *Manual of tests and criteria*.

11 Class 5: Oxidizing substances and organic peroxides

11.1 Division 5.1: Oxidizing substances

11.1.1 General

11.1.1.1 Although oxidizing substances are not necessarily combustible, they can, either by yielding oxygen or by similar processes, cause or contribute to, the combustion of other materials with which they come into contact.

11.1.1.2 Depending on the amount and nature of combustible impurities they might contain, certain oxidizing substances are sensitive to impact, friction or a rise in temperature.

11.1.1.3 Some mixtures of oxidizing substances and combustible material are so readily ignited that friction or impact can cause ignition. Such a mixture can burn with explosive force.

11.1.1.4 There will be a violent reaction between most oxidizing substances and strong liquid acids, resulting in the emission of highly toxic gases. Such gases can also be emitted when certain oxidizing substances are involved in a fire.

11.1.1.5 For oxidizing substances that have other risks, for example toxicity or corrosiveness, the precedence of hazards in accordance with clause 21 and table 17 shall be complied with.

11.1.2 Oxidizing solids

11.1.2.1 Classification of oxidizing solids

11.1.2.1.1 A solid substance is classified as an oxidizing substance of division 5.1 on the basis of its potential to increase the burning rate or burning intensity of a combustible substance when the two are thoroughly mixed. For classification purposes oxidizing solids shall be tested in accordance with the test method given in A.5.1.1

11.1.2.1.2 Tests are conducted on the substance to be evaluated mixed with dry fibrous cellulose in mixing ratios of 1:1 (by mass) and 4:1 (by mass), of specimen to cellulose. The burning characteristics of the test mixture are compared with the standard 2:3 (by mass), 3:2 (by mass) and 3:7 (by mass) mixtures, respectively, of potassium bromate to cellulose.

11.1.2.1.3 The test results are assessed on the basis of

a) the comparison of the mean burning time of the specimen with that of the standard mixtures, and

b) whether the mixture of specimen and cellulose ignites and burns.

11.1.2.1.4 A solid substance is classified as an oxidizing substance of division 5.1 when the test mixtures of 1:1 (by mass) or 4:1 (by mass) specimen-to-cellulose ratio exhibit a mean burning time equal to or less than that of the standard mixtures (see 11.1.2.1.2).

11.1.2.1.5 A solid substance is not regarded as an oxidizing substance of division 5.1 if both the 1:1 (by mass) and 4:1 (by mass) mixtures of specimen and cellulose do not ignite and burn, or if the mixtures exhibit mean burning times exceeding the 3:7 (by mass) standard mixture of potassium bromate and cellulose.

11.1.2.2 Assignment of packing groups

11.1.2.2.1 Packing group I

A solid substance is assigned to packing group I of division 5.1 if the 1:1 (by mass) or 4:1 (by mass) specimen-to-cellulose ratio exhibits a mean burning time less than that of the 3:2 (by mass) standard potassium bromate-to-cellulose ratio.

11.1.2.2.2 Packing group II

A solid substance is assigned to packing group II of division 5.1 if the 1:1 (by mass) or 4:1 (by mass) specimen-to-cellulose ratio exhibits a mean burning time equal to or less than that of the 2:3 (by mass) standard potassium bromate-to-cellulose ratio; and the criteria for packing group I are not complied with.

11.1.2.2.3 Packing group III

A solid substance is assigned to packing group III of division 5.1 if the 1:1 (by mass) or 4:1 (by mass) specimen-to-cellulose ratio exhibits a mean burning time equal to or less than that of the 3:7 (by mass) standard potassium bromate-to-cellulose ratio; and the criteria for packing groups I and II are not complied with.

11.1.3 Oxidizing liquids

11.1.3.1 Classification of oxidizing liquids

11.1.3.1.1 A liquid substance is classified as an oxidizing liquid of division 5.1 on the basis of its potential to increase the burning rate or burning intensity of a combustible substance, or for spontaneous ignition to occur when the liquid and the combustible substance are thoroughly mixed. The test procedure is given in A.5.1.2.

11.1.3.1.2 A liquid substance is classified as an oxidizing substance of division 5.1 when the test mixture of 1:1 (by mass) of specimen to cellulose exhibits a mean pressure rise equal to or less than that of the standard 1:1 (by mass) mixture of 65 % nitric acid and cellulose.

11.1.3.1.3 A liquid substance is not regarded as an oxidizing substance of division 5.1 if the 1:1 (by mass) mixture of specimen and cellulose exhibits a pressure rise of less than 2 070 kPa gauge pressure, or if the mixture exhibits a mean pressure rise time exceeding that of the standard 1:1 (by mass) mixture of 65 % nitric acid and cellulose.

11.1.3.1.4 Tests are conducted on the substance to be evaluated mixed with fibrous cellulose in a mixing ratio of 1:1 (by mass) of specimen to cellulose and heated in a pressure vessel. The burning characteristics of the test mixture are compared with the standard 1:1 (by mass) mixture of 50 % perchloric acid, 40 % sodium chlorate or 65 % nitric acid to cellulose , as applicable (see also 11.1.3.2).

11.1.3.1.5 The test results are assessed on the basis of

a) the mean time taken for the pressure to rise from 690 kPa to 2 070 kPa gauge pressure in comparison with that of the standard mixture, and

b) whether the mixture of specimen and cellulose spontaneously ignites.

11.1.3.2 Assignment of packing groups

11.1.3.2.1 Packing group I

A liquid substance is assigned to packing group I of division 5.1 if

a) the 1:1 (by mass) mixture of specimen and cellulose ignites spontaneously, or

b) the mean pressure rise time of the 1:1 (by mass) mixture of specimen and cellulose is less than that of a 1:1 (by mass) mixture of 50 % perchloric acid and cellulose.

11.1.3.2.2 Packing group II

A liquid substance is assigned to packing group II of division 5.1 if the 1:1 (by mass) mixture of specimen and cellulose exhibits a mean pressure rise time equal to or less than that of a 1:1 (by mass) mixture of a 40 % aqueous sodium chlorate solution and cellulose, and the criteria for packing group I are not complied with.

11.1.3.2.3 Packing group III

A liquid substance is assigned to packing group III of division 5.1 if the 1:1 (by mass) mixture of specimen and cellulose exhibits a mean pressure rise time equal to or less than that of a 1:1 (by mass) mixture of 65 % nitric acid and cellulose, and the criteria for packing groups I and II are not complied with.

11.2 Division 5.2: Organic peroxides

11.2.1 General

11.2.1.1 Organic peroxides are thermally unstable substances that can undergo exothermic decomposition at normal or at elevated temperatures. The decomposition can be initiated by heat, friction, impact or contact with impurities, for example acids, heavy metal compounds and amines. The rate of decomposition increases with a rise in temperature and can vary with different formulations of the same organic peroxide.

11.2.1.2 Organic substances that contain the bivalent –O–O– structure can be considered derivatives of hydrogen peroxide where one or both of the hydrogen atoms have been replaced by organic radicals, and are known as organic peroxides.

11.2.1.3 Most organic peroxides burn rapidly and decomposition of the substance can result in the evolution of harmful or flammable gases or vapours. For certain organic peroxides the temperature shall be controlled during transport. Some organic peroxides decompose explosively, particularly if confined (see also 11.2.2.1.2). This characteristic can be modified by the addition of diluents (see 3.1.19 and 3.1.20), or by the use of appropriate packaging (see table 8).

11.2.1.4 Contact of organic peroxides with the eyes and skin should be avoided since they can cause serious injury to the cornea even after brief contact, and they can be corrosive to the skin.

11.2.2 Classification of organic peroxides

11.2.2.1 General

11.2.2.1.1 An organic peroxide shall not be considered for classification in division 5.2 if it contains

a) 1,0 % (or less) of available oxygen derived from the organic peroxide and 1,0 % (or less) of hydrogen peroxide, or

b) 0,5 % (or less) of available oxygen derived from the organic peroxide and more than 1,0 %, but less than or equal to 7,0 % of hydrogen peroxide.

NOTE The percentage available oxygen content of an organic peroxide formulation is given by the formula

$$16 \times \Sigma(n_i \times \frac{c_i}{m_i})$$

where

n_i is the number of peroxygen groups per molecule of organic peroxide i;

c_i is the concentration in percentage by mass of organic peroxide i;

m_i is the molecular mass of organic peroxide i.

11.2.2.1.2 An organic peroxide formulation shall be regarded as possessing explosive properties when, in laboratory testing, the formulation is liable to detonate, deflagrate rapidly, or show a violent effect when heated under confinement.

11.2.2.1.3 Organic peroxides are classified into seven types according to the degree of danger they present. The types of organic peroxide range from type A, (which may not be accepted for transport in the packaging in which they have been tested) to type G, which is not subject to the provisions for organic peroxides of division 5.2. The classification of type B to type F is directly related to the maximum quantity allowed in one packaging.

11.2.2.1.4 Organic peroxides permitted for transport are listed in table 8. Organic peroxides permitted for transport in packaging are listed in packing instruction P520 (see SANS 10229-1), those permitted for transport in IBCs are listed in packing instruction IBC520 (see SANS 10233) and those permitted for transport in portable tanks are listed in tank instruction T23 (see SANS 1518). Each entry for an organic peroxide specifies the

a) type of organic peroxide (see 11.2.3),

b) physical state (liquid or solid), and

c) temperature control requirements, when required (see 11.2.4).

11.2.2.2 Mixtures of organic peroxides

Mixtures of organic peroxides can be classified under the generic entry of the most dangerous component and can be transported under the conditions of transport given for this type of peroxide (see 11.2.3). However, since two stable components can form a thermally less stable mixture, the self-accelerating decomposition temperature (SADT) of the mixture shall be determined in accordance with the procedures described in part II of the United Nations' *Manual of tests and criteria.* If necessary, the control and emergency temperatures of the mixture can be derived from the SADT (see 11.2.4.4 and table 8).

NOTE The test selected for the determination of the SADT should be conducted in such a way that it is representative of the size, material and package to be transported, handled or stored.

Table 8 — Classification and packaging of currently assigned organic peroxides

1	2	3	4	5	6	7	8	9	10	11
Organic peroxide	**Concentration** %	**Diluent type A** %	**Diluent type B** (see remark 1) %	**Inert solid** %	**Water** %	**Packing method** (see SANS 10229-1)	**Control temperature** °C	**Emergency temperature** °C	**UN No. (generic entry)**	**Remarks**
Acetyl acetone peroxide	≤ 42	≥ 48			≥ 8	OP7			3105	2
	≤ 32 as a paste					OP7			3106	20
Acetyl cyclohexanesulphonyl peroxide	≤ 82				≥ 12	OP4	−10	0	3112	3
	≤ 32		≥ 68			OP7	−10	0	3115	
tert-Amyl hydroperoxide	≤ 88	≥ 6			≥ 6	OP8			3107	
tert-Amyl peroxyacetate	≤ 62	≥ 38				OP7			3105	
tert-Amyl peroxybenzoate	≤ 100					OP5			3103	
tert-Amyl peroxy-2-ethylhexanoate	≤ 100					OP7	+20	+25	3115	
tert-Amyl peroxy-2-ethylhexyl carbonate	≤ 100					OP7			3105	
tert-Amyl peroxy isopropyl carbonate	≤ 77	≥ 23				OP5			3103	
tert-Amyl peroxyneodecanoate	≤ 77		≥ 23			OP7	0	+10	3115	
tert-Amyl peroxypivalate	≤ 77		≥ 23			OP5	+10	+15	3113	
tert-Amylperoxy-3,5,5-trimethylhexanoate	≤ 100					OP5			3101	3
tert-Butyl cumyl peroxide	> 42 — 100					OP8			3107	
	≤ 52			≥ 48		OP8			3108	
n-Butyl-4,4-di-(tert-butylperoxy)valerate	> 52 — 100					OP5			3103	
	≤ 52			≥ 48		OP8			3108	

Table 8 *(continued)*

1	2	3	4	5	6	7	8	9	10	11
Organic peroxide	**Concentration** %	**Diluent type A** %	**Diluent type B** (see remark 1) %	**Inert solid** %	**Water** %	**Packing method** (see SANS 10229-1)	**Control tempe-rature** °C	**Emergency temperature** °C	**UN No. (generic entry)**	**Remarks**
tert-Butyl hydroperoxide	> 79 — 90				≥ 10	OP5			3103	13
	≤ 80	≥ 20				OP7			3105	4, 13
	≤ 79				> 14	OP8			3107	13, 23
	≤ 72				≥ 28	OP8			3109	13
tert-Butyl hydroperoxide *and* Di-tert-butylperoxide (mixture)	< 82 *and* > 9				≥ 7	OP5			3103	13
tert-Butyl monoperoxymaleate	> 52 — 100					OP5			3102	3
	≤ 52	≥ 48				OP6			3103	
	≤ 52			≥ 48		OP8			3108	
	≤ 52 as a paste					OP8			3108	
tert-Butyl peroxyacetate	> 52 — 77	≥ 23				OP5			3101	3
	> 32 — 52	≥ 48				OP6			3103	
	≤ 32		≥ 68			OP8			3109	
tert-Butyl peroxybenzoate	> 77—100					OP5			3103	
	> 52 — 77	≥ 23				OP7			3105	
	≤ 52			≥ 48		OP7			3106	
tert-Butyl peroxybutyl fumarate	≤ 52	≥ 48				OP7			3105	
tert-Butyl peroxycrotonate	≤ 77	≥ 23				OP7			3105	
tert-Butyl peroxydiethylacetate	≤ 100					OP5	+20	+25	3113	

Table 8 *(continued)*

1	2	3	4	5	6	7	8	9	10	11
Organic peroxide	**Concentration** %	**Diluent type A** %	**Diluent type B** (see remark 1) %	**Inert solid** %	**Water** %	**Packing method** (see SANS 10229-1)	**Control temperature** °C	**Emergency temperature** °C	**UN No. (generic entry)**	**Remarks**
tert-Butyl peroxy-2-ethylhexanoate	> 52 — 100					OP6	+20	+25	3113	
	> 32 — 52		≥ 48			OP8	+30	+35	3117	
	≤ 52			≥ 48		OP8	+20	+25	3118	
	≤ 32		≥ 68			OP8	+40	+45	3119	
tert-Butyl peroxy-2-ethylhexanoate and 2,2-Di-(tert-butylperoxy)-butane (mixture)	≤ 12 and ≤ 14	≥ 14		≥ 60		OP7			3106	
	≤ 31 and ≤ 36		≥ 33			OP7	+35	+40	3115	
tert-Butyl peroxy-2-ethylhexylcarbonate	≤ 100					OP7			3105	
tert-Butyl peroxyisobutyrate	> 52 — 77		≥ 23			OP5	+15	+20	3111	3
	≤ 52		≥ 48			OP7	+15	+20	3115	
tert-Butylperoxy isopropylcarbonate	≤ 77	≥ 23				OP5			3103	
1-(2-tert-Butylperoxy isopropyl)-3-isopropenylbenzene	≤ 77	≥ 23				OP7			3105	
	≤ 42			≥ 58		OP8			3108	
tert-Butyl peroxy-2-methylbenzoate	≤ 100					OP5			3103	
tert-Butyl peroxyneodecanoate	> 77 — 100	≥ 23				OP7	−5	+5	3115	
	≤ 77		≥ 23			OP7	0	+10	3115	

Table 8 *(continued)*

1	2	3	4	5	6	7	8	9	10	11
Organic peroxide	**Concentration** %	**Diluent type A** %	**Diluent type B** (see remark 1) %	**Inert solid** %	**Water** %	**Packing method** (see SANS 10229-1)	**Control temperature** °C	**Emergency temperature** °C	**UN No. (generic entry)**	**Remarks**
tert-Butyl peroxyneodecanoate *(continued)*	≤ 52 as a stable dispersion in water					OP8	0	+10	3119	
	≤ 42 as a stable dispersion in water (frozen)					OP8	0	+10	3119	
	≤ 32	≥ 68				OP8	0	+10	3119	
tert-Butyl peroxyneoheptanoate	≤ 77	≥ 23				OP7	0	+10	3115	
	≤ 42 as a stable dispersion in water					OP8	0	+10	3117	
tert-Butyl peroxypivalate	> 67 — 77	≥ 23				OP5	0	+10	3113	
	> 27 — 67		≥ 33			OP7	0	+10	3115	
	≤ 27		≥ 73			OP8	+30	+35	3119	
tert-Butylperoxy stearylcarbonate	≤ 100					OP7			3106	
tert-Butyl peroxy-3,5,5-trimethylhexanoate	> 32 — 100					OP7			3105	
	≤ 42			≥ 58		OP7			3106	
	≤ 32		≥ 68			OP8			3109	
3-Chloroperoxybenzoic acid	> 57 — 86			≥ 14		OP1			3102	3
	≤ 57			≥ 3	≥ 40	OP7			3106	
	≤ 77			≥ 6	≥ 17	OP7			3106	

Table 8 *(continued)*

1	2	3	4	5	6	7	8	9	10	11
Organic peroxide	**Concentration** %	**Diluent type A** %	**Diluent type B** (see remark 1) %	**Inert solid** %	**Water** %	**Packing method** (see SANS 10229-1)	**Control tempe- rature** °C	**Emergency temperature** °C	**UN No. (generic entry)**	**Remarks**
Cumyl hydroperoxide	> 90 — 98	≤10				OP8			3107	13
	≤ 90	≥ 10				OP8			3109	13, 18
Cumyl peroxyneodecanoate	≤ 87		≥ 13			OP7	−10	0	3115	
	≤ 77		≥ 23			OP7	−10	0	3115	
	≤ 52 as a stable dispersion in water					OP8	−10	0	3119	
Cumyl peroxyneoheptanoate	≤ 77	≥ 23				OP7	−10	0	3115	
Cumyl peroxypivalate	≤ 77		≥ 23			OP7	−5	+5	3115	
Cyclohexanone peroxide(s)	≤ 91				≥ 9	OP6			3104	13
	≤ 72	≥ 28				OP7			3105	5
	≤ 72 as a paste					OP7			3106	5, 20
	≤ 32			≥ 68					Exempt	29
Diacetone alcohol peroxides	≤ 57		≥ 26		≥ 8	OP7	+40	+45	3115	6
Diacetyl peroxide	≤ 27		≥ 73			OP7	+20	+25	3115	7, 13
Di-tert-amyl peroxide	≤ 100					OP8			3107	
1,1-Di-(tert-amylperoxy)cyclohexane	≤ 82	≥ 18				OP6			3103	
Dibenzoyl peroxide	> 51 — 100			≤ 48		OP2			3102	3
	> 77 — 94				≥ 6	OP4			3102	3
	≤ 77				≥ 23	OP6			3104	
	≤ 62			≥ 28	≥ 10	OP7			3106	

Table 8 *(continued)*

1	2	3	4	5	6	7	8	9	10	11
Organic peroxide	**Concentration** %	**Diluent type A** %	**Diluent type B** (see remark 1) %	**Inert solid** %	**Water** %	**Packing method** (see SANS 10229-1)	**Control tempe-rature** °C	**Emergency temperature** °C	**UN No. (generic entry)**	**Remarks**
Dibenzoyl peroxide *(continued)*	> 52 — 62 as a paste					OP7			3106	20
	> 35 — 52			≥ 48		OP7			3106	
	> 36 — 42	≥ 18			≤ 40	OP8			3107	
	≤ 56,5 as a paste				≥ 15	OP8			3108	
	≤ 52 as a paste					OP8			3108	20
	≤ 42 as a stable dispersion in water					OP8			3109	
	≤ 35			≥ 65					Exempt	29
Di-(4-tert-butylcyclohexyl) peroxydicarbonate	≤ 100					OP6	+30	+35	3114	
	≤ 42 as a stable dispersion in water					OP8	+30	+35	3119	
Di-tert-butyl peroxide	> 52 — 100					OP8			3107	
	≤ 52		≥ 48			OP8			3109	25
Di-tert-butyl peroxyazelate	≤ 52	≥ 48				OP7			3105	
2,2-Di-(tert-butylperoxy)butane	≤ 52	≥ 48				OP6			3103	
1,6-Di-(tert-butylperoxycarbonyloxy) hexane	≤ 72	≥ 28				OP5			3103	

Table 8 *(continued)*

1	2	3	4	5	6	7	8	9	10	11
Organic peroxide	**Concentration** %	**Diluent type A** %	**Diluent type B** (see remark 1) %	**Inert solid** %	**Water** %	**Packing method** (see SANS 10229-1)	**Control tempe-rature** °C	**Emergency temperature** °C	**UN No. (generic entry)**	**Remarks**
1,1-Di-(tert-butylperoxy) cyclohexane	> 80 — 100					OP5			3101	3
	≤ 72		≤ 28			OP5			3103	30
	> 52 — 80	≥ 20				OP5			3103	
	> 42 — 52	≥ 48				OP7			3105	
	≤ 42	≥ 13		≥ 45		OP7			3106	
	≤ 42	≥ 58				OP8			3109	
	≤ 27	≥ 25				OP8			3107	21
	≤ 13	≥ 13	≥ 74			OP8			3109	
1,1-Di-(tert-butylperoxy)-cyclohexane and tert-butyl peroxy-2-ethylhexanoate (mixture)	≤ 43 and ≤ 16	≤ 41				OP7			3105	
Di-n-butyl peroxydicarbonate	> 27 — 52		≥ 48			OP7	−15	−5	3115	
	≤ 42 as a stable dispersion in water (frozen)					OP8	−15	−5	3118	
	≤ 27		≥ 73			OP8	−10	0	3117	
Di-sec-butyl peroxydicarbonate	> 52 — 100					OP4	−20	−10	3113	
	≤ 52		≥ 48			OP7	−15	−5	3115	
Di-(2-tert-butylperoxyisopropyl)benzene(s)	> 42 — 100			≤ 57		OP7			3106	
	≤ 42			≥ 58					Exempt	29
Di-(tert-butylperoxy) phthalate	> 42 — 52	≥ 48				OP7			3105	
	≤ 52 as a paste					OP7			3106	20
	≤ 42	≥ 58				OP8			3107	

Table 8 *(continued)*

1	2	3	4	5	6	7	8	9	10	11
Organic peroxide	**Concentration** %	**Diluent type A** %	**Diluent type B** (see remark 1) %	**Inert solid** %	**Water** %	**Packing method** (see SANS 10229-1)	**Control temperature** °C	**Emergency temperature** °C	**UN No. (generic entry)**	**Remarks**
2,2-Di-(tert-butylperoxy)propane	≤ 52	≥ 48				OP7			3105	
	≤ 42	≥ 13		≥ 45		OP7			3106	
1,1-Di-(tert-butylperoxy)-3,3,5-trimethylcyclohexane	> 90 — 100					OP5			3101	3
	> 57 — 90	≥ 10				OP5			3103	
	≤ 77		≥ 23			OP5			3103	
	≤ 57			≥ 43		OP8			3110	
	≤ 57	≥ 43				OP8			3107	
	≤ 32	≥ 26	≥ 42			OP8			3107	
Dicetyl peroxydicarbonate	≤ 100					OP7	+30	+35	3116	
	≤ 42 as a stable dispersion in water					OP8	+30	+35	3119	
Di-4-chlorobenzoyl peroxide	≤ 77				≥ 23	OP5			3102	3
	≤ 52 as a paste					OP7			3106	20
	≤ 32			≥ 68					Exempt	29
Dicumyl peroxide	> 52 — 100			≤ 57		OP8			3110	12
	≤ 52			≥ 48					Exempt	29

Table 8 *(continued)*

1	2	3	4	5	6	7	8	9	10	11
Organic peroxide	**Concentration** %	**Diluent type A** %	**Diluent type B** (see remark 1) %	**Inert solid** %	**Water** %	**Packing method** (see SANS 10229-1)	**Control tempe-rature** °C	**Emergency temperature** °C	**UN No. (generic entry)**	**Remarks**
Dicyclohexyl peroxydicarbonate	> 91 — 100					OP3	+10	+15	3112	3
	≤ 91				≥ 9	OP5	+10	+15	3114	
	≤ 42 as a stable dispersion in water					OP8	+15	+20	3119	
Didecanoyl peroxide	≤ 100					OP6	+30	+35	3114	
2,2-Di-(4,4-di (tert-butylperoxy)cyclohexyl) propane	≤ 42			≥ 58		OP7			3106	
	≤ 22		≥ 78			OP8			3107	
Di-2,4-dichlorobenzoyl peroxide	≤ 77				≥ 23	OP5			3102	3
	≤ 52 as a paste with silicon oil					OP7			3106	
Di-(2-ethoxyethyl) peroxydicarbonate	≤ 52		≥ 48			OP7	−10	0	3115	
Di-(2-ethylhexyl) peroxydicarbonate	> 77—100					OP5	−20	−10	3113	
	≤ 77		≥ 23			OP7	−15	−5	3115	
	≤ 62 as a stable dispersion in water					OP8	−15	−5	3117	
	≤ 52 as a stable dispersion in water					OP8	−15	−5	3119	

Table 8 *(continued)*

1	2	3	4	5	6	7	8	9	10	11
Organic peroxide	**Concentration** %	**Diluent type A** %	**Diluent type B** (see remark 1) %	**Inert solid** %	**Water** %	**Packing method** (see SANS 10229-1)	**Control tempe-rature** °C	**Emergency temperature** °C	**UN No. (generic entry)**	**Remarks**
Di-(2-ethylhexyl) peroxydicarbonate *(continued)*	≤ 52 as a stable dispersion in water (frozen)					OP8	-15	-5	3120	
2,2-Dihydroperoxypropane	≤ 27			≥ 73		OP5			3102	3
Di-(1-hydroxycyclohexyl) peroxide	≤ 100					OP7			3106	
Diisobutyryl peroxide	> 32 — 52		≥ 48			OP5	−20	−10	3111	3
	≤ 32		≥ 68			OP7	−20	−10	3115	
Diisopropylbenzene dihydroperoxide	≤ 82	≥ 5			≥ 5	OP7			3106	24
Diisopropyl peroxydicarbonate	> 52—100					OP2	−15	−5	3112	3
	≤ 52		≥ 48			OP7	−20	−10	3115	
	≤ 28	≥ 72				OP7	−15	−5	3115	
Dilauroyl peroxide	≤ 100					OP7			3106	
	≤ 42 as a stable dispersion in water					OP8			3109	
Di-(3-methoxybutyl) peroxydicarbonate	≤ 52		≥ 48			OP7	−5	+5	3115	
Di-(2-methylbenzoyl) peroxide	≤ 87				≥ 13	OP5	+30	+35	3112	3
Di-(3-methylbenzoyl) peroxide and Benzoyl (3-methylbenzoyl) peroxide *plus* Dibenzoyl peroxide	≤ 20 and ≤ 18 and ≤ 4		≥ 58			OP7	+35	+40	3115	
Di-(4-methylbenzoyl) peroxide	≤ 52 as a paste with silicon oil					OP7			3106	

Table 8 *(continued)*

1	2	3	4	5	6	7	8	9	10	11
Organic peroxide	**Concentration** %	**Diluent type A** %	**Diluent type B** (see remark 1) %	**Inert solid** %	**Water** %	**Packing method** (see SANS 10229-1)	**Control tempe-rature** °C	**Emergency temperature** °C	**UN No. (generic entry)**	**Remarks**
2,5-Dimethyl-2,5-di-(benzoylperoxy)hexane	> 82 — 100					OP5			3102	3
	≤ 82			≥ 18		OP7			3106	
	≤ 82				≥ 18	OP5			3104	
2,5-Dimethyl-2,5-di-(tert-butylperoxy)hexane	> 52 — 100					OP7			3105	
	≤ 77			≥ 23		OP8			3108	
	≤ 52	≥ 48				OP8			3109	
	≤ 47 as a paste					OP8			3108	
2,5-Dimethyl-2,5-di-(tert-butylperoxy)hexyne-3	> 86 — 100					OP5			3101	3
	>52 — 86	≥ 14				OP5			3103	26
	≤ 52			≥ 48		OP7			3106	
2,5-Dimethyl-2,5-di-(2-ethylhexanoylperoxy) hexane	≤ 100					OP5	+20	+25	3113	
2,5-Dimethyl-2,5-dihydroperoxyhexane	≤ 82				≥ 18	OP6			3104	
2,5-Dimethyl-2,5-di-(3,5,5-trimethylhexanoyl-peroxy)hexane	≤ 77	≥ 23				OP7			3105	
1,1-Dimethyl-3-hydroxybutyl peroxyneo-heptanoate	≤ 52	≥ 48				OP8	0	+10	3117	
Dimyristyl peroxydicarbonate	≤ 100					OP7	+20	+25	3116	
	≤ 42 as a stable dispersion in water					OP8	+20	+25	3119	
Di-(2-neodecanoylperoxyisopropyl) benzene	≤ 52	≥ 48				OP7	−10	0	3115	

Table 8 *(continued)*

1	2	3	4	5	6	7	8	9	10	11
Organic peroxide	**Concentration** %	**Diluent type A** %	**Diluent type B** (see remark 1) %	**Inert solid** %	**Water** %	**Packing method** (see SANS 10229-1)	**Control tempe-rature** °C	**Emergency temperature** °C	**UN No. (generic entry)**	**Remarks**
Di-n-nonanoyl peroxide	≤ 100					OP7	0	+10	3116	
Di-n-octanoyl peroxide	≤ 100					OP5	+10	+15	3114	
Di-(2-phenoxyethyl) peroxydicarbonate	> 85—100					OP5			3102	3
	≤ 85				≥ 15	OP7			3106	
Dipropionyl peroxide	≤ 27		≥ 73			OP8	+15	+20	3117	
Di-n-propyl peroxydicarbonate	≤ 100					OP3	−25	−15	3113	
	≤ 77		≥ 23			OP5	−20	−10	3113	
Disuccinic acid peroxide	> 72—100					OP4			3102	3, 17
	≤ 72				≥ 28	OP7	+10	+15	3116	
Di-(3,5,5-trimethylhexanoyl) peroxide	> 38—82	≥ 18				OP7	0	+10	3115	
	≤ 52 as a stable dispersion in water					OP8	+10	+15	3119	
	≤ 38	≥ 62				OP8	+20	+25	3119	
Ethyl 3,3-di-(tert-amylperoxy)butyrate	≤ 67	≥ 33				OP7			3105	
Ethyl 3,3-di-(tert-butylperoxy)butyrate	> 77 — 100					OP5			3103	
	≤ 77	≥ 23				OP7			3105	
	≤ 52			≥ 48		OP7			3106	
1-(2-Ethylhexanoylperoxy)-1,3-dimethylbutyl peroxypivalate	≤ 52	≥ 45	≥ 10			OP7	−20	−10	3115	

Table 8 *(continued)*

1	2	3	4	5	6	7	8	9	10	11
Organic peroxide	**Concentration** %	**Diluent type A** %	**Diluent type B** (see remark 1) %	**Inert solid** %	**Water** %	**Packing method** (see SANS 10229-1)	**Control tempe-rature** °C	**Emergency temperature** °C	**UN No. (generic entry)**	**Remarks**
tert-Hexyl peroxyneodecanoate	≤ 71	≥ 29				OP7	0	+10	3115	
tert-Hexyl peroxypivalate	≤ 72		≥ 28			OP7	+10	+15	3115	
3-Hydroxy-1,1-dimethylbutyl peroxyneodecanoate	≤ 77	≥ 23				OP7	−5	+5	3115	
	≤ 52	≥ 48				OP8	−5	+5	3117	
	≥ 52 as a stable dispersion in water					OP8	−5	+5	3119	
Isopropyl sec-butyl peroxydicarbonate and Di-sec-butyl peroxydicarbonate and Di-isopropyl peroxydicarbonate	≤ 32 + ≤ 15–18 ≤ 12–15	≥ 38				OP7	−20	−10	3115	
	≤ 52 and ≤ 28 and ≤ 22					OP5	−20	−10	3111	3
Isopropylcumyl hydroperoxide	≤ 72	≥ 28				OP8			3109	13
p-Menthyl hydroperoxide	> 72 — 100					OP7			3105	13
	≤ 72	≥ 28				OP8			3109	27
Methylcyclohexanone peroxide(s)	≤ 67		≥ 33			OP7	+35	+40	3115	
Methyl ethyl ketone peroxide(s)	See remark 8	≥ 48				OP5			3101	3, 8, 13
	See remark 9	≥ 55				OP7			3105	9
	See remark 10	≥ 60				OP8			3107	10
Methyl isobutyl ketone peroxide(s)	≤ 62	≥ 19				OP7			3105	22
Organic peroxide, liquid, sample						OP2			3103	11
Organic peroxide, liquid, sample, temperature controlled						OP2			3113	11
Organic peroxide, solid, sample						OP2			3104	11
Organic peroxide, solid, sample, temperature controlled						OP2			3114	11

Table 8 *(concluded)*

1	2	3	4	5	6	7	8	9	10	11
Organic peroxide	**Concentration** %	**Diluent type A** %	**Diluent type B** (see remark 1) %	**Inert solid** %	**Water** %	**Packing method** (see SANS 10229-1)	**Control tempe-rature** °C	**Emergency temperature** °C	**UN No. (generic entry)**	**Remarks**
3,3,5,7,7-PENTAMETHYL-1,2,4-TRIOXEPANE	≤ 100					OP8			3107	
Peroxyacetic acid, type D stabilized	≤ 43					OP7			3105	13, 14 19
Peroxyacetic acid, type E, stabilized	≤ 43					OP8			3107	13, 15 19
Peroxyacetic acid, type F, stabilized	≤ 43					OP8			3109	13, 16, 19
Peroxylauric acid	≤ 100					OP8	+35	+40	3118	
Pinanyl hydroperoxide	> 56—100					OP7			3105	13
	≤ 56	≥ 44				OP8			3109	
Polyether poly-tert-butylperoxycarbonate	≤ 52		≥ 48			OP8			3107	
1,1,3,3-Tetramethylbutyl hydroperoxide	≤ 100					OP7			3105	
1,1,3,3-Tetramethylbutyl peroxy-2 ethyl-hexanoate	≤ 100					OP7	+15	+20	3115	
1,1,3,3- Tetramethylbutyl peroxyneodecanoate	≤ 72		≥ 28			OP7	−5	+5	3115	
	≤ 52 as a stable dispersion in water					OP8	−5	+5	3119	
1,1,3,3-Tetramethylbutyl peroxypivalate	≤ 77	≥ 23				OP7	0	+10	3115	
3,6,9-Triethyl-3,6,9-trimethyl-1,4,7 triperoxonane	≤ 42	≥ 58				OP7			3105	28

11.2.2.3 Remarks to table 8

1 Diluent type B may always be replaced by diluent type A. The boiling point of diluent type B should be at least 60 °C higher than the SADT of the organic peroxide.

2 Available oxygen ≤ 4,7 %.

3 "EXPLOSIVE" subsidiary risk label required (see SANS 10229-1).

4 The diluent may be replaced by di-tert-butyl peroxide.

5 Available oxygen ≤ 9 %.

6 With ≤ 9 % hydrogen peroxide; available oxygen ≤ 10 %.

7 Only non-metallic packaging allowed.

8 Available oxygen > 10 % and ≤ 10,7 %, with or without water.

9 Available oxygen ≤ 10 %, with or without water.

10 Available oxygen ≤ 8,2 %, with or without water.

11 See 11.2.2.4.

12 Up to 2 000 kg per receptacle assigned to ORGANIC PEROXIDE TYPE F on the basis of large scale trials.

13 "CORROSIVE" subsidiary risk label required (see SANS 10229-1).

14 Peroxyacetic acid formulations that meet the requirements of 11.2.3.5.

15 Peroxyacetic acid formulations that meet the requirements of 11.2.3.6.

16 Peroxyacetic acid formulations that meet the requirements of 11.2.3.7.

17 Addition of water to this organic peroxide will decrease its thermal stability.

18 No "CORROSIVE" subsidiary risk label required for concentrations below 80 %.

19 Mixtures with hydrogen peroxide, water and acid(s).

20 With diluent type A, with or without water.

21 With ≥ 25 % diluent type A, by mass, and the addition of ethylbenzene.

22 With ≥ 19 % diluent type A, by mass, and the addition of methyl isobutyl ketone.

23 With < 6 % di-tert-butyl peroxide.

24 With ≤ 8 % 1-isopropylhydroperoxy-4-isopropylhydroxybenzene.

25 Diluent type B with boiling point > 110 °C.

26 With a hydroperoxides content < 0,5 %.

27 "CORROSIVE" subsidiary risk label (see SANS 10229-1) for concentrations > 56 %.

28 Available active oxygen ≤ 7,6 % in diluent type A with a 95 % boil-off point in the range of 200 °C to 260 °C.

29 Not subject to the requirements for an organic peroxide of division 5.2.

30 Diluent type B with boiling point > 130 °C.

31 Active oxygen ≤ 6,7 %.

11.2.2.4 New formulations of organic peroxides

Samples of new organic peroxides or new formulations of currently allocated organic peroxides that are not listed in table 8, for which complete test data are not available and which are to be transported for further testing or evaluation, may be assigned to one of the appropriate entries for "ORGANIC PEROXIDE TYPE C", provided that

a) the available data indicate that

   1) the substance would be less dangerous than "ORGANIC PEROXIDE TYPE B", and

   2) the control temperature, if any, is sufficiently low to prevent any dangerous decomposition and sufficiently high to prevent any dangerous phase separation, and

b) the substance is packaged in accordance with packing method OP2A or OP2B (see packing instruction P520 in SANS 10229-1) and the quantity per transport unit is limited to 10 kg.

11.2.3 Types of organic peroxides

11.2.3.1 General

Organic peroxides are classified in seven types, in accordance with the degree of danger that they present.

11.2.3.2 Type A

A type A organic peroxide formulation is one that can detonate or deflagrate rapidly when packaged for transport. Type A organic peroxides shall not be transported in that packaging under division 5.2 (see SANS 10229-1).

11.2.3.3 Type B

A type B organic peroxide formulation is one that has explosive properties and that, when packaged for transport, neither detonates nor deflagrates rapidly, but is liable to undergo a thermal explosion in the package. Type B peroxides shall bear an "EXPLOSIVE" risk label.

Such an organic peroxide can be packaged in amounts of up to 25 kg, unless the maximum quantity has to be limited to a lower amount to preclude detonation or rapid deflagration in the package.

11.2.3.4 Type C

A type C organic peroxide formulation is one that has explosive properties but is so packaged for transport that it cannot detonate or deflagrate rapidly or undergo a thermal explosion. A type C organic peroxide can be transported without an "EXPLOSIVE" subsidiary risk label provided that the mass of the substance as packaged does not exceed 50 kg.

11.2.3.5 Type D

A type D organic peroxide formulation is one that, in laboratory testing and when packaged for transport,

a) detonates partially, does not deflagrate rapidly and shows no violent effect when heated under confinement, or

b) does not detonate at all, deflagrates slowly and shows no violent effect when heated under confinement, or

c) does not detonate or deflagrate at all and shows a medium effect when heated under confinement.

Such an organic peroxide substance can be transported in packages with a capacity not exceeding 50 kg net mass.

11.2.3.6 Type E

A type E organic peroxide formulation is one that, in laboratory testing, does not detonate or deflagrate and shows little or no effect when heated under confinement.

Such an organic peroxide can be transported in packages with a capacity not exceeding 400 kg or 450 L.

11.2.3.7 Type F

A type F organic peroxide formulation is one that, in laboratory testing, does not detonate or deflagrate, shows little or no effect when heated under confinement and shows low or no explosive power.

Such an organic peroxide can be transported in intermediate bulk containers (see SANS 10233) or tanks (see SANS 1518).

11.2.3.8 Type G

A type G organic peroxide formulation is one that, in laboratory testing, does not detonate or deflagrate, shows no effect when heated under confinement and shows no explosive power.

A type G organic peroxide may be exempted from division 5.2, provided that the formulation is thermally stable, and diluent type A (see 3.1.21) is used for the desensitization of a liquid formulation. However, division 5.2 applies if the formulation is not thermally stable and when a diluent other than diluent type A is used for desensitization.

NOTE An organic peroxide is thermally stable if the SADT is 60 °C or higher when it is transported in a 50 kg package.

11.2.4 Temperature control requirements for organic peroxides

11.2.4.1 General

All organic peroxides shall be protected from direct sunlight and from all sources of heat and shall be stored in adequately ventilated areas. Certain organic peroxides may be transported only under conditions where the temperature is controlled.

11.2.4.2 Control temperature

11.2.4.2.1 The control temperature is the maximum temperature at which an organic peroxide can be safely transported, handled or stored. The requirements for the temperature of certain substances are based on the assumption that the temperature in the immediate surroundings of a package shall not exceed 50 °C during transport and shall attain this temperature for only a relatively short time during each period of 24 h.

11.2.4.2.2 Temperature control could be required if an organic peroxide that is not normally temperature controlled, is subjected to a temperature exceeding 50 °C (see table 8).

11.2.4.2.3 The following organic peroxides shall be subjected to temperature control during transport:

a) type B and type C with SADTs equal to or less than 50 °C;

b) type D that shows

1) a medium effect when heated under confinement (when tested in accordance with test series H in part II, section 28 of the United Nations' *Manual of tests and criteria*) and with a SADT equal to or less than 50 °C, or

2) a low or no effect when heated under confinement and with a SADT equal to or less than 45 °C; and

c) type E and type F with SADTs equal to or less than 45 °C.

11.2.4.3 Emergency temperature

The emergency temperature is the temperature at which there is a loss of temperature control and emergency procedures are to be implemented (see table 9).

11.2.4.4 Self-accelerating decomposition temperature (SADT)

The SADT of a substance is the lowest temperature at which self-accelerating decomposition occurs in a package presented for transport, handling and storage. The SADT is the combined effect of ambient temperature, decomposition kinetics, package size and the heat of transfer properties of the substance and its packaging. The SADT of a substance shall be determined in order to ascertain whether the substance needs to be subjected to temperature control.

Table 9 — Derivation of control and emergency temperatures

1	2	3	4
Type of packaging	**SADT**[a]	**Control temperature**	**Emergency temperature**
Single packaging and intermediate bulk containers (IBCs)[b]	≤ 20 °C	20 °C below SADT	10 °C below SADT
	> 20 °C ≤ 35 °C	15 °C below SADT	10 °C below SADT
	> 35 °C	10 °C below SADT	5 °C below SADT
Portable tanks[c]	< 50 °C	10 °C below SADT	5 °C below SADT

[a] The SADT of the substance as packaged for transport.

[b] See SANS 10229-1 and SANS 10233 respectively.

[c] See SANS 1518.

11.2.5 Test methods for organic peroxides

For classification purposes, organic peroxides shall be tested in accordance with

a) part II, section 28 of the United Nations' *Manual of tests and criteria – SADT and thermal stability,* and

b) part III, section 32.4 of the United Nations' *Manual of tests and criteria – Flammability*. Because organic peroxides can react vigorously when heated, it is recommended that the flash point be determined by using small sample sizes such as described in ISO 3679.

11.2.6 Desensitization of organic peroxides

11.2.6.1 In order to ensure safety during transport, handling and storage, organic peroxides can be desensitized by the use of diluent type A (see 3.1.21) or diluent type B (see 3.1.22). Type A diluents can be used for the desensitization of all organic peroxides and self-reactive substances. Type B diluents can only be used for the desensitization of organic peroxides, provided that the boiling point of the diluent is at least 60 °C higher than the SADT (see 11.2.4.4) in a 50 kg package. When a diluent is used, the organic peroxide shall be tested with the diluent present, in the concentration and form to be used during transport, handling and storage.

NOTE A percentage of a substance stipulated in table 8 refers to the percentage by mass, rounded off to the nearest whole number.

11.2.6.2 A diluent which can allow an organic peroxide to concentrate to a dangerous extent in the event of leakage from a package, shall not be used.

11.2.6.3 Diluents, other than diluents of type A or type B, can be added to an organic peroxide formulation, provided that they are compatible. However, if all or part of a type A or type B diluent is replaced by another diluent with different properties, the organic peroxide formulation shall be re-assessed in accordance with the acceptance procedure for division 5.2.

11.2.6.4 A compatible diluent is that liquid or solid that has no detrimental influence on the thermal stability and hazard type of an organic peroxide formulation.

11.2.6.5 Water can only be used for the desensitization of an organic peroxide if it is shown in table 8 that the substance forms a stable dispersion in water.

12 Class 6: Toxic and infectious substances

12.1 Division 6.1: Toxic substances

12.1.1 General

12.1.1.1 Toxic substances are substances that are liable to cause death or injury or to harm human health if they are swallowed, inhaled, or come into contact with the skin.

12.1.1.2 Nearly all toxic substances emit toxic gases when involved in a fire or when heated to decomposition.

12.1.1.3 Some toxic substances also present other hazards, such as flammability.

12.1.1.4 A liquid toxic substance, or a liquid in which a toxic substance of division 6.1 is suspended or dissolved, and that has a closed-cup flash point of 60 °C (or lower) is, by definition, also a flammable liquid.

12.1.1.5 A substance specified as "stabilized" shall not be transported in an unstabilized condition.

12.1.1.6 A substance that complies with the criteria of class 8 (corrosives) and has an inhalation toxicity (LC_{50}) for dusts and mists, and is consequently assigned to packing group I, shall be accepted for allocation to division 6.1 if its oral and dermal toxicities are in the range of packing group I or packing group II. Otherwise the substance shall be allocated to class 8 (see also 12.1.4.3 and 14.2.2).

12.1.2 Acute toxicity

12.1.2.1 General

For the purposes of this standard, oral ingestion, dermal contact and inhalation of dusts, mists or vapours are the routes of exposure taken into account for determining the acute toxicity properties of a substance.

12.1.2.2 LD_{50} for acute oral toxicity

The LD_{50} for acute oral toxicity, in milligrams per kilogram of body mass, is a single dose of the substance that, when administered orally, is most likely to cause the death, within 14 d, of 50 % of both male and female young adult albino test rats. The number of animals tested shall be sufficient to give a statistically significant result and the test shall comply with good laboratory practice (GLP).

NOTE GLP generally refers to a system of management controls for laboratories and research organizations to ensure the generation of high quality and reliable test data as outlined in the OECD *Principles of GLP*.

12.1.2.3 LD_{50} for acute dermal toxicity

The LD_{50} for acute dermal toxicity, in milligrams per kilogram of body mass, is that dose of the substance that, when administered by continuous contact with the bare skin of both male and female albino test rabbits for 24 h, is most likely to cause the death, within 14 d, of 50 % of the animals tested. The number of animals tested shall be sufficient to give a statistically significant result and the test shall comply with good laboratory practice.

12.1.2.4 LC_{50} for acute toxicity on inhalation

The LC_{50} for acute toxicity on inhalation, is that concentration of vapour, mist or dust that, when continuously inhaled by both male and female young adult albino test rats for 1 h, is most likely to cause the death, within 14 d, of 50 % of the animals tested. The number of animals tested shall be sufficient to give a statistically significant result and the test shall comply with good laboratory practice.

A solid substance shall be tested if at least 10 % (by mass) of its total mass is likely to occur as dust particles in a respirable range, i.e. the aerodynamic diameter of the particles available for inhalation shall not exceed 10 µm. A liquid substance shall be tested if a mist is likely to be generated in the case of leakage of the substance from the packaging during transport. If the substance under test is administered to the animals as dust or mist, more than 90 % (by mass) of the specimen particles shall be in the respirable range.

In the case of dusts and mists, the results obtained shall be expressed in milligrams per litre of air. In the case of vapours, the results obtained shall be expressed in millilitres per cubic metre of air (parts per million).

12.1.3 Classification of toxic substances

12.1.3.1 Substances are classified as toxic substances of division 6.1 based on human experience in instances of accidental poisoning and based on special properties possessed by an individual substance, such as liquid state, high volatility, any special likelihood of penetration, and special biological effects.

12.1.3.2 If no history of the poisoning of humans by a substance is available, the substance shall be classified on the basis of data obtained from animal tests.

12.1.3.3 When two or more routes of administering a substance exhibit different orders of toxicity, the highest degree of danger indicated by the animal tests shall be used for the classification of the substance.

12.1.4 Packing group assignment

12.1.4.1 Toxic substances (including pesticides) of division 6.1 are assigned to three packing groups in accordance with the degree of toxic hazard they pose during transport:

a) packing group **I** for substances and preparations that present a very severe toxicity risk;

b) packing group **II** for substances and preparations that present a serious toxicity risk; and

c) packing group **III** for substances and preparations that present a relatively low toxicity risk.

12.1.4.2 The packing group criteria for oral ingestion, dermal contact and inhalation of dusts and mists are given in table 10.

Table 10 — Packing group criteria based on oral ingestion, dermal contact and inhalation of dusts and mists

1	2	3	4
Packing group	**Oral toxicity LD_{50}** mg/kg	**Dermal toxicity LD_{50}** mg/kg	**Inhalation toxicity for dusts and mists LC_{50}** mg/L
I	≤ 5,0	≤ 50	≤ 0,2
II	> 5,0 and ≤ 50	> 50 and ≤ 200	> 0,2 and ≤ 2,0
III[a]	> 50 and ≤ 300	> 200 and ≤ 1 000	> 2,0 and ≤ 4,0

[a] Tear gas substances have been assigned to packing group II even though their toxicity data correspond to packing group III levels.

12.1.4.3 A substance that complies with the criteria of class 8, packing group **I**, and has an inhalation toxicity (LC_{50}) for dusts and mists, shall only be accepted for allocation to division 6.1 if its oral and dermal toxicities are in the range of packing group **I** or packing group **II**. Otherwise the substance shall be allocated to class 8 (see also 12.1.1.6 and 14.2.2).

12.1.4.4 The criteria for acute inhalation toxicity for dusts and mists are based on LC_{50} data relating to exposures of 1 h (see 12.1.2.4) and where such information is available it shall be used for the classification of a substance. However, where only LC_{50} data relating to exposures of 4 h are available, such values can be multiplied by four, as LC_{50} (4 h) x 4 is considered the equivalent of LC_{50} (1 h).

12.1.4.5 The criteria for acute inhalation toxicity for vapours are based on LC_{50} data relating to exposures of 1 h (see 12.1.4.6) and where such information is available it shall be used for the classification of a substance. However, where only LC_{50} data relating to exposures of 4 h are available, such values can be multiplied by two, as LC_{50} (4 h) x 2 is considered the equivalent of LC_{50} (1 h).

12.1.4.6 The packing group to which a liquid that emits toxic vapours shall be assigned can be determined as follows:

a) packing group **I**	if $V \geq 10 \times LC_{50}$ and $LC_{50} \leq 1\,000$ mL/m^3;
b) packing group **II**	if $V \geq LC_{50}$ and $LC_{50} \leq 3\,000$ mL/m^3, and the liquid does not comply with the criteria for packing group **I**; or
c) packing group **III**	if $V \geq 0{,}2 \times LC_{50}$ and $LC_{50} \leq 5\,000$ mL/m^3, and the liquid does not comply with the criteria for packing group **I** or packing group **II**.

NOTE V is the saturated vapour concentration of a liquid, in millilitres per cubic metre of air, at 20 °C, and at a standard pressure of 101,3 kPa.

12.1.4.7 The packing group criteria for substances that emit vapours which are toxic on inhalation, can also be expressed in graphical form (see figure 2) to facilitate classification. However, owing to approximations inherent in the use of graphs, substances falling on or near packing group borderlines shall be checked against numerical criteria.

12.1.4.8 Mixtures of liquids that are toxic by inhalation shall be assigned to packing groups by using the formulas given in 12.1.4.9 or by following the threshold toxicity tests given in A.6.

12.1.4.9 If the LC_{50} data are available for each toxic substance in a mixture of liquids, the packing group of such a mixture can be calculated as follows:

a) Determine the LC_{50} of the liquid mixture by using the following formula:

$$LC_{50}\,(\text{mixture}) = \frac{1}{\sum_{i=1}^{n}\left(\frac{f_i}{LC_{50i}}\right)}$$

where

LC_{50} (mixture)	is the acute inhalation toxicity, in millilitres per cubic metre;
n	is the number of toxic substances in the liquid mixture;
f_i	is the mole fraction of the i$^{\text{th}}$ substance of the liquid;
LC_{50i}	is the mean lethal concentration of the i$^{\text{th}}$ substance, in millimetres per cubic metre.

b) Determine the volatility of each substance present in the liquid mixture by using the following formula:

$$V_i = \left(\frac{P_i \times 10^6}{101{,}3}\right)$$

where

V_i	is the volatility of the i$^{\text{th}}$ substance in the liquid mixture;
P_i	is the partial pressure of the i$^{\text{th}}$ substance, in kilopascals at 20 °C and at a pressure of 101,3 kPa.

c) Calculate the ratio of the volatility R to the LC_{50} of the liquid mixture by using the following formula:

$$R = \sum_{i=1}^{n} \left(\frac{V_i}{LC_{50i}} \right)$$

where

R is the ratio of the volatility of the i^th^ substance (V_i) to the acute inhalation toxicity of the i^th^ component (LC_{50i});

d) Assign a packing group for the liquid mixture by using the calculated values for LC_{50} (see 12.1.4.9(a)) and R (see 12.1.4.9 (c)) as follows:

1) packing group **I**: $R \geq 10$ and the LC_{50}(mixture) $\leq$ 1 000 mL/m^3;

2) packing group **II**: $R \geq 1$ and the LC_{50}(mixture) $\leq$ 3 000 mL/m^3 and the liquid mixture does not comply with the criteria for packing group **I**;

3) packing group **III**: $R \geq 0{,}2$ and the LC_{50}(mixture) $\leq$ 5 000 mL/m^3 and the liquid mixture does not comply with the criteria for packing group **I** or packing group **II**.

12.1.4.10 If experimental data on the oral and dermal toxicities of a mixture are not available, the classification and packing group assignment can be calculated by means of the formulas given in 12.1.4.11 or 12.1.4.12, as applicable.

12.1.4.11 In the case of a preparation that contains only one active ingredient and the LD_{50} of that constituent is known, but reliable experimental data are unavailable on the oral and dermal toxicities of the actual mixtures intended for transport, the oral and dermal toxicities can be calculated by using the following formula:

$$LD_{50f} = \frac{LD_{50a}}{P_a} \times 100$$

where

LD_{50f} is the LD_{50} value for the formulation;

LD_{50a} is the LD_{50} value for the active ingredient;

P_a is the percentage (by mass) of active ingredient in the formulation.

12.1.4.12 There are three possible approaches to determine the oral or dermal toxicities of a preparation that contains several active ingredients. The preferred method is to obtain reliable experimental data on the acute oral and dermal toxicities of the actual mixture intended for transport. If such reliable data are not available, either of the following methods can be used:

a) classify the formulation according to the most hazardous constituent of the mixture as if that constituent were present in the same concentration as the total concentration of all the active ingredients; or

b) apply the following formula:

$$\frac{C_a}{T_a} + \frac{C_b}{T_b} + \frac{C_z}{T_z} = \frac{100}{T_m}$$

where

C is the concentrations of constituents a to z in the mixture, as a percentage (by mass);

T is the oral LD_{50} values of constituents a to z;

T_m is the oral LD_{50} value of the mixture.

NOTE The formula may also be used for dermal toxicities, provided that information is available on the same route of toxicity for all constituents. The use of this formula does not take into account any potentiation or protective phenomena.

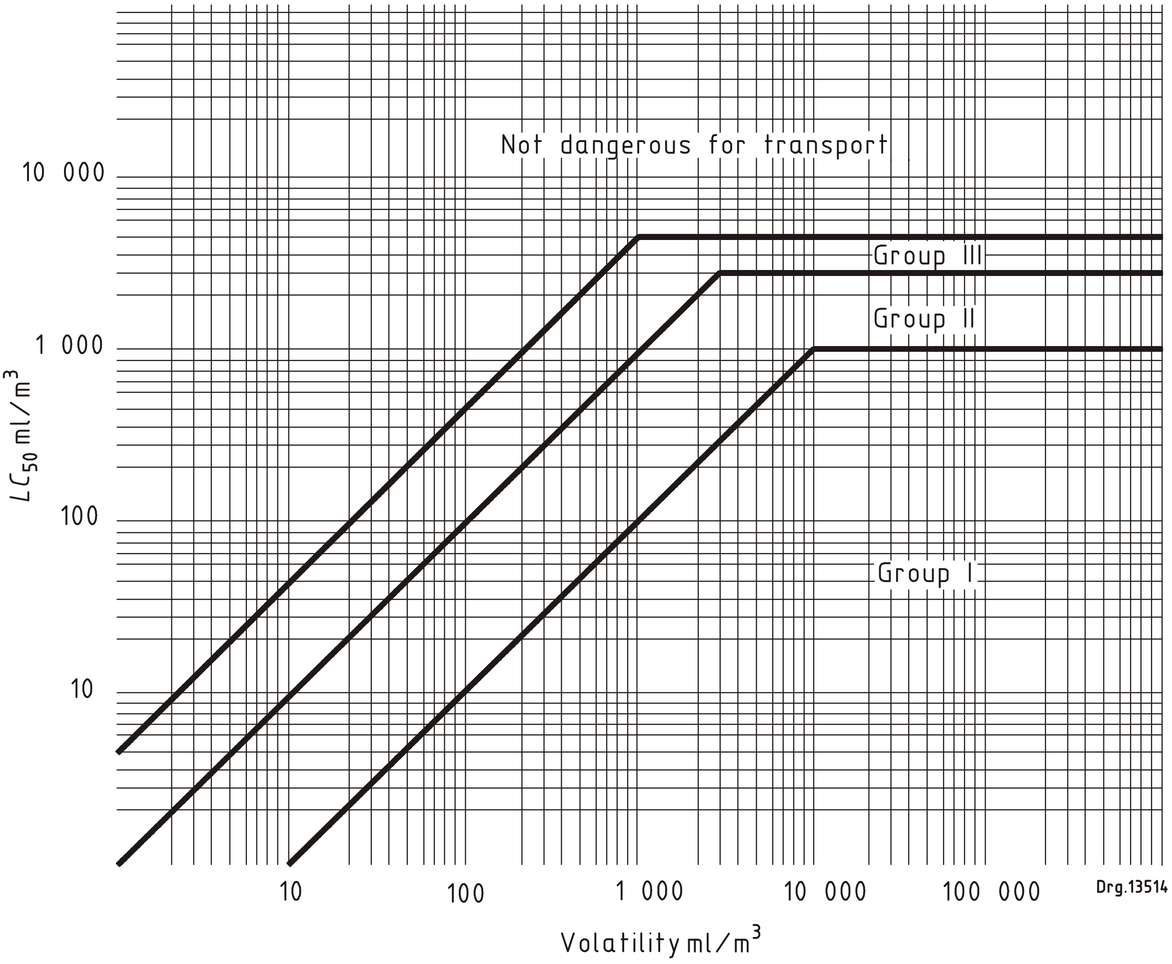


Figure 2 — Packing group borderlines for vapour inhalation toxicity

12.1.5 Classification of pesticides

12.1.5.1 Pesticides and their preparations are classified in division 6.1 in accordance with the criteria given in 12.1.1 to 12.1.4.

12.1.5.2 Pesticides and preparations which are characterized by subsidiary risks shall be classified in accordance with the precedence of hazards (see table 19) and assigned the appropriate packing groups.

12.1.5.3 If the experimental oral or dermal LD_{50} value for a pesticide preparation is not known, but the LD_{50} values of its active ingredient(s) are known, the LD_{50} value of the preparation can be obtained by the application of the formulas given in 12.1.4.11 or 12.1.4.12.

12.1.5.4 The toxicity data for a number of common pesticides (technical) are given in annex E in accordance with *The WHO recommended classification of pesticides by hazard and guidelines to classification*.

This document can be used as a source of LD_{50} data for pesticides, but its classification system shall not be used for purposes of transport classification or assignment of packing groups. Pesticides intended for transport shall be classified in accordance with the requirements of this standard.

12.1.5.5 The proper shipping name used in the transport of a pesticide shall be selected on the basis of its active ingredient, physical state and any subsidiary risks it may exhibit.

12.2 Division 6.2: Infectious substances

12.2.1 General

Infectious substances are those substances known, or reasonably expected, to contain pathogens. Pathogens are micro-organisms such as bacteria, viruses, rickettsiae, parasites or fungi, and other agents such as prions, that are known or reasonably believed to cause infectious disease in animals or humans. However, infectious substances are only subject to the requirements of division 6.2 if they are capable of spreading disease in the event of exposure to them. They are not classified as infectious substances of division 6.2 if they are unlikely to cause human or animal disease.

For the purposes of this standard, the products given in 12.2.2 to 12.2.7 (inclusive) shall be considered infectious substances.

12.2.2 Biological products

12.2.2.1 Biological products are substances derived from living organisms that are manufactured and distributed in accordance with the requirements of the competent authority. The competent authority has special licensing requirements that are used for the prevention, the diagnosis or the treatment (or both) of diseases in humans and animals and for development, and experimental or investigational purposes related thereto. The licensing requirements include, but are not limited to, finished or unfinished products such as vaccines.

12.2.2.2 For the purposes of this standard, biological products are divided into the following groups:

a) biological products that are manufactured and packaged in accordance with the requirements of the competent authority and transported for the purposes of

  1) final packaging or distribution, or

  2) use for personal healthcare by medical professionals or individuals. Substances in this group are not subject to the requirements applicable to division 6.2; and

b) biological products that do not fall under 12.2.2.2(a) but are known, or reasonably expected to contain infectious substances that meet the criteria for inclusion in category A (see table 11) or category B (see 12.2.8.3).

Substances in this group shall be classified in division 6.2 and assigned to UN 2814 or UN 2900 or UN 3373, as appropriate.

12.2.2.3 Some biological products can present a bio-hazard in certain parts of the world only. In this case the competent authority can require that these biological products comply with the requirements of infectious substances, or they can impose other restrictions.

12.2.3 Cultures

Cultures are the result of a process by which pathogens are intentionally propagated and do not include human or animal patient specimens (see 12.2.4).

12.2.4 Patient specimens

Patient specimens are human or animal material, collected directly from humans or animals and include, but are not limited to, excreta, secreta, blood and its components, tissue and tissue fluid swabs, and body parts being transported for purposes such as research, diagnosis, investigational activities, disease treatment and prevention (see also 12.2.9).

12.2.5 Genetically modified micro-organisms and organisms

12.2.5.1 For the purposes of this standard, genetically modified micro-organisms and organisms (see 3.1.28) of division 6.2 are divided into the following groups:

a) genetically modified micro-organisms and organisms that comply with the definition of an infectious substance (see 12.2.1) shall be assigned to UN 2814 or to UN 2900, as appropriate;

b) genetically modified micro-organisms and organisms that are known, or suspected, to be dangerous to humans, animals or the environment. Such substances shall be classified in division 6.2 and shall be transported in accordance with conditions specified by the competent authority; and

c) animals which contain, or are contaminated with, genetically modified micro-organisms and organisms that comply with the definition of an infectious substance. Such animals shall be transported in accordance with conditions specified by the competent authority.

12.2.5.2 Genetically modified micro-organisms and organisms that do not comply with the definition of infectious substances, but that are capable of altering animals, plants or microbiological substances in a way that does not occur naturally in normal reproduction shall be classified in class 9 and assigned to UN 3245. However, the competent authority can authorize such substances for unconditional use in which case the requirements of this standard would not apply.

12.2.6 Medical or clinical waste

12.2.6.1 Medical or clinical wastes are derived from the medical treatment of animals or humans or from bio-research.

12.2.6.2 Medical or clinical wastes that contain category A infectious substances (see 12.2.8.2 and table 11) shall be assigned to to UN 2814 or to UN 2900, as appropriate.

12.2.6.3 Medical or clinical wastes shall be assigned to UN 3291 when

a) they contain category B infectious substances (see 12.2.8.3), and

b) it can be reasonably believed that there is a low probability that they contain infectious substances.

12.2.6.4 Decontaminated medical or clinical wastes that previously contained infectious substances are considered non-dangerous, provided that they do not comply with the criteria of another hazard class.

12.2.7 Infected animals

12.2.7.1 Infectious substances are permitted to be consigned in live animals only when the substance cannot be consigned by any other means.

12.2.7.2 A live animal which has been intentionally infected and is known, or suspected, to contain an infectious substance shall only be transported under terms and conditions approved by the competent authority.

12.2.7.3 Animal carcasses affected by pathogens of category A, or pathogens that would be assigned to category A in cultures only, shall be assigned to UN 2814 or UN 2900, as appropriate.

12.2.7.4 Animal carcasses affected by pathogens of category B shall only be transported in accordance with provisions determined by the competent authority.

12.2.8 Classification of infectious substances

12.2.8.1 General

Infectious substances shall be classified in division 6.2 and assigned to UN 2814, UN 2900, UN 3291 or UN 3373, as appropriate. Infectious substances are assigned to category A or category B in accordance with 12.2.8.2 (see also table 11) and 12.2.8.3, respectively.

12.2.8.2 Category A infectious substances

12.2.8.2.1 A category A infectious substance is a substance that is transported in a form that, when exposure to it occurs, is capable of causing permanent disability, life-threatening or fatal disease in otherwise healthy humans or animals.

NOTE An exposure occurs when an infectious substance is released outside of its protective packaging resulting in physical contact with humans or animals.

12.2.8.2.2 An infectious substance that meets the criteria of a category A substance and causes disease in humans or both in humans and animals shall be assigned to UN 2814. An infectious substance that causes disease in animals only shall be assigned to UN 2900.

12.2.8.2.3 Assignment of an infectious substance to UN 2814 or UN 2900 shall be based on known medical history and symptoms of the human source or the animal source, endemic conditions, or professional judgement by a qualified medical practitioner concerning individual circumstances of the human source or animal source.

12.2.8.2.4 All patient specimens (diagnostic or clinical), including blood intended for the Blood Transfusion Service, shall be packaged and transported as a category A infectious substance if the medical history of the donor or any other source is unknown. Only after such a specimen has been tested by an accredited laboratory (see foreword) and declared free of any infectious substance, can the specimen be exempt from division 6.2 (see 12.2.9).

12.2.8.2.5 Infectious substances not listed in table 11, including new or emerging pathogens that meet the criteria of a category A infectious substance, shall be assigned to category A. In addition, if there is doubt as to whether or not a substance meets the criteria of category A, it shall nevertheless be included in category A.

Table 11 — Category A infectious substances

1	2
UN number and proper shipping name	**Micro-organism**[a]
UN 2814 INFECTIOUS SUBSTANCES, AFFECTING HUMANS	*Bacillus anthracis (cultures only)*
	Brucella abortus (cultures only)
	Brucella melitensis (cultures only)
	Brucella suis (cultures only)
	Burkholderia mallei - Pseudomonas mallei – Glanders *(cultures only)*
	Burkholderia pseudomallei – Pseudomonas pseudomallei (cultures only)
	Chlamydia psittaci - avian strains (cultures only)
	Clostridium botulinum (cultures only)
	Coccidioides immitis (cultures only)
	Coxiella burnetii (cultures only)
	Crimean-Congo haemorrhagic fever virus
	Dengue virus (cultures only)
	Eastern equine encephalitis virus (cultures only)
	Escherichia coli, verotoxigenic (cultures only)
	Ebola virus
	Flexal virus
	Guanarito virus
	Hantaan virus
	Hantaviruses causing haemorrhagic fever with renal syndrome
	Hendra virus
	Hepatitis B virus (cultures only)
	Herpes B virus (cultures only)
	Human immunodeficiency virus (cultures only)
	Highly pathogenic avian influenza virus (cultures only)
	Japanese Encephalitis virus (cultures only)
	Junin virus
	Kyasanur Forest disease virus
	Lassa virus
	Machupo virus
	Marburg virus
	Monkeypox virus
	Mycobacterium tuberculosis (cultures only)
	Nipah virus
	Omsk haemorrhagic fever virus
	Omsk haemorrhagic fever virus
	Poliovirus (cultures only)
	Rabies virus (cultures only)
	Rickettsia prowazekii (cultures only)
	Rickettsia rickettsii (cultures only)
	Rift Valley fever virus (cultures only)
	Russian spring-summer encephalitis virus (cultures only)
	Sabia virus
	Shigella dysenteriae type 1 (cultures only)
	Tick-borne encephalitis virus (cultures only)

Table 11 *(concluded)*

1	2
UN number and proper shipping name	**Micro-organism**[a]
	Variola virus
UN 2900 INFECTIOUS SUBSTANCE, AFFECTING ANIMALS only	Venezuelan equine encephalitis virus (cultures only)
	West Nile virus (cultures only)
	Yellow fever virus (cultures only)
	Yersinia pestis (cultures only)
	Lumpy skin disease virus (cultures only)
	Mycoplasma mycoides – Contagious bovine pleuropneumonia (cultures only)
	Peste des petits ruminants virus (cultures only)
	Rinderpest virus (cultures only)
	Sheep-pox virus (cultures only)
	Goatpox virus (cultures only)
	Swine vesicular disease virus (cultures only)
	Vesicular stomatitis virus (cultures only)

[a] The micro-organisms in italics are bacteria, mycoplasmas, tickettsia or fungi.

12.2.8.3 Category B infectious substances

An infectious substance that does not meet the requirements for inclusion in category A is assigned to category B and UN 3373.

12.2.9 Substances exempt from division 6.2

12.2.9.1 General

12.2.9.1.1 A substance is exempt from division 6.2 when:

a) it does not contain infectious substances;

b) it is unlikely to cause disease in humans or animals; and

c) it contains

  1) microorganisms that are non-pathogenic to humans or animals,

  2) substances in a form that any present pathogens have been neutralized or inactivated such that they no longer pose a health risk, and

  3) environmental samples (including food and water samples) that are not considered to pose a significant risk of infection.

12.2.9.1.2 Dried blood spots, collected by applying a drop of blood onto absorbent material, or faecal occult blood screening tests and blood or blood components which have been collected from the Blood Transfusion Service for the purposes of transfusion or for the preparation of blood products to be used for transfusion or any tissues or organs intended for use in transplantation are not subject to the requirements of division 6.2.

12.2.9.1.3 Human or animal specimens for which there is minimal likelihood that pathogens are present (see 12.2.9.1.4), and that are not subject to the requirements of division 6.2, shall be transported in packaging that prevents any leakage (see 12 2.9.2) and that is marked with the words “Exempt human specimen” or “Exempt animal specimen”, as appropriate.

12.2.9.1.4 Professional judgement by a qualified medical practitioner is required to determine whether a substance is exempt from division 6.2. That judgement shall be based on the known medical history, symptoms and individual circumstances of the source, human or animal, and endemic local conditions. In such a case the consignment shall be accompanied by a declaration of the said medical practitioner stating that the consignment is exempt from division 6.2.

12.2.9.1.5 Examples of specimens that may be transported as exempt from division 6.2 include blood or urine specimens to monitor cholesterol levels, blood glucose levels, hormone levels, or prostate specific antibodies (PSA); those required to monitor organ function such as heart, liver or kidney function for humans or animals with non-infectious diseases, or for therapeutic drug monitoring; those conducted for insurance or employment purposes and are intended to determine the presence of drugs or alcohol; pregnancy test; biopsies to detect cancer; and antibody detection in humans or animals.

12.2.9.2 Packaging for substances exempt from division 6.2

12.2.9.2.1 The packaging for substances exempted from division 6.2 shall consist of the following three components:

a) a leak-proof primary receptacle(s);

b) a leak-proof secondary packaging; and

c) an outer packaging of adequate strength for its capacity, mass and intended use, and with at least one surface of minimum dimensions 100 mm × 100 mm.

12.2.9.2.2 For liquid substances, absorbent material in sufficient quantity to absorb the entire contents shall be placed between the primary receptacle(s) and the secondary packaging so that, during transport, any release or leak of a liquid substance shall not reach the outer packaging and shall not compromise the integrity of the cushioning material.

12.2.9.2.3 When multiple fragile primary receptacles are placed in a single secondary packaging, they shall be either individually wrapped or shall be separated in such a manner as to prevent contact between them.

13 Class 7: Radioactive material

13.1 General

13.1.1 All radioactive substances are dangerous because the ionizing radiation emitted by them can damage body tissue and this can result, for example, in cancer or in birth defects.

13.1.2 There is no threshold for the harmful effects of ionizing radiation.

13.1.3 A background of natural ionizing radiation from cosmic and terrestrial sources is always present and it is impossible to avoid being irradiated by these sources.

13.1.4 Irradiation by the electromagnetic component of the ionizing radiation from radioactive material cannot be reduced to zero.

13.1.5 Statutory control over radioactive substances is intended to limit the irradiation which people undergo as a result of activities that involve radioactive substances to levels as low as reasonably achievable, and not exceeding set limits for members of the public and for occupationally exposed persons.

13.1.6 Internationally, radioactive material is regarded as any material that contains radionuclides, where both the activity concentration and the total activity in the consignment exceed the values given in D.1 or in table 12.

13.1.7 For the purposes of this standard, the following radioactive materials are not included in class 7:

a) radioactive material that is an integral part of the means of transport;

b) radioactive material moved within an establishment that is subject to appropriate safety regulations in force in the establishment and where the movement does not involve public roads and railways;

c) radioactive material implanted or incorporated into a person or live animal for diagnosis or treatment;

d) radioactive material in consumer products that have received regulatory approval, following their sale to the end user;

e) natural material and ore that contain naturally occurring radionuclides that are not intended to be processed for use of these radionuclides, provided the activity concentration of the material does not exceed 10 times the value given in D.1; and

f) non-radioactive solid objects with radioactive substances present on any surfaces (contaminants) in quantities not exceeding the 0,4 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters, or 0,04 Bq/cm^2 for all other alpha emitters.

NOTE Contamination that can be removed from a surface during routine conditions of transport is referred to as "non-fixed contamination". All non-fixed contaminations are referred to as "fixed contamination".

13.2 South African legislation

NOTE This subclause (13.2) is normative only when the standard is used in a South African context.

13.2.1 General

13.2.1.1 In South Africa, the total and the specific activity levels of a material which, if these levels are exceeded, shall define the material as class 7 dangerous goods, are determined by the regulatory authorities responsible for the statutory control of radioactive material and are controlled in terms of the Nuclear Energy Act, 1999 (Act No. 46 of 1999), the National Nuclear Regulator Act, 1999 (Act No. 47 of 1999) and the Hazardous Substances Act, 1973 (Act No. 15 of 1973) (as amended).

13.2.1.2 The following declarations have been made in terms of the said Nuclear Energy Act:

a) 0,2 Bq/g shall be the specific activity of each radioactive nuclide in radioactive material below which the provisions of the Act do not apply;

b) source material shall be any substance that contains

1) uranium, expressed as U_3O_8, in excess of 3 kg and 0,5 % of the mass of the substance, or

   2) thorium, expressed as ThO_2, in excess of 3 kg and 0,5 % of the mass of the substance, or

   3) uranium, depleted in the uranium-235 (U-235) nuclide, in excess of 3 kg;

c) special nuclear material shall be any substance in a quantity such that it consists of, or contains more than 0,5 g of

   1) uranium-235 (U-235), or

   2) uranium enriched in its U-235 nuclide, or

   3) any trans-uranium element;

d) at the discretion of the National Nuclear Regulator (NNR), activities that involve radioactive material intended for transport can be conducted without being subject to the requirements for obtaining nuclear authorization from the NNR (see 13.2.2.2), provided that

   1) the specific activity of the radionuclides in the material involved does not exceed 100 Bq/g, or

   2) the total radioactivity involved in a year does not exceed 10 kBq, or

   3) the radiation dose does not exceed 1 mSv per year.

13.2.1.3 The said Hazardous Substances Act defines a group IV hazardous substance as radioactive material outside a nuclear installation that does not form part of, nor is used, nor is intended to be used, in the nuclear fuel cycle, and that has

a) an activity concentration exceeding 100 Bq/g and a total activity exceeding 4 kBq, or

b) an activity concentration not exceeding 100 Bq/g and a total activity not exceeding 4 kBq, and is used, or is intended to be used for medical, scientific, agricultural, commercial or industrial purposes, and such radioactive material together with any radioactive waste that evolves from it, has been declared a group IV hazardous substance by the Minister of Health by notice in the *Government Gazette*.

13.2.2 Authorities responsible for the control of radioactive material

13.2.2.1 General

The authorities given in 13.2.2.2 to 13.2.2.4 (inclusive) are responsible for the control of radioactive material and shall be consulted for information regarding this material and matters pertaining to it.

13.2.2.2 National Nuclear Regulator (NNR)

The responsibility of the National Nuclear Regulator is to provide for the protection of persons, property and the environment against nuclear damage through the establishment of safety standards and regulatory practices, and to exercise regulatory control related to safety, by granting nuclear authorizations for

a) siting, design, construction, operation, decommissioning and closure of nuclear installations, and

b) other actions to which the National Nuclear Regulator Act, 1999 (Act No. 47 of 1999), applies, including the transport of radioactive material, for which the NNR acts as the national competent authority in terms of the International Atomic Energy Agency (IAEA), *Regulations for the safe transport of radioactive material*; and

c) the exemption of material or practices, provided that such material or practices comply with the Regulations in terms of Section 36, read with Section 47 of the National Nuclear Regulator Act, 1999 (Act No. 47 of 1999) on Safety Standards and Regulatory Practices, No. R. 338 of 28 April 2006.

13.2.2.3 Directorate: Health Technology of the Department of Health

The Directorate: Health Technology of the Department of Health has been assigned the power to grant written authority for

a) the production, acquisition, disposal, possession, use, and conveyance of any group IV hazardous substance, and

b) the importation into or exportation from South Africa of any group IV hazardous substance (see 13.2.1.4).

13.2.2.4 South African Nuclear Energy Corporation Limited (NECSA)

NECSA has been assigned the power, subject to approval by the Minister of Minerals and Energy, to

a) acquire, possess, use, dispose of, import and export source material, and special nuclear material, and

b) transport source material, special nuclear material, nuclear fuel, irradiated nuclear fuel, radioactive material and radioactive waste.

13.3 Classification of radioactive material

13.3.1 General

Radioactive material shall be assigned to one of the UN numbers given in table 12, depending on the activity level of the radionuclides contained in a package, the fissile or non-fissile properties of these radionuclides, the type of package intended for transport, (see SANS 10229-1) and the nature or form of the contents of the package, or special arrangements governing the transport operation (see 13.3.11).

Table 12 — Assignment of UN numbers

1	2	3
Material or packaging[a]	**UN number**	**Proper shipping name**
Excepted packages	1208	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE – EMPTY PACKAGING
	2909	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE – ARTICLES MANUFACTURED FROM NATURAL URANIUM or DEPLETED URANIUM or NARURAL THORIUM
	2910	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE – LIMITED QUANTITY OF MATERIAL
	2911	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE – INSTRUMENTS or ARTICLES

Table 12 *(concluded)*

1 **Material or packaging**[a]	2 **UN number**	3 **Proper shipping name**
Low specific activity radioactive material	2912	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-I), non-fissile or fissile-excepted
	3321	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-II), non-fissile or fissle-excepted
	3322	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-II), non-fissile or fissle-excepted
	3324	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-II), FISSILE
	3325	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-III), FISSILE
Surface contaminated objects	2913	RADIOACTIVE MATERIAL, SURFACE CONTAMINATED OBJECTS (SCO-I or SCO-II), non-fissile or fissile-excepted
	3326	RADIOACTIVE MATERIAL, SURFACE CONTAMINATED OBJECTS (SCO-I or SCO-II), FISSILE
Type A packages	2915	RADIOACTIVE MATERIAL, TYPE A PACKAGE, non-special form, non-fissile or fissile excepted
	3327	RADIOACTIVE MATERIAL, TYPE A PACKAGE, FISSILE, non-special form
	3332	RADIOACTIVE MATERIAL, TYPE A PACKAGE, SPECIAL FORM, non-fissile or fissile-excepted
	3333	RADIOACTIVE MATERIAL, TYPE A PACKAGE, SPECIAL FORM, FISSILE
Type B(U) packages	2916	RADIOACTIVE MATERIAL, TYPE B(U) PACKAGE, non-fissile or fissile-excepted
	3328	RADIOACTIVE MATERIAL, TYPE B(U) PACKAGE, FISSILE
Type B(M) packages	2917	RADIOACTIVE MATERIAL, TYPE B(M) PACKAGE, non-fissile or fissile-excepted
	3329	RADIOACTIVE MATERIAL, TYPE B(M) PACKAGE, FISSILE
Type C packages	3323	RADIOACTIVE MATERIAL, TYPE C PACKAGE, non-fissile or fissile-excepted
	3330	RADIOACTIVE MATERIAL, TYPE C PACKAGE, FISSILE
Special arrangement	2919	RADIOACTIVE MATERIAL, TRANSPORTED UNDER SPECIAL ARRANGEMENT, non-fissile or fissile-excepted
	3331	RADIOACTIVE MATERIAL, TRANSPORTED UNDER SPECIAL ARRANGEMENT, FISSILE
Uranium hexafluoride	2977	RADIOACTIVE MATERIAL, URANIUM FLUORIDE, FISSILE
	2978	RADIOACTIVE MATERIAL, URANIUM FLUORIDE, FISSILE, non-fissile or fissile-excepted

[a] See SANS 10229-1 for the packaging requirements.

13.3.2 Fissile material

13.3.2.1 Fissile material is uranium-233 (U-233), uranium-235 (U-235), plutonium-239 (Pu-239), plutonium-241 (Pu-241), or any combination of these radionuclides.

13.3.2.2 The following radioactive materials are excepted from the definition of fissile material:

a) natural uranium or depleted uranium which has not been irradiated; and

b) natural uranium or depleted uranium which has been irradiated in thermal reactors only.

13.3.3 Low dispersible radioactive material

The term "low dispersible radioactive material" refers to a solid radioactive material, or a solid radioactive material sealed in a capsule that has limited dispersibility and is not in powder form.

13.3.4 Low specific activity (LSA) material

13.3.4.1 Radioactive material which, by its nature, has limited specific activity, or radioactive material to which limits of estimated average specific activity apply, is termed "low specific activity (LSA) material". External shielding materials that surround the LSA material shall not be considered when the estimated average specific activity is being determined. LSA material can be classified into three groups, LSA-I, LSA-II or LSA-III as given in 13.3.4.2 to 13.3.4.4.

13.3.4.2 LSA-I radioactive material comprises

a) uranium and thorium ores and concentrates of such ores, and other ores that contain naturally occurring radionuclides which are intended to be processed for the use of these radionuclides,

b) solid unirradiated natural uranium or depleted uranium, or natural thorium, or their solid or liquid compounds or mixtures,

c) radioactive material for which the A_2 value is unlimited, excluding fissile material in quantities not excepted in accordance with the requirements of SANS 10229-1 for fissile material, or

d) other radioactive material in which the activity is distributed throughout the material and the estimated average specific activity does not exceed 30 times the value for the activity concentration as given in D.1 and table 13, excluding fissile material in quantities not excepted in accordance with the requirements of SANS 10229-1 for fissile material.

13.3.4.3 LSA-II radioactive material comprises

a) water with a tritium concentration of up to 0,8 TBq/L, or

b) other radioactive material in which the activity is distributed throughout the material and the estimated average specific activity does not exceed 10^{-4} A_2/g for solids and gases, and 10^{-5} A_2/g for liquids.

13.3.4.4 LSA-III radioactive material comprises solids, for example consolidated wastes and activated materials, excluding powders, in which

a) the radioactive material is distributed throughout a solid or a collection of solid objects, or is essentially uniformly distributed in a solid compact binding agent, such as concrete, bitumen or ceramic,

b) the radioactive material is relatively insoluble, or is intrinsically contained in a relatively insoluble matrix, so that, even under loss of packaging, the loss of radioactive material per package by leaching when placed in water for 7 d, would not exceed 0,1 A_2, and

c) the estimated average specific activity of the solid, excluding any shielding material, does not exceed 2 x 10^{-3} A_2/g.

13.3.5 Low-toxicity alpha emitters

Low-toxicity alpha emitters are natural or depleted uranium, natural thorium, U-235, U-238, Th-228, Th-230 or Th-232 contained in ores or physical and chemical concentrates, or alpha emitters with a half-life of less less than 10 d.

13.3.6 Special form radioactive material

13.3.6.1 Special form radioactive material is either

a) an indispersible solid radioactive material, or

b) a sealed capsule that contains radioactive material and is so manufactured that it can only be opened by destroying the capsule.

13.3.6.2 Special form radioactive material shall have at least one dimension of not less than 5 mm.

13.3.7 Surface contaminated objects (SCO)

13.3.7.1 A surface contaminated object (SCO) is a solid object that is not in itself radioactive, but that has radioactive material distributed on its surfaces. An SCO can be classified into two groups, i.e. SCO-I or SCO-II (see 13.3.7.2 and 13.3.7.3).

13.3.7.2 SCO-I is a solid object on which

a) the non-fixed contamination on the accessible surface, averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2), does not exceed

   1) 4 Bq/cm^2 for beta and gamma emitters and low-toxicity alpha emitters, or

   2) 0,4 Bq/cm^2 for all other alpha emitters; and

b) the fixed contamination on the accessible surface, averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2), does not exceed

   1) 4 × 10^4 Bq/cm^2 for beta and gamma emitters and low-toxicity alpha emitters, or

   2) 4 × 10^3 Bq/cm^2 for all other alpha emitters; and

c) the non-fixed contamination plus the fixed contamination (see the note to 13.1.7(f)) on the inaccessible surface, averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2), does not exceed

   1) 4 × 10^4 Bq/cm^2 for beta and gamma emitters and low-toxicity alpha emitters, or

   2) 4 × 10^3 Bq/cm^2 for all other alpha emitters.

13.3.7.3 SCO-II is a solid object on which either the fixed or non-fixed contamination on the surface exceeds the applicable limits specified for SCO-I in 13.3.7.2, and on which:

a) the non-fixed contamination on the accessible surface, averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2), does not exceed

   1) 400 Bq/cm^2 for beta and gamma emitters and low-toxicity alpha emitters, or

   2) 40 Bq/cm^2 for all other alpha emitters; and

b) the fixed contamination on the accessible surface, averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2), does not exceed

   1) 8 × 10^5 Bq/cm^2 for beta and gamma emitters and low-toxicity alpha emitters, or

   2) 8 × 10^4 Bq/cm^2 for all other alpha emitters; and

c) the non-fixed contamination plus the fixed contamination on the inaccessible surface, averaged over 300 m^2 (or the area of the surface if less than 300 cm^2), does not exceed

   1) 8 × 10^5 Bq/cm^2 for beta and gamma emitters and low-toxicity alpha emitters, or

   2) 8 × 10^4 Bq/cm^2 for all other alpha emitters.

13.3.8 Uranium hexafluoride

Uranium hexafluoride shall only be assigned to UN 2977 RADIOACTIVE MATERIAL, URANIUM HEXAFLURIDE, FISSILE, or RADIOACTIVE MATERIAL, URANUM HEXAFLUORIDE, non-fissile or fissile-excepted (see also table 12).

13.3.9 Unirradiated thorium

Unirradited thorium is thorium that contains not more than 10^{-7} g of U-233 per gram of thorium-232.

13.3.10 Unirradiated uranium

Unirradiated uranium is uranium that contains not more than 2 x 10^3 Bq of plutonium per gram of U-235, not more than 9 x10^6 of fission products per gram of U-235 and not more than 5 x 10^{-3} g of U-236 per gram of U-235

13.3.11 Natural, depleted and enriched uranium

a) natural uranium — uranium (that could be chemically separated) that contains the naturally distribution of uranium isotopes (approximately 99,28 % U-238 and 0,72 %, U-235, by mass),

b) depleted uranium — uranium that contains less U-235 than that of natural uranium, and

c) enriched uranium — uranium that contains more than 0,72 % U-235, by mass.

NOTE In all cases, a very small mass percentage of U-235 is present.

13.3.12 Special arrangements

Radioactive material shall be classified as transported under special arrangement when it does not meet all the requirements of this standard but has been approved by the competent authority.

13.4 Basic radionuclide values

13.4.1 Basic radionuclide values for individual radionuclides

13.4.1.1 The basic radionuclide values for individual radionuclides are listed in D.1, the determination of their basic radionuclide values shall require competent authority approval or, for international transport, multilateral approval. It is permissible to use the A_2 value related to its solubility class as recommended by the International Commission on Radiological Protection, provided that the chemical form under both normal and accident conditions of transport is taken into consideration.

13.4.1.3 In the case of a radionuclide not listed in D.1, a single radionuclide decay chain in which the radionuclides are present in their naturally occurring proportions, and in which no daughter nuclide has a half-life either longer than 10 d, or longer than that of the parent nuclide, shall be considered as a single radionuclide. Furthermore, the activity to be taken into account, and the A_1 and A_2 values to be applied, shall be those corresponding to the parent nuclide of that chain (also see 13.4.2.2).

13.4.2 Basic radionuclide values for unknown radionuclides or mixtures

13.4.2.1 The basic radionuclide values for unknown radionuclides or mixtures are given in table 13. Contrary to individual radionuclides (see 13.4.1.1), the basic radionuclide values for unknown radionuclides or mixtures can be used without obtaining competent authority approval.

13.4.2.2 In the case of radioactive decay chains in which any daughter nuclide has a half-life either longer than 10 d or a half-life exceeding that of the parent nuclide, the parent and such daughter nuclides shall be considered mixtures of different nuclides.

Table 13 — Basic radionuclide values for unknown radionuclides or mixtures

1	2	3	4	5
Radioactive contents	**A_1** TBq	**A_2** TBq	**Activity concentration for exempt material** Bq/g	**Activity limits for exempt consignments** Bq
Only beta or gamma emitting nuclides are known to be present	0,1	0,02	1×10^{1}	1×10^{4}
Only alpha emitting nuclides are known to be present	0,2	9×10^{-5}	1×10^{-1}	1×10^{3}
Neutron emitting nuclides are known to be present or no relevant data are available	1×10^{-3}	9×10^{-5}	1×10^{-1}	1×10^{3}

13.4.2.3 In the case of material that contains mixtures of known radionuclides (see D.1), the A_1 or A_2 value for the material can be derived by applying the following formula:

$$A_{\mathrm{m}} = \frac{1}{\sum\limits_{\mathrm{i}} \frac{g_{(\mathrm{i})}}{A_{(\mathrm{i})}}}$$

where

A_{m} is the derived value of A_1 or A_2 for the material that contains a mixture of radionuclides, in becquerels;

$g_{(\mathrm{i})}$ is the fraction of the activity of radionuclide i in the mixture;

$A_{(\mathrm{i})}$ is the appropriate value of A_1 or A_2 for the radionuclide i, in becquerels.

13.4.2.4 When the identity of each radionuclide is known but the individual activities of some of the radionuclides are not known, the radionuclides can be grouped. Groups can be based on the total alpha activity and the total beta or gamma activity when these are known, using the lowest radionuclide values for the alpha emitters or the beta or gamma emitters, respectively.

14 Class 8: Corrosives

14.1 General

Corrosive substances are solids or liquids that, by chemical action, severely damage living tissue. The leakage of such a substance from its packaging can also damage, or even destroy, other cargo or the means of transport.

14.2 Volatility and toxicity of corrosive substances

14.2.1 Many corrosive substances are sufficiently volatile to emit vapours that irritate the nose and eyes. When decomposed at very high temperatures, certain corrosive substances can emit toxic gases. In addition to acting destructively when in contact with the skin or with mucous membranes, some corrosive substances of class 8 are toxic. Poisoning can result if they are swallowed or if their vapours are inhaled, and some of them can even penetrate the skin.

14.2.2 A substance or preparation that complies with the criteria of class 8 and has an inhalation toxicity (LC_{50}) for dusts and mists in the range of packing group **I**, but toxicity through ingestion or dermal contact in the range of packing group **III**, shall be allocated to class 8 (see also 12.1.1.6 and 12.1.4.3).

14.2.3 All substances in class 8 have a more or less destructive effect on materials such as metals and textiles. Many substances in this class become corrosive only after having reacted with water or with moisture in the air. The reaction between water and many substances of class 8 is accompanied by the emission of irritating and corrosive gases. Such gases usually become visible as fumes in the air.

14.3 Packing group criteria for corrosive substances

14.3.1 The allocation of corrosive substances to packing groups has been based on experience and on additional factors such as inhalation risk, reactivity with water and the formation of dangerous decomposition products. Substances, including mixtures, are classified on the basis of the length of time of contact necessary to produce full thickness destruction of human skin tissue (see 14.3.2 and table 14). Substances that do not cause full thickness destruction of the intact skin shall still be considered as corrosive owing to their potential to corrode metal surfaces.

14.3.2 In assigning the packing group to a substance, account shall be taken of human experience in instances of accidental exposure. In the absence of human experience, the packing group shall be determined by a test conducted on the healthy intact skin of an animal in accordance with *OECD Guideline 404*. If full thickness destruction of healthy intact skin is not caused, a corrosion rate test on steel or aluminium surfaces can be performed (see section 37, part III of the United Nations' *Manual of tests and criteria*).

Table 14 — Packing groups for corrosives

1	2	3	4
Packing group	**Full thickness destruction of intact skin**		**Corrosion rate on steel or aluminium**[a] mm/year at 55 °C
	Exposure time min	**Observation period**	
I	≤ 3	≤ 1 h	–
II	> 3 ≤ 60	≤ 14 d	–
III	> 60 ≤ 240	≤ 14 d	> 6,25

[a] Suitable metals are steel, grade 240 WA of SANS 1431 (or a similar type) and aluminium, non-clad type 7075-T6 or AZ5GU-T6.

15 Class 9: Miscellaneous dangerous substances and articles

15.1 General

Dangerous substances and goods that cannot be classified into one of the other classes but are nevertheless of such dangerous character that the provisions of this standard apply to them, are classified in class 9.

The following substances are included in class 9:

a) liquids or solids that has anaesthetic, noxious or other similar properties that could cause extreme annoyance or discomfort to humans and animals;

b) magnetized material that, when packaged as for transport, has a magnetic field strength of 0,159 A/m or more at a distance of 2,1 m from any point on the surface of the assembled package;

c) miscellaneous substances and articles, for example, asbestos, dry ice, life-saving appliances, internal combustion engines, polymeric beads, battery-powered vehicles, electric wheelchairs and zinc dithionite;

d) substances at elevated temperature, i.e. liquids that are transported at a temperature of not less than 100 °C and solids that are transported at a temperature of not less than 240 °C;

e) environmentally hazardous substances (see 15.2); and

f) GMMOs or GMOs that do not meet the definition of infectious substances of division 6.2 (see 12.2), but that are capable of altering animals, plants or microbiological substances in a way not normally the result of natural reproduction. They shall be assigned to UN 3245.

NOTE GMMOs or GMOs are not subject to the requirements of this standard when authorized for use by the competent authorities of the Governments of the countries of origin, transit and destination.

15.2 Environmentally hazardous substances

15.2.1 General

15.2.1.1 For the purposes of this standard, environmentally hazardous substances are considered in terms of aquatic organisms that live in water and the aquatic ecosystem of which they are part. It does not include aquatic pollutants for which there may be a need to consider effects beyond the aquatic environment, for example the impact on human health. The basis of the identification of hazard is the aquatic toxicity of the substance or mixture, although this might be modified by further information on degradation (see 3.1.18) and bioaccumulation (see 3.1.8) behaviour.

15.2.1.2 While the classification procedure is intended to apply to all substances and mixtures, special guidance is needed for metals and poorly water-soluble inorganic compounds.

15.2.1.3 The basic elements used for the classification of environmentally hazardous substances as hazardous to the aquatic environment are:

a) acute aquatic toxicity (see 3.1.5 and 15.2.1.5);

b) bioaccumulation (see 3.1.8 and 15.2.1.6);

c) degradation (abiotic or biotic) for organic chemicals (see 3.1.1, 3.1.11, 15.2.1.7 and 15.2.1.8); and

d) chronic aquatic toxicity (see 3.1.15 and 15.2.1.9).

15.2.1.4 The toxicity data on freshwater species and marine species are considered as equivalent data for the classification of substances and mixtures as hazardous to the aquatic environment. The relevant test methods set out in the OECD Test Guidelines shall be used for the classification of a substance or a mixture in accordance with the principles of GLP. Where such data are not available, classification shall be based on the best available data.

NOTE The competent authority may approve other test methods, for example, ASTM methods, if adequate justification has been provided.

15.2.1.5 The acute toxicity shall be determined by exposing the following aquatic species to the test substance:

a) a fish population (see OECD Test Guideline 203);

b) a crustacea species (daphnia or water flea) (see OECD Test Guideline 202); or

c) an algal species (or other water plants) (see OECD Test Guideline 201).

NOTE These species are considered as surrogates for all aquatic organisms and data on other species such as Lemna may also be considered if the test methodology is suitable.

15.2.1.6 The potential for bioaccumulation can be determined by using the octanol/water partition coefficient, usually reported as a log K_{ow} and determined in accordance with OECD Test Guideline 107 or OECD Test Guideline 117. While this represents a potential to bioaccumulate, a bioconcentration factor (BCF) (see 3.1.10), determined experimentally in accordance with OECD Test Guideline 305, provides a better measure and should be used in preference when available.

15.2.1.7 Environmental degradation could be biotic or abiotic, for example, hydrolysis. Biodegradation in fresh water shall be determined by means of OECD Test Guideline 301 (A-F). A pass level is regarded as indicative of rapid degradation in most aquatic environments. However, OECD Test Guideline 306 is more suitable for the marine environment. Where such data are not available, a substance or mixture is considered readily degradable if the ratio BOD_5/COD is greater than 0,5. Abiotic degradation such as hydrolysis, primary degradation, both abiotic and biotic, degradation in non-aquatic media and proven rapid degradation in the environment may all be taken into account in defining rapid degradability.

NOTE BOD_5 is the biochemical oxygen demand over a period of 5 days.

15.2.1.8 A substance is considered rapidly degradable in the aquatic environment if the following criteria are met:

a) if, in a 28 d biodegradation study, the following levels of degradation are achieved:

   1) tests based on dissolved organic carbon: 70 %; and

   2) tests based on oxygen depletion or carbon dioxide generation: 60 % of the theoretical maxima.

   These levels of biodegradation shall be achieved within 10 d of the start of degradation, which is taken as the point at which 10 % of the substance has been degraded; or

b) the ratio BOD_5/COD is equal to or greater than 0,5 (in cases where only BOD and COD data are available); or

c) other convincing scientific evidence is available to demonstrate that the substance or mixture can be degraded biotically or abiotically (or both) in the aquatic environment to a level above 70 % within a 28 d period.

15.2.1.9 Chronic toxicity data are less available than acute toxicity data and the range of testing procedures for chronic toxicity is less standardized. However, data generated in accordance with OECD Test Guidelines 201, 210 and 211 are acceptable. The "No Observed Effect Concentrations" (NOECs) or other equivalent $L(E)C_x$ shall be used.

15.2.2 Classification criteria for substances

15.2.2.1 General

A substance shall be classified as an "environmentally hazardous substance (aquatic environment)", if it satisfies the criteria for acute category 1 and chronic categories 1 or 2 in accordance with 15.2.2.2 and 15.2.2.3.

15.2.2.2 Acute toxicity

A substance hazardous to the environment shall be assigned to acute category 1 if the following requirements are met:

a) 96 h LC_{50} (for fish) $\leq$ 1 mg/L and/or

b) 48 h EC_{50} (for crustacea) $\leq$ 1 mg/L and/or

c) 72 h or 96 h ErC_{50} (for algae or other aquatic plants) $\leq$ 1 mg/L.

15.2.2.3 Chronic toxicity

A substance hazardous to the environment shall be assigned to chronic category 1 or chronic category 2 if the requirements given in table 15 are met.

Table 15 — Classification criteria for chronic categories 1 and 2 toxicity

1	2
Chronic categories	**Classification criteria**
1	a) 96 h LC_{50} (for fish) $\leq$ 1 mg/L; and/or b) 48 h EC_{50} (for crustacea) $\leq$ 1 mg/L; and/or c) 72 h or 96 h ErC_{50} (for algae or other aquatic plants) $\leq$ 1 mg/L and the substance is not rapidly degradable; and/or d) log $K_{ow} \geq 4$ (unless the experimentally determined BCF < 500).
2	a) 96 h LC_{50} (for fish) >1 to $\leq$ 10 mg/L; and/or b) 48 h EC_{50} (for crustacea) >1 to $\leq$ 10 mg/L; and/or c) 72 h or 96 h ErC_{50} (for algae or other aquatic plants) >1 to $\leq$ 10 mg/L and the substance is not rapidly degradable; and/or d) log $K_{ow} \geq 4$ (unless the experimentally determined BCF <500), unless the chronic toxicity NOECs are > 1 mg/L.

15.2.3 Classification criteria for mixtures

15.2.3.1 General

15.2.3.1.1 Mixtures are assigned to the same classification categories as for substances, i.e. acute category 1, and chronic categories 1 and 2.

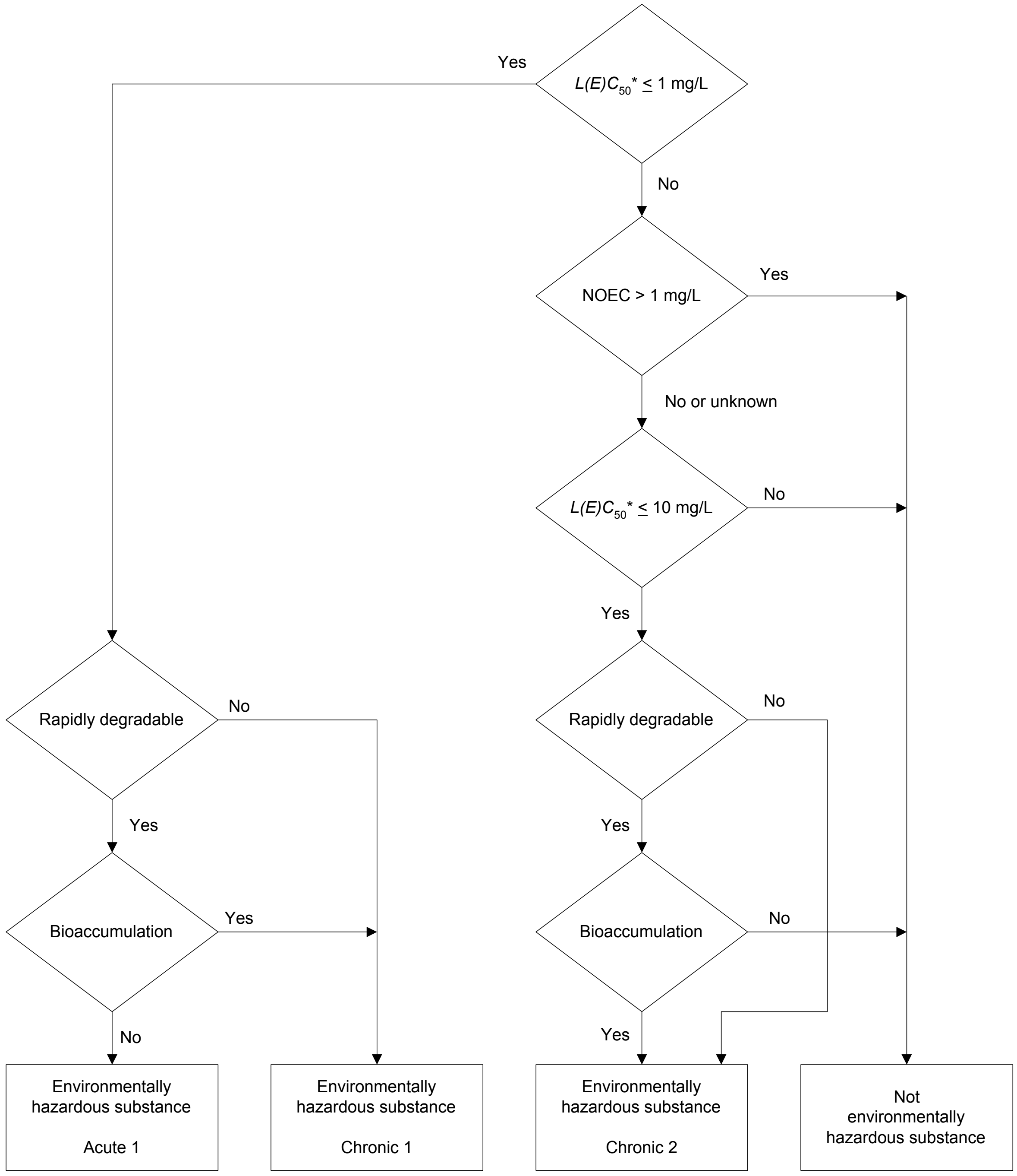
15.2.3.1.2 The “relevant components” of a mixture are those substances present in the mixture at a concentration equal to or greater than 1 % (by mass), unless there is a presumption (for example, in the case of highly toxic components) that a component present at less than 1 % (by mass), is still relevant for classification of the mixture for aquatic environmental hazards.

15.2.3.1.3 The approach for the classification of mixtures as hazardous to the aquatic environmental is tiered and is dependent upon the type of information available for the mixture itself and for its components (see figure 3). Elements of the tiered approach include:

a) classification based on tested mixtures;

b) classification based on bridging principles (see 15.2.3.3); and

c) the use of “summation of classified components” (see 15.2.3.4.2)” or an “additivity formula” (see 15.2.3.4.1.2) (or both).



NOTE* Lowest value of 96-h LC_{50}, 48-h EC_{50} or 72-h or 96-h ErC_{50}, as appropriate.

Figure 3 — Scheme of procedure for the classification of an environmentally hazardous substance or mixture

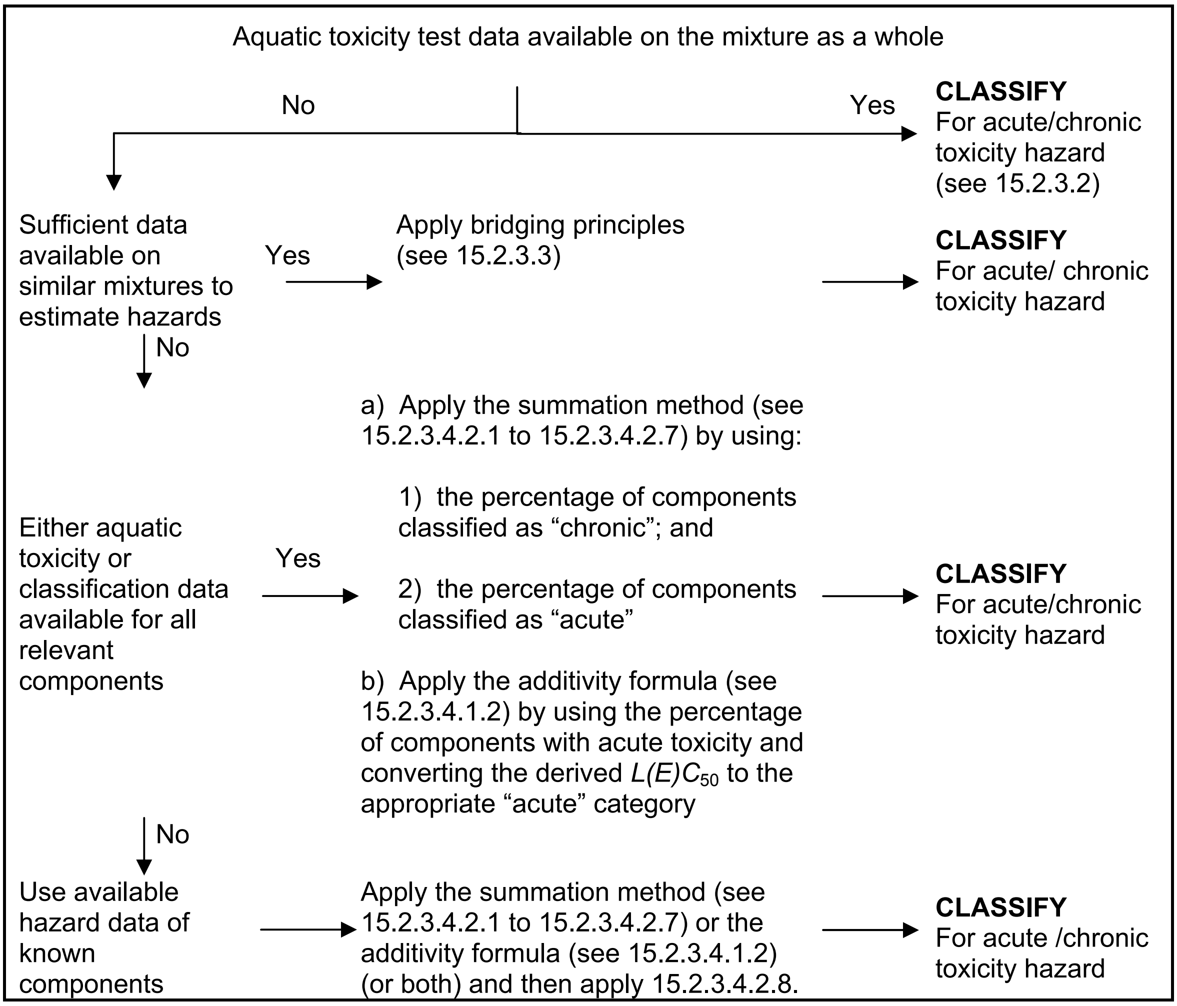


Figure 4 — Tiered approach to classification of mixtures for acute and chronic aquatic environmental hazards

15.2.3.2 Classification of mixtures when data are available for the complete mixture

15.2.3.2.1 When a mixture as a whole has been tested to determine its aquatic toxicity, it shall be classified in accordance with the acute toxicity criteria that have been agreed on for substances, based on the data for fish, crustacea and algae/plants. It is not possible to use LC_{50} or EC_{50} data for the classification of a mixture as a whole for chronic toxicity since both toxicity data and environmental fate data are needed. At present no degradability and bioaccumulation data are available for mixtures as a whole. Furthermore, it is not possible to apply the criteria for chronic classification because the data from degradability and bio-accumulation tests of mixtures cannot be interpreted; they are meaningful only for single substances.

15.2.3.2.2 The acute toxicity test data (LC_{50} or EC_{50}) for a mixture as a whole as well as information with respect to the classification of components for chronic toxicity, for example, NOEC if available, shall be used for the classification of a mixture as indicated in 15.2.3.2.3 to 15.2.3.2.6.

15.2.3.2.3 A mixture with an experimental $L(E)C_{50}$ (LC_{50} or EC_{50}) value equal to or less than 1 mg/L and an NOEC of the tested mixture equal to or less than 1,0 mg/L, or unknown, shall be classified as:

a) acute category 1; or

b) chronic categories 1 or 2 by means of the summation methods (see 15.2.3.4.2.4 to 15.2.3.4.2.7); or

c) no need for chronic classification if the mixture is not classified as chronic category 1.

15.2.3.2.4 A mixture with an experimental $L(E)C_{50}$ (LC_{50} or EC_{50}) value equal to or less than 1 mg/L and an NOEC greater than 1,0 mg/L shall be classified as:

a) acute category 1; or

b) chronic category 1 by means of the summation methods (see 15.2.3.4.2.4 to 15.2.3.4.2.7); or

c) no need for chronic classification if the mixture is not classified as chronic category 1.

15.2.3.2.5 A mixture with an experimental $\mathrm{L(E)C}_{50}$ (LC_{50} or EC_{50}) value greater than 1 mg/L, or above the water solubility, and an NOEC equal to or less than 1,0 mg/L, or unknown, shall be classified as:

a) no need to classify for acute toxicity; or

b) chronic category 2 by means of the summation methods (see 15.2.3.4.2.4 to 15.2.3.4.2.7); or

c) no need to classify for chronic toxicity if the mixture is not classified as chronic category 2.

15.2.3.2.6 A mixture with an experimental $L(E)C_{50}$ (LC_{50} or EC_{50}) greater than 1 mg/L, or above the water solubility, and an NOEC of greater than 1,0 mg/L need not be classified for acute or chronic toxicity.

15.2.3.3 Bridging principles for the classification of mixtures when data are not available for the complete mixture

15.2.3.3.1 General

Where the mixture itself has not been tested to determine its aquatic environmental hazard but there are sufficient data on the individual components and similar tested mixtures to adequately characterize the hazards of the mixture, these data shall be used in accordance with the bridging principles given in 15.2.3.3.2 to 15.2.3.3.6. This ensures that the available data are used to the greatest extent possible in characterizing the hazards of the mixture without the necessity for additional animal testing.

15.2.3.3.2 Dilution

15.2.3.3.2.1 If a mixture is formed by diluting another classified mixture or a substance with a component that has an equivalent or lower aquatic hazard classification than the least toxic original component and that is not expected to affect the aquatic hazards of other components, then the new mixture shall be classified as equivalent to the original mixture or substance.

15.2.3.3.2.2 If a mixture is formed by diluting another classified mixture or a substance with water or another non-toxic material, the toxicity of the new mixture shall be calculated from the original mixture or substance.

15.2.3.3.3 Batching

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

15.2.3.3.4 Concentration of mixtures classified as acute category 1 and chronic category 1

If a mixture is classified as acute category 1 or chronic category 1 (or both), and components of the mixture are classified as acute category 1 or chronic 1 (or both) are further concentrated, the more concentrated mixture shall be classified with the same hazard category as the original mixture without additional testing.

15.2.3.3.5 Interpolation within one toxicity category

In the case of two mixtures with identical ingredients where mixture A and mixture B are in the same classification category and mixture C contains the same toxicologically active components but at concentrations intermediate to those in mixture A and mixture B, then mixture C shall be in the same category as mixture A and mixture B.

NOTE The identity of the components is the same in all three mixtures.

15.2.3.3.6 Substantially similar mixtures

In the case of two mixtures (A + B) and (C + B) where:

a) the concentration of component B is the same in both mixtures;

b) the concentration of component A equals that of component C;

c) the classification of component A and component C are available and are the same, i.e. they are in the same hazard category and are not expected to affect the aquatic toxicity of B; and

d) mixture (A + B) has already been classified by testing,

then there shall be no need to test mixture (C + B) and both mixtures shall be classified in the same hazard category.

15.2.3.4 Classification of mixtures when data are available for all components or only for some components

15.2.3.4.1 General

15.2.3.4.1.1 The classification of a mixture is based on summation of the classification of its components. Therefore, the percentage of components classified as “acute” or “chronic” feeds straight into the summation method (see 15.2.3.4.2).

15.2.3.4.1.2 A mixture is often a combination of components that are classified as acute category 1 and chronic category 1 or chronic category 2 (or both), and components for which test data are available. When toxicity data are available for more than one component in the mixture, the combined toxicity of those components shall be calculated by using the additivity formula shown below. The calculated toxicity shall be used to assign an acute hazard category to that portion of the mixture for subsequent use in applying the summation method.

$$\frac{\sum C_i}{L(E)C_{50m}} = \sum_n \frac{C_i}{L(E)C_{50i}}$$

where

C_i is the concentration of component “i” in percentage by mass;

$L(E)C_{50i}$ is the LC_{50} or EC_{50} for component “i” in milligrams per litre;

n is the number of components, and “i” is running from 1 to n;

$L(E)C_{50m}$ is the $L(E)C_{50}$ of the part of the mixture with test data.

15.2.3.4.1.3 When the additivity formula is applied to a part of a mixture, the toxicity of this part of the mixture shall be calculated by using the toxicity values for each substance that relates to the same species (fish, daphnia or algae). The highest toxicity (lowest value) obtained, i.e. the most sensitive of the three species, shall be used for classification. However, when toxicity data for each component are not available in the same species, the toxicity value of each component shall be selected in the same manner that toxicity values are selected for the classification of substances, i.e. the higher toxicity (from the most sensitive test organism) shall be used. The calculated acute toxicity shall then be used to classify this part of the mixture as acute category 1 by using the same criteria as described for substances in 15.2.2.

15.2.3.4.1.4 If a mixture is classified by more than one method, then the method yielding the more conservative result shall be used.

15.2.3.4.2 Summation method

15.2.3.4.2.1 In general, a more severe classification for a mixture overrides a less severe classification, for example, a classification of chronic category 1 overrides a classification of chronic category 2. As a consequence, the classification is completed if the results of the classification procedure indicate chronic category 1. A more severe classification than chronic category 1 is not possible and therefore no further classification procedure is necessary.

15.2.3.4.2.2 All components of a mixture classified as acute category 1 shall be taken into account for the classification of a mixture. If the sum of these components is greater than 25 %, the mixture shall be classified as acute category 1. If the result of the calculation (see 15.2.3.4.1.2) shows a classification of the mixture as acute category 1, the classification process is complete.

15.2.3.4.2.3 The classification of a mixture for acute hazards to the aquatic environment, based on the summation of the classified components, is given in table 16.

Table 16 — Classification of mixtures for acute hazards to the aquatic environment, based on the summation of classified components

1	2
Sum of components classified as:	**Mixture classified as:**
Acute 1 × M [a] ≥ 25 %	Acute category 1
[a] See 15.2.3.4.2.7 for the explanation of factor M.	

15.2.3.4.2.4 All the components of a mixture classified as chronic category 1 shall be taken into account for the classification of the mixture for chronic toxicity. If the sum of these components is equal to or greater than 25 %, the mixture shall be classified as chronic category 1. The classification of the mixture is completed if the result of the calculation (see 15.2.3.4.1.2) shows a classification of chronic category 1.

15.2.3.4.2.5 In cases where a mixture is not classified as chronic category 1, classification of the mixture as chronic caregory 2 shall be considered. A mixture shall be classified as chronic category 2 if 10 times the sum of all components classified as chronic category 1, plus the sum of all components classified as chronic category 2 is equal to or greater than 25 %. The classification process is completed when the result of the calculation shows a classification of chronic category 2.

15.2.3.4.2.6 The classification of a mixture for chronic hazards to the aquatic environment, based on the summation of the classified components, is given in table 17.

Table 17 — Classification of a mixture for chronic hazards, based on summation of classified components

1		2
Sum of components classified as:		**Mixture classified as:**
Chronic 1 × *M* [a]	≥ 25 %	Chronic category 1
(*M* × 10 × Chronic 1) + Chronic 2	≥ 25 %	Chronic category 2
[a] See 15.2.3.4.2.7 for the explanation of factor *M*.		

15.2.3.4.2.7 Components of a mixture classified as acute category 1 and with toxicities well below 1 mg/L might influence the toxicity of the mixture and shall be given increased weight in applying the summation of classification approach. When a mixture contains components classified as acute category 1 or chronic category 1, the tiered approach (see 15.2.3.1.3 and figure 4) shall be applied using a weighted sum by multiplying the concentrations of acute category 1 components by a factor, instead of merely adding up the percentages. This means that the concentration of “Acute 1” in column 1 of table 16 and the concentration of “Chronic 1” in column 1 of table 17 are multiplied by the appropriate multiplying factor given in table 18. Therefore, in order to apply the summation method, the correct value of the factor *M* shall be used for the classification of a mixture that contains acute category 1 or chronic category 1 (or both) components. Alternatively, the additivity formula (see 15.2.3.4.1.2) may be used when toxicity data are available for all highly toxic components in the mixture and there is convincing evidence that all other components, including those for which specific acute toxicity data are not available, are of low or no toxicity and do not significantly contribute to the aquatic environmental hazard of the mixture.

Table 18 — Multiplication factors for highly toxic components of mixtures

1	2
Toxicity $L(E)C_{50}$	**Multiplication factor** (*M*)
$0,1 < L(E)C_{50} \le 1$	1
$0,01 < L(E)C_{50} \le 0,1$	10
$0,001 < L(E)C_{50} \le 0,01$	100
$0,0001 < L(E)C_{50} \le 0,001$	1 000
$0,00001 < L(E)C_{50} \le 0,0001$	10 000
(continue in factor 10 intervals)	

15.2.3.4.2.8 When no usable information on the acute or the chronic (or both) aquatic hazard is available for one or more components, the mixture cannot be attributed a definitive hazard category or categories. In such a case, classification shall be based on the known components only and with the additional statement “x percent of the mixture consists of a component or components of unknown hazards to the aquatic environment”.

15.2.3.5 Substances or mixtures dangerous to the aquatic environment not otherwise classified

15.2.3.5.1 Substances or mixtures dangerous to the aquatic environment not otherwise classified under classes 2 to 6 and class 8, shall be designated:

UN 3077 ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. or

UN 3082 ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S.

15.2.3.5.2 Environmentally hazardous substances (UN 3077 and UN 3082), shall be assigned to packing group III.

16 Classification of dangerous substances and goods not listed in this standard

16.1 General

16.1.1 B.2 and annex C list the dangerous goods most commonly transported, but these lists are not exhaustive. It is intended that the lists cover, as far as practical, all dangerous substances of commercial importance.

16.1.2 A generic or N.O.S. (not otherwise specified) entry can be used for a substance or an article that is not specifically named in this standard. The dangerous properties of the substance or article should first be determined and then it should be classified in accordance with class definitions and test criteria that cover all the subsidiary risks inherent in the substance.

16.1.3 Classification is necessary for the selection of the N.O.S. entry and the corresponding identification number that most accurately describes the substance within its class and subsidiary risk category. A substance should therefore be classified under the more accurate description rather than under a general description, for example, a flammable liquid of class 3 that is known to be an aldehyde shall be classified as *Aldehydes N.O.S.* (UN 1989) rather than as *Flammable liquids N.O.S.* (UN 1993).

16.2 Suspected explosives and substances prohibited from transport

16.2.1 Any substance or article that has or is suspected of having explosive characteristics shall first be considered for inclusion in class 1.

16.2.2 If there is any doubt about classification, packing group or UN number, the competent authority shall be consulted.

16.2.3 B.2 and annex C do not include goods that are so dangerous that their transport is prohibited. Such goods can only be transported with special authorization. Unless otherwise specified by this standard, any substance or article that is liable to explode, react dangerously, produce a flame or dangerous evolution of heat, or dangerous emission of toxic, corrosive or flammable gases or vapours under normal conditions of transport, is prohibited from transport.

16.3 Collective entries for response action

16.3.1 Practical considerations prohibit the listing of all dangerous goods by name in this standard. A generic or N.O.S. classification shall therefore be used (see 16.1, 16.2 and clause 17).

16.3.2 Because of the highly generic nature of some of these collective entries, neither the entry itself nor its corresponding UN number provides sufficient information about such dangerous goods to ensure that appropriate response action is initiated in the event of an incident. For this reason it is considered necessary to supplement the generic or N.O.S. entry with the technical name of the substance and the applicable packing group.

16.3.3 The technical name shall be shown in parentheses immediately after the proper shipping name, unless, in the case of a controlled substance, a national law or international convention prohibits its disclosure. For explosives of class I, the dangerous goods description may be supplemented by additional descriptive text to indicate commercial or military names. The technical name shall be a recognized chemical or other name currently used in scientific and technical handbooks, journals and texts. Trade names shall not be used for this purpose. In the case of pesticides, only ISO approved names, or names in *The WHO recommended classification of pesticides by hazard and guidelines to classification*, or the name(s) of the active substance(s) may be used.

Examples of a proper shipping name supplemented with the technical name of the goods for N.O.S. entries are:

UN 2902 PESTICIDE, LIQUID, TOXIC, N.O.S. (drazoxolon); and

UN 3394 ORGANOMETALLIC SUBSTANCE, LIQUID, PYROPHORIC, WATER-REACTIVE (trimethyl-gallium).

17 Classification of solutions and mixtures

17.1 A mixture or solution that contains both a dangerous substance identified by name in this standard (see B.2 and annex C) and one or more non-dangerous substance(s), shall be assigned the UN number and the proper shipping name of the dangerous substance, unless

a) the mixture or solution is specifically identified by name in this standard, or

b) the entry in this standard specifically indicates that it applies only to the pure substance, or

c) the class or division, physical state or packing group of the solution or mixture is different from that of the dangerous substance, or

d) there is significant change in the measures to be taken in emergencies.

17.2 In the case of a mixture or solution for which 17.1(b) to 17.1(d) apply, the mixture or solution shall be treated as a dangerous substance and the appropriate N.O.S. entry shall be used, including its packaging and labelling requirements.

17.3 If a mixture or solution presents more than one hazard, see clause 21 and table 19.

17.4 To each mixture and each solution relevant to clause 21, the qualifying word "solution" or "mixture", as appropriate, shall be added for correct classification.

17.5 The technical names of not more than two of the constituents that predominantly contribute to the hazards of the mixture shall be shown, excluding controlled substances when their disclosure is prohibited by national law or international convention (see also 16.3.3). If the classification shows a subsidiary risk, one of the two technical names shall be that of the constituent that compels the use of a label indicating the subsidiary risk.

18 Classification of waste

18.1 Waste of dangerous goods shall be classified in accordance with the requirements of the appropriate class or division, considering their hazards and the criteria of this standard.

18.2 Waste of dangerous goods (other than radioactive waste) shall be classified either as a single entry or as a suitable collective entry, preceded by the word "waste".

18.3 Waste not otherwise subject to the requirements of this standard, but covered by the Basel Convention, can be transported under class 9.

19 Classification of empty containers

Empty containers that have not been cleaned and containers that are not gas-free shall be classified in accordance with the class and the packing group of the dangerous substances they contained.

20 Classification of samples

20.1 When the hazard class of a substance is uncertain and it is intended for transport for further testing, a tentative hazard class, a proper shipping name and a UN number shall be assigned on the basis of the consignor's knowledge of the substance and the application of

a) the classification criteria of this standard, and

b) the precedence of hazard characteristics given in clause 21 and table 19.

20.2 The proper shipping name used shall be supplemented with the word "sample", for example "FLAMMABLE LIQUID, N.O.S. Sample". In certain cases, where a specific proper shipping name is provided for a sample of a substance considered to meet certain classification criteria, for example, GAS SAMPLE, NON-PRESSURIZED, FLAMMABLE, that proper shipping name shall be used. In the case where an N.O.S. entry is used, the proper shipping name need not be supplemented with the technical name as required by Special Provision 274 (see B.1).

20.3 A sample of a substance shall be classified in accordance with the requirements applicable to the tentative assigned proper shipping name, provided that the sample:

a) is not considered to be prohibited from transport (see 16.2.3);

b) is not considered to comply with the requirements of an explosive of class 1, an infectious substance of division 6.2 and a radioactive material of class 7;

c) is a self-reactive substance or an organic peroxide, not listed in table 7 or table 8 respectively, but available data indicate that the substance can be assigned to one of the appropriate entries for a type C self-reactive substance (see 10.1.2.4.4) or a type C organic peroxide (see 11.2.3.4);

d) is transported in a combination packaging (see SANS 10229-1) with a net mass per package not exceeding 2,5 kg; and

e) is not packaged with other goods.

21 Precedence of hazards (see table 19)

21.1 If a substance, mixture or solution is not specifically listed by name in this standard, table 17 shall be used to determine the class of a substance, mixture or solution that has more than one hazard characteristic.

21.2 In the case of goods that present multiple risks and that are not specifically listed by name, the most stringent packing group allocated to the respective hazards of the goods takes precedence over other packing groups, irrespective of the precedence given in table 19.

21.3 The precedence information given in table 19 indicates which of the hazards should be regarded as the primary risk. The class that appears at the intersection of the horizontal line and vertical column is the primary risk and the remaining class is the subsidiary risk. The packing groups for all of the risks associated with the substance, mixture or solution shall be determined by reference to the appropriate criteria (see also 21.2).

21.4 The precedence of hazard characteristics of the following substances, goods and articles is not given in table 19, since these primary risks always take precedence:

a) explosive substances and articles of class 1;

b) gases of class 2;

c) liquid desensitized explosives of class 3;

d) self-reactive substances and desensitized explosives of division 4.1;

e) pyrophoric substances of division 4.2;

f) organic peroxides of division 5.2;

g) toxic substances of division 6.1 with a packing group I inhalation toxicity (see 12.1.4.3 to 12.1.4.9 and 14.2.2);

h) infectious substances of division 6.2; and

i) radioactive material of class 7.

21.5 Apart from exempted radioactive material in excepted packages (see SANS 10229-1), where the other dangerous properties take precedence, radioactive material that presents other dangerous properties as well, shall always be classified in class 7, and the subsidiary risk shall also be identified.

Table 19 — Precedence of hazards

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Class and packing group	**4.2**	**4.3**	**5.1** **I**	**5.1** **II**	**5.1** **III**	**6.1** **I** **Dermal**	**6.1** **I** **Oral**	**6.1** **II**	**6.1** **III**	**8** **I** **Liquid**	**8** **I** **Solid**	**8** **II** **Liquid**	**8** **II** **Solid**	**8** **III** **Liquid**	**8** **III** **Solid**
3 I[a]		4.3				3	3	3	3	3	–[c]	3	–[c]	3	–[c]
3 II[a]		4.3				3	3	3	3	8	–[c]	3	–[c]	3	–[c]
3 III[a]		4.3				6.1	6.1	6.1	3[b]	8	–[c]	8	–[c]	3	–[c]
4.1 II[a]	4.2	4.3	5.1	4.1	4.1	6.1	6.1	4.1	4.1	–[c]	8	–[c]	4.1	–[c]	4.1
4.1 III[a]	4.2	4.3	5.1	4.1	4.1	6.1	6.1	6.1	4.1	–[c]	8	–[c]	8	–[c]	4.1
4.2 II		4.3	5.1	4.2	4.2	6.1	6.1	4.2	4.2	8	8	4.2	4.2	4.2	4.2
4.2 III		4.3	5.1	5.1	4.2	6.1	6.1	6.1	4.2	8	8	8	8	4.2	4.2
4.3 I			5.1	4.3	4.3	6.1	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
4.3 II			5.1	4.3	4.3	6.1	4.3	4.3	4.3	8	8	4.3	4.3	4.3	4.3
4.3 III			5.1	5.1	4.3	6.1	6.1	6.1	4.3	8	8	8	8	4.3	4.3
5.1 I						5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
5.1 II						6.1	5.1	5.1	5.1	8	8	5.1	5.1	5.1	5.1
5.1 III						6.1	6.1	6.1	5.1	8	8	8	8	5.1	5.1
6.1 I, Dermal										8	6.1	6.1	6.1	6.1	6.1
6.1 I, Oral										8	6.1	6.1	6.1	6.1	6.1
6.1 II, Inhalation										8	6.1	6.1	6.1	6.1	6.1
6.1 II, Dermal										8	6.1	8	6.1	6.1	6.1
6.1 II, Oral										8	8	8	6.1	6.1	6.1
6.1 III										8	8	8	8	8	8

NOTE For hazards not shown in this table, see clause 21.

[a] Substances of division 4.1 other than self-reactive substances and solid desensitized explosives, and substances of class 3 other than liquid desensitized explosives.

[b] For pesticides only, the primary risk is division 6.1, packing group III.

[c] Denotes an impossible combination.

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