

2.2.8 Class 8 Corrosive substances

2.2.8.1 Criteria

2.2.8.1.1 The heading of Class 8 covers substances and articles containing substances of this class which by chemical action attack epithelial tissue - of skin or mucous membranes - with which they are in contact, or which in the event of leakage are capable of damaging or destroying other goods, or means of transport. The heading of this class also covers other substances which form a corrosive liquid only in the presence of water, or which produce corrosive vapour or mist in the presence of natural moisture of the air.

2.2.8.1.2 Substances and articles of Class 8 are subdivided as follows:

C1-C11 Corrosive substances without subsidiary risk and articles containing such substances:

C1-C4	Acid substances: C1 Inorganic, liquid; C2 Inorganic, solid; C3 Organic, liquid; C4 Organic, solid;
C5-C8	Basic substances: C5 Inorganic, liquid; C6 Inorganic, solid; C7 Organic, liquid; C8 Organic, solid;
C9-C10	Other corrosive substances: C9 Liquid; C10 Solid;
C11	Articles;
CF	Corrosive substances, flammable: CF1 Liquid; CF2 Solid;
CS	Corrosive substances, self-heating: CS1 Liquid; CS2 Solid;
CW	Corrosive substances which, in contact with water, emit flammable gases: CW1 Liquid; CW2 Solid;
CO	Corrosive substances, oxidizing: CO1 Liquid; CO2 Solid;
CT	Corrosive substances, toxic and articles containing such substances: CT1 Liquid; CT2 Solid; CT3 Articles;
CFT	Corrosive substances, flammable, liquid, toxic;

COT Corrosive substances, oxidizing, toxic.

Classification and assignment of packing groups

2.2.8.1.3 Substances of Class 8 shall be classified in three packing groups according to the degree of danger they present for carriage, as follows:

Packing group I:	highly corrosive substances
Packing group II:	corrosive substances
Packing group III:	slightly corrosive substances.

2.2.8.1.4 Substances and articles classified in Class 8 are listed in Table A of Chapter 3.2. Allocation of substances to packing groups I, II and III has been made on the basis of experience taking into account such additional factors as inhalation risk (see 2.2.8.1.5) and reactivity with water (including the formation of dangerous decomposition products).

2.2.8.1.5 A substance or preparation meeting the criteria of Class 8 having an inhalation toxicity of dusts and mists (LC₅₀) in the range of packing group I, but toxicity through oral ingestion or dermal contact only in the range of packing group III or less, shall be allocated to Class 8.

2.2.8.1.6 Substances, including mixtures, not mentioned by name in Table A of Chapter 3.2 can be assigned to the relevant entry of sub-section 2.2.8.3, and to the relevant packing group on the basis of the length of time of contact necessary to produce full thickness destruction of human skin in accordance with the criteria of (a) to (c) below.

Liquids, and solids which may become liquid during carriage, which are judged not to cause full thickness destruction of human skin shall still be considered for their potential to cause corrosion to certain metal surfaces. In assigning the packing group, account shall be taken of human experience in instances of accidental exposure. In the absence of human experience, the grouping shall be based on data obtained from experiments in accordance with OECD Test Guideline 404⁷ or 435⁸. A substance which is determined not to be corrosive in accordance with OECD Test Guideline 430⁹ or 431¹⁰ may be considered not to be corrosive to skin for the purposes of ADR without further testing.

- (a) Packing group I is assigned to substances that cause full thickness destruction of intact skin tissue within an observation period up to 60 minutes starting after the exposure time of 3 minutes or less;
- (b) Packing group II is assigned to substances that cause full thickness destruction of intact skin tissue within an observation period up to 14 days starting after the exposure time of more than 3 minutes but not more than 60 minutes;
- (c) Packing group III is assigned to substances that:
 - cause full thickness destruction of intact skin tissue within an observation period up to 14 days starting after the exposure time of more than 60 minutes but not more than 4 hours; or
 - are judged not to cause full thickness destruction of intact skin tissue, but which exhibit a corrosion rate on either steel or aluminium surfaces exceeding 6.25 mm a year at a test temperature of 55 °C when tested on both materials.

⁷ OECD Guideline for the testing of chemicals No. 404 "Acute Dermal Irritation/Corrosion" 2002.

⁸ OECD Guideline for the testing of chemicals No. 435 "In Vitro Membrane Barrier Test Method for Skin Corrosion" 2006.

⁹ OECD Guideline for the testing of chemicals No. 430 "In Vitro Skin Corrosion: Transcutaneous Electrical Resistance Test (TER)" 2004.

¹⁰ OECD Guideline for the testing of chemicals No. 431 "In Vitro Skin Corrosion: Human Skin Model Test" 2004.

For the purposes of testing steel, type S235JR+CR (1.0037 resp. St 37-2), S275J2G3+CR (1.0144 resp. St 44-3), ISO 3574, Unified Numbering System (UNS) G10200 or SAE 1020, and for testing aluminium, non-clad, types 7075-T6 or AZ5GU-T6 shall be used. An acceptable test is prescribed in the Manual of Tests and Criteria, Part III, Section 37.

NOTE: Where an initial test on either steel or aluminium indicates the substance being tested is corrosive the follow up test on the other metal is not required.

Table 2.2.8.1.6: Table summarizing the criteria in 2.2.8.1.6

Packing Group	Exposure Time	Observation Period	Effect
I	≤ 3 min	≤ 60 min	Full thickness destruction of intact skin
II	> 3 min ≤ 1 h	≤ 14 d	Full thickness destruction of intact skin
III	> 1 h ≤ 4 h	≤ 14 d	Full thickness destruction of intact skin
III	-	-	Corrosion rate on either steel or aluminium surfaces exceeding 6.25 mm a year at a test temperature of 55 °C when tested on both materials

2.2.8.1.7 If substances of Class 8, as a result of admixtures, come into categories of risk different from those to which the substances mentioned by name in Table A of Chapter 3.2 belong, these mixtures or solutions shall be assigned to the entries to which they belong, on the basis of their actual degree of danger.

NOTE: For the classification of solutions and mixtures (such as preparations and wastes), see also 2.1.3.

2.2.8.1.8 On the basis of the criteria set out in paragraph 2.2.8.1.6, it may also be determined whether the nature of a solution or mixture mentioned by name or containing a substance mentioned by name is such that the solution or mixture is not subject to the provisions for this class.

2.2.8.1.9 Substances, solutions and mixtures, which

- do not meet the criteria of Directives 67/548/EEC³ or 1999/45/EC⁴ as amended and therefore are not classified as corrosive according to these directives, as amended; and
- do not exhibit a corrosive effect on steel or aluminium;

may be considered as substances not belonging to Class 8.

NOTE: UN No. 1910 calcium oxide and UN No. 2812 sodium aluminate, listed in the UN Model Regulations, are not subject to the provisions of ADR.

2.2.8.2 Substances not accepted for carriage

2.2.8.2.1 The chemically unstable substances of Class 8 shall not be accepted for carriage unless the necessary steps have been taken to prevent their dangerous decomposition or polymerization

³ Council Directive 67/548/EEC of 27 June 1967 on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances (Official Journal of the European Communities No. L 196 of 16.08.1967).

⁴ Directive 1999/45/EC of the European Parliament and of the Council of 31 May 1999 on the approximation of laws, regulations and administrative provisions of the Member States relating to the classification, packaging and labelling of dangerous preparations (Official Journal of the European Communities No. L 200 of 30 July 1999).

during carriage. To this end it shall in particular be ensured that receptacles and tanks do not contain any substance liable to promote these reactions.

2.2.8.2.2 The following substances shall not be accepted for carriage:

- UN No. 1798 NITROHYDROCHLORIC ACID;
- chemically unstable mixtures of spent sulphuric acid;
- chemically unstable mixtures of nitrating acid or mixtures of residual sulphuric and nitric acids, not denitrated;
- perchloric acid aqueous solution with more than 72% pure acid, by mass, or mixtures of perchloric acid with any liquid other than water.

2.2.8.3

List of collective entries

Corrosive substances without subsidiary risk and articles containing such substances

Acid	inorganic	liquid C1	2584 ALKYL SULPHONIC ACIDS, LIQUID with more than 5% free sulphuric acid or 2584 ARYL SULPHONIC ACIDS, LIQUID with more than 5% free sulphuric acid 2693 BISULPHITES, AQUEOUS SOLUTION, N.O.S. 2837 BISULPHATES, AQUEOUS SOLUTION 3264 CORROSIVE LIQUID, ACIDIC, INORGANIC, N.O.S.
		solid C2	1740 HYDROGEN DIFLUORIDES, SOLID, N.O.S. 2583 ALKYL SULPHONIC ACIDS, SOLID with more than 5% free sulphuric acid or 2583 ARYL SULPHONIC ACIDS, SOLID with more than 5% free sulphuric acid 3260 CORROSIVE SOLID, ACIDIC, INORGANIC, N.O.S.
	organic	liquid C3	2586 ALKYL SULPHONIC ACIDS, LIQUID with not more than 5% free sulphuric acid or 2586 ARYL SULPHONIC ACIDS, LIQUID with not more than 5% free sulphuric acid 2987 CHLOROSILANES, CORROSIVE, N.O.S. 3145 ALKYL PHENOLS, LIQUID, N.O.S. (including C ₂ -C ₁₂ homologues) 3265 CORROSIVE LIQUID, ACIDIC, ORGANIC, N.O.S.
		solid C4	2430 ALKYL PHENOLS, SOLID, N.O.S. (including C ₂ -C ₁₂ homologues) 2585 ALKYL SULPHONIC ACIDS, SOLID with not more than 5% free sulphuric acid or 2585 ARYL SULPHONIC ACIDS, SOLID with not more than 5% free sulphuric acid 3261 CORROSIVE SOLID, ACIDIC, ORGANIC, N.O.S.
Basic	inorganic	liquid C5	1719 CAUSTIC ALKALI LIQUID, N.O.S. 2797 BATTERY FLUID, ALKALI 3266 CORROSIVE LIQUID, BASIC, INORGANIC, N.O.S.
		solid C6	3262 CORROSIVE SOLID, BASIC, INORGANIC, N.O.S.
Other corrosive substances	organic	liquid C7	2735 AMINES, LIQUID, CORROSIVE, N.O.S. or 2735 POLYAMINES, LIQUID, CORROSIVE, N.O.S. 3267 CORROSIVE LIQUID, BASIC, ORGANIC, N.O.S.
		solid C8	3259 AMINES, SOLID, CORROSIVE, N.O.S., or 3259 POLYAMINES, SOLID, CORROSIVE, N.O.S. 3263 CORROSIVE SOLID, BASIC, ORGANIC, N.O.S.
	C9-C10	liquid C9	1903 DISINFECTANT, LIQUID, CORROSIVE, N.O.S. 2801 DYE, LIQUID, CORROSIVE, N.O.S. or 2801 DYE INTERMEDIATE, LIQUID, CORROSIVE, N.O.S. 3066 PAINT (including paint, enamel, stain, shellac, varnish, polish, liquid filler and lacquer base) or 3066 PAINT RELATED MATERIAL (including paint thinning or reducing compound) 1760 CORROSIVE LIQUID, N.O.S.
		solid ^a C10	3147 DYE, SOLID, CORROSIVE, N.O.S. or 3147 DYE INTERMEDIATE, SOLID, CORROSIVE, N.O.S. 3244 SOLIDS CONTAINING CORROSIVE LIQUID, N.O.S. 1759 CORROSIVE SOLID, N.O.S.
Articles		C11	2794 BATTERIES, WET, FILLED WITH ACID, electric storage 2795 BATTERIES, WET, FILLED WITH ALKALI, electric storage 2800 BATTERIES, WET, NON-SPILLABLE, electric storage 3028 BATTERIES, DRY, CONTAINING POTASSIUM HYDROXIDE SOLID, electric storage 1774 FIRE EXTINGUISHER CHARGES, corrosive liquid 2028 BOMBS, SMOKE, NON-EXPLOSIVE with corrosive liquid, without initiating device 3477 FUEL CELL CARTRIDGES containing corrosive substances, or 3477 FUEL CELL CARTRIDGES CONTAINED IN EQUIPMENT, containing corrosive substances, or 3477 FUEL CELL CARTRIDGES PACKED WITH EQUIPMENT, containing corrosive substances

^a Mixtures of solids which are not subject to the provisions of ADR and of corrosive liquids may be carried under UN No. 3244 without being subject to the classification criteria of Class 8, provided there is no free liquid visible at the time the substance is loaded or at the time the packaging, container or transport unit is closed. Each packaging shall correspond to a design type which has passed the leakproofness test for Packing group II level.

Corrosive substances with subsidiary risk(s) and articles containing such substances

(cont'd)	Flammable ^b	liquid	CF1	3470	PAINT, CORROSIVE, FLAMMABLE (including paint, enamel, stain, shellac, varnish, polish, liquid filler and lacquer base) or	
				3470	PAINT RELATED MATERIAL, CORROSIVE, FLAMMABLE (including paint thinning or reducing compound)	
				2734	AMINES, LIQUID, CORROSIVE, FLAMMABLE, N.O.S. or	
				2734	POLYAMINES, LIQUID, CORROSIVE, FLAMMABLE, N.O.S.	
				2986	CHLOROSILANES, CORROSIVE, FLAMMABLE, N.O.S.	
	CF	solid	CF2	2920	CORROSIVE LIQUID, FLAMMABLE, N.O.S.	
				2921	CORROSIVE SOLID, FLAMMABLE, N.O.S.	
	Self-heating	liquid	CS1	3301	CORROSIVE LIQUID, SELF-HEATING, N.O.S.	
				CS	solid	CS2
	Water-reactive	liquid ^b	CW1	3094		
				CW	solid	CW2
	Oxidizing	liquid	CO1			
				CO	solid	CO2
	Toxic ^d	liquid ^c	CT1			
				CT	solid ^e	CT2
	articles	CT3	2923			
			3506		MERCURY CONTAINED IN MANUFACTURED ARTICLES	
	Flammable, liquid, toxic ^d			CFT	No collective entry with this classification code available; if need be, classification under a collective entry with a classification code to be determined according to table of precedence of hazard in 2.1.3.10.	
	Oxidizing, toxic ^{d, e}			COT	No collective entry with this classification code available; if need be, classification under a collective entry with a classification code to be determined according to table of precedence of hazard in 2.1.3.10.	

^b Chlorosilanes which, in contact with water or moist air, emit flammable gases, are substances of Class 4.3.

^c Chloroformates having predominantly toxic properties are substances of Class 6.1.

^d Corrosive substances which are highly toxic by inhalation, as defined in 2.2.61.1.4 to 2.2.61.1.9 are substances of Class 6.1.

^e UN No. 2505 AMMONIUM FLUORIDE, UN No. 1812 POTASSIUM FLUORIDE, SOLID, UN No. 1690 SODIUM FLUORIDE, SOLID, UN No. 2674 SODIUM FLUOROSILICATE, UN No. 2856 FLUOROSILICATES, N.O.S., UN No. 3415 SODIUM FLUORIDE SOLUTION and UN No. 3422 POTASSIUM FLUORIDE SOLUTION are substances of Class 6.1.

2.2.9 Class 9 Miscellaneous dangerous substances and articles

2.2.9.1 Criteria

2.2.9.1.1 The heading of Class 9 covers substances and articles which, during carriage, present a danger not covered by the heading of other classes.

2.2.9.1.2 The substances and articles of Class 9 are subdivided as follows:

M1 Substances which, on inhalation as fine dust, may endanger health;

M2 Substances and apparatus which, in the event of fire, may form dioxins;

M3 Substances evolving flammable vapour;

M4 Lithium batteries;

M5 Life-saving appliances;

M6-M8 Environmentally hazardous substances:

M6 Pollutant to the aquatic environment, liquid;

M7 Pollutant to the aquatic environment, solid;

M8 Genetically modified microorganisms and organisms;

M9-M10 Elevated temperature substances:

M9 Liquid;

M10 Solid;

M11 Other substances presenting a danger during carriage, but not meeting the definitions of another class.

Definitions and classification

2.2.9.1.3 Substances and articles classified in Class 9 are listed in Table A of Chapter 3.2. The assignment of substances and articles not mentioned by name in Table A of Chapter 3.2 to the relevant entry of that Table or of sub-section 2.2.9.3 shall be done in accordance with 2.2.9.1.4 to 2.2.9.1.14 below.

Substances which, on inhalation as fine dust, may endanger health

2.2.9.1.4 Substances which, on inhalation as fine dust, may endanger health include asbestos and mixtures containing asbestos.

Substances and apparatus which, in the event of fire, may form dioxins

2.2.9.1.5 Substances and apparatus which, in the event of fire, may form dioxins include polychlorinated biphenyls (PCBs) and terphenyls (PCTs) and polyhalogenated biphenyls and terphenyls and mixtures containing these substances, as well as apparatus such as transformers, condensers and apparatus containing those substances or mixtures.

NOTE: Mixtures with a PCB or PCT content of not more than 50 mg/kg are not subject to the provisions of ADR.

Substances evolving flammable vapour

- 2.2.9.1.6 Substances evolving flammable vapour include polymers containing flammable liquids with a flash-point not exceeding 55 °C.

Lithium batteries

- 2.2.9.1.7 Cells and batteries, cells and batteries contained in equipment, or cells and batteries packed with equipment, containing lithium in any form shall be assigned to UN Nos. 3090, 3091, 3480 or 3481 as appropriate. They may be carried under these entries if they meet the following provisions:

- (a) Each cell or battery is of the type proved to meet the requirements of each test of the Manual of Tests and Criteria, Part III, sub-section 38.3;

NOTE: *Batteries shall be of a type proved to meet the testing requirements of the Manual of Tests and Criteria, part III, sub-section 38.3, irrespective of whether the cells of which they are composed are of a tested type.*

- (b) Each cell and battery incorporates a safety venting device or is designed to preclude a violent rupture under normal conditions of carriage;
- (c) Each cell and battery is equipped with an effective means of preventing external short circuits;
- (d) Each battery containing cells or series of cells connected in parallel is equipped with effective means as necessary to prevent dangerous reverse current flow (e.g., diodes, fuses, etc.);
- (e) Cells and batteries shall be manufactured under a quality management programme that includes:
- (i) A description of the organizational structure and responsibilities of personnel with regard to design and product quality;
 - (ii) The relevant inspection and test, quality control, quality assurance, and process operation instructions that will be used;
 - (iii) Process controls that should include relevant activities to prevent and detect internal short circuit failure during manufacture of cells;
 - (iv) Quality records, such as inspection reports, test data, calibration data and certificates. Test data shall be kept and made available to the competent authority upon request;
 - (v) Management reviews to ensure the effective operation of the quality management programme;
 - (vi) A process for control of documents and their revision;
 - (vii) A means for control of cells or batteries that are not conforming to the type tested as mentioned in (a) above;
 - (viii) Training programmes and qualification procedures for relevant personnel; and
 - (ix) Procedures to ensure that there is no damage to the final product.

NOTE: *In house quality management programmes may be accepted. Third party certification is not required, but the procedures listed in (i) to (ix) above shall be properly recorded and traceable. A copy of the quality management programme shall be made available to the competent authority upon request.*

Lithium batteries are not subject to the provisions of ADR if they meet the requirements of special provision 188 of Chapter 3.3.

NOTE: *The entry UN 3171 Battery-powered vehicle or UN 3171 Battery-powered equipment only applies to vehicles powered by wet batteries, sodium batteries, lithium metal batteries or lithium ion batteries and equipment powered by wet batteries or sodium batteries transported with these batteries installed.*

For the purpose of this UN number, vehicles are self-propelled apparatus designed to carry one or more persons or goods. Examples of such vehicles are electrically-powered cars, motorcycles, scooters, three- and four-wheeled vehicles or motorcycles, e-bikes, wheel-chairs, lawn tractors, boats and aircraft.

Examples of equipment are lawnmowers, cleaning machines or model boats and model aircraft. Equipment powered by lithium metal batteries or lithium ion batteries shall be consigned under the entries UN 3091 LITHIUM METAL BATTERIES CONTAINED IN EQUIPMENT or UN 3091 LITHIUM METAL BATTERIES PACKED WITH EQUIPMENT or UN 3481 LITHIUM ION BATTERIES CONTAINED IN EQUIPMENT or UN 3481 LITHIUM ION BATTERIES PACKED WITH EQUIPMENT, as appropriate.

Hybrid electric vehicles powered by both an internal combustion engine and wet batteries, sodium batteries, lithium metal batteries or lithium ion batteries, transported with the battery(ies) installed shall be classified under the entries UN 3166 vehicle, flammable gas powered or UN 3166 vehicle, flammable liquid powered, as appropriate. Vehicles which contain a fuel cell shall be classified under the entries UN 3166 vehicle, fuel cell, flammable gas powered or UN 3166 vehicle, fuel cell, flammable liquid powered, as appropriate.

Life-saving appliances

- 2.2.9.1.8 Life-saving appliances include life-saving appliances and motor vehicle components which meet the descriptions of special provisions 235 or 296 of Chapter 3.3.

Environmentally hazardous substances

- 2.2.9.1.9 *(Deleted)*

Pollutants to the aquatic environment

- 2.2.9.1.10 *Environmentally hazardous substances (aquatic environment)*

- 2.2.9.1.10.1 General definitions

- 2.2.9.1.10.1.1 Environmentally hazardous substances include, inter alia, liquid or solid substances pollutant to the aquatic environment and solutions and mixtures of such substances (such as preparations and wastes).

For the purposes of 2.2.9.1.10, "substance" means chemical elements and their compounds in the natural state or obtained by any production process, including any additive necessary to preserve the stability of the product and any impurities deriving from the process used, but excluding any solvent which may be separated without affecting the stability of the substance or changing its composition.

- 2.2.9.1.10.1.2 The aquatic environment may be considered in terms of the aquatic organisms that live in the water, and the aquatic ecosystem of which they are part¹¹. The basis, therefore, of the identification of hazard is the aquatic toxicity of the substance or mixture, although this may be modified by further information on the degradation and bioaccumulation behaviour.

¹¹ *This does not address aquatic pollutants for which there may be a need to consider effects beyond the aquatic environment such as the impacts on human health etc.*

2.2.9.1.10.1.3 While the following classification procedure is intended to apply to all substances and mixtures, it is recognised that in some cases, e.g. metals or poorly soluble inorganic compounds, special guidance will be necessary¹².

2.2.9.1.10.1.4 The following definitions apply for acronyms or terms used in this section:

- BCF: Bioconcentration Factor;
- BOD: Biochemical Oxygen Demand;
- COD: Chemical Oxygen Demand;
- GLP: Good Laboratory Practices;
- EC_x: the concentration associated with x% response;
- EC₅₀: the effective concentration of substance that causes 50% of the maximum response;
- ErC₅₀: EC₅₀ in terms of reduction of growth;
- K_{ow}: octanol/water partition coefficient;
- LC₅₀ (50% lethal concentration): the concentration of a substance in water which causes the death of 50% (one half) in a group of test animals;
- L(E)C₅₀: LC₅₀ or EC₅₀;
- NOEC (No Observed Effect Concentration): the test concentration immediately below the lowest tested concentration with statistically significant adverse effect. The NOEC has no statistically significant adverse effect compared to the control;
- OECD Test Guidelines: Test guidelines published by the Organization for Economic Cooperation and Development (OECD).

2.2.9.1.10.2 Definitions and data requirements

2.2.9.1.10.2.1 The basic elements for classification of environmentally hazardous substances (aquatic environment) are:

- (a) Acute aquatic toxicity;
- (b) Chronic aquatic toxicity;
- (c) Potential for or actual bioaccumulation; and
- (d) Degradation (biotic or abiotic) for organic chemicals.

2.2.9.1.10.2.2 While data from internationally harmonised test methods are preferred, in practice, data from national methods may also be used where they are considered as equivalent. In general, it has been agreed that freshwater and marine species toxicity data can be considered as equivalent data and are preferably to be derived using OECD Test Guidelines or equivalent according to the principles of Good Laboratory Practices (GLP). Where such data are not available, classification shall be based on the best available data.

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

Acute (short-term) hazard, for classification purposes, means the hazard of a chemical caused by its acute toxicity to an organism during short-term aquatic exposure to that chemical.

Acute aquatic toxicity shall normally be determined using a fish 96 hour LC₅₀ (OECD Test Guideline 203 or equivalent), a crustacea species 48 hour EC₅₀ (OECD Test Guideline 202 or equivalent) and/or an algal species 72 or 96 hour EC₅₀ (OECD Test Guideline 201 or equivalent). These species are considered as surrogate for all aquatic organisms and data on other species such as Lemna may also be considered if the test methodology is suitable.

¹² This can be found in Annex 10 of the GHS.

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

Long-term hazard, for classification purposes, means the hazard of a chemical caused by its chronic toxicity following long-term exposure in the aquatic environment.

Chronic toxicity data are less available than acute data and the range of testing procedures less standardised. Data generated according to the OECD Test Guidelines 210 (Fish Early Life Stage) or 211 (Daphnia Reproduction) and 201 (Algal Growth Inhibition) may be accepted. Other validated and internationally accepted tests may also be used. The NOECs or other equivalent EC_x shall be used.

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

The potential for bioaccumulation shall normally be determined by using the octanol/water partition coefficient, usually reported as a log K_{ow} determined according to OECD Test Guideline 107 or 117. While this represents a potential to bioaccumulate, an experimentally determined Bioconcentration Factor (BCF) provides a better measure and shall be used in preference when available. A BCF shall be determined according to OECD Test Guideline 305.

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

Environmental degradation may be biotic or abiotic (e.g. hydrolysis) and the criteria used reflect this fact. Ready biodegradation is most easily defined using the biodegradability tests (A-F) of OECD Test Guideline 301. A pass level in these tests may be considered as indicative of rapid degradation in most environments. These are freshwater tests and thus the use of the results from OECD Test Guideline 306, which is more suitable for marine environments, has also been included. Where such data are not available, a BOD(5 days)/COD ratio ≥ 0.5 is considered as indicative of rapid degradation.

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 considered in defining rapid degradability¹³.

Substances are considered rapidly degradable in the environment if the following criteria are met:

- (a) In 28-day ready biodegradation studies, the following levels of degradation are achieved:
 - (i) Tests based on dissolved organic carbon: 70%;
 - (ii) Tests based on oxygen depletion or carbon dioxide generation: 60% of theoretical maxima;

These levels of biodegradation shall be achieved within 10 days of the start of degradation which point is taken as the time when 10% of the substance has been degraded", unless the substance is identified as a complex, multi-component substance with structurally similar constituents. In this case, and where there is

¹³ Special guidance on data interpretation is provided in Chapter 4.1 and Annex 9 of the GHS.

sufficient justification, the 10-day window condition may be waived and the pass level applied at 28 days¹⁴; or

- (b) In those cases where only BOD and COD data are available, when the ratio of BOD5/COD is ≥ 0.5 ; or
- (c) If other convincing scientific evidence is available to demonstrate that the substance or mixture can be degraded (biotically and/or abiotically) in the aquatic environment to a level above 70% within a 28 day period.

2.2.9.1.10.3 Substance classification categories and criteria

2.2.9.1.10.3.1 Substances shall be classified as "environmentally hazardous substances (aquatic environment)", if they satisfy the criteria for Acute 1, Chronic 1 or Chronic 2, according to Table 2.2.9.1.10.3.1. These criteria describe in detail the classification categories. They are diagrammatically summarized in Table 2.2.9.1.10.3.2.

¹⁴ See Chapter 4.1 and Annex 9, paragraph A9.4.2.2.3 of the GHS.

Table 2.2.9.1.10.3.1: Categories for substances hazardous to the aquatic environment (see Note 1)

(a) Acute (short-term) aquatic hazard

Category Acute 1: (see Note 2)		
96 hr LC ₅₀ (for fish)		≤ 1 mg/l and/or
48 hr EC ₅₀ (for crustacea)		≤ 1 mg/l and/or
72 or 96hr ErC ₅₀ (for algae or other aquatic plants)		≤ 1 mg/l (see Note 3)

(b) Long-term aquatic hazard (see also Figure 2.2.9.1.10.3.1)

(i) Non-rapidly degradable substances (see Note 4) for which there are adequate chronic toxicity data available

Category Chronic 1: (see Note 2)		
Chronic NOEC or EC _x (for fish)		≤ 0.1 mg/l and/or
Chronic NOEC or EC _x (for crustacea)		≤ 0.1 mg/l and/or
Chronic NOEC or EC _x (for algae or other aquatic plants)		≤ 0.1 mg/l
Category Chronic 2:		
Chronic NOEC or EC _x (for fish)		≤ 1 mg/l and/or
Chronic NOEC or EC _x (for crustacea)		≤ 1 mg/l and/or
Chronic NOEC or EC _x (for algae or other aquatic plants)		≤ 1 mg/l

(ii) Rapidly degradable substances for which there are adequate chronic toxicity data available

Category Chronic 1: (see Note 2)		
Chronic NOEC or EC _x (for fish)		≤ 0.01 mg/l and/or
Chronic NOEC or EC _x (for crustacea)		≤ 0.01 mg/l and/or
Chronic NOEC or EC _x (for algae or other aquatic plants)		≤ 0.01 mg/l
Category Chronic 2:		
Chronic NOEC or EC _x (for fish)		≤ 0.1 mg/l and/or
Chronic NOEC or EC _x (for crustacea)		≤ 0.1 mg/l and/or
Chronic NOEC or EC _x (for algae or other aquatic plants)		≤ 0.1 mg/l

(iii) Substances for which adequate chronic toxicity data are not available

Category Chronic 1: (see Note 2)		
96 hr LC ₅₀ (for fish)		≤ 1 mg/l and/or
48 hr EC ₅₀ (for crustacea)		≤ 1 mg/l and/or
72 or 96hr ErC ₅₀ (for algae or other aquatic plants)		≤ 1 mg/l (see Note 3)
and the substance is not rapidly degradable and/or the experimentally determined BCF is ≥ 500 (or, if absent the log K _{ow} ≥ 4) (see Notes 4 and 5).		
Category Chronic 2:		
96 hr LC ₅₀ (for fish)		>1 but ≤ 10 mg/l and/or
48 hr EC ₅₀ (for crustacea)		>1 but ≤ 10 mg/l and/or
72 or 96hr ErC ₅₀ (for algae or other aquatic plants)		>1 but ≤ 10 mg/l (see Note 3)
and the substance is not rapidly degradable and/or the experimentally determined BCF is ≥ 500 (or, if absent the log K _{ow} ≥ 4) (see Notes 4 and 5).		

NOTE 1: The organisms fish, crustacea and algae are tested as surrogate species covering a range of trophic levels and taxa, and the test methods are highly standardized. Data on other organisms may also be considered, however, provided they represent equivalent species and test endpoints.

NOTE 2: When classifying substances as Acute 1 and/or Chronic 1 it is necessary at the same time to indicate an appropriate M factor (see 2.2.9.1.10.4.6.4) to apply the summation method.

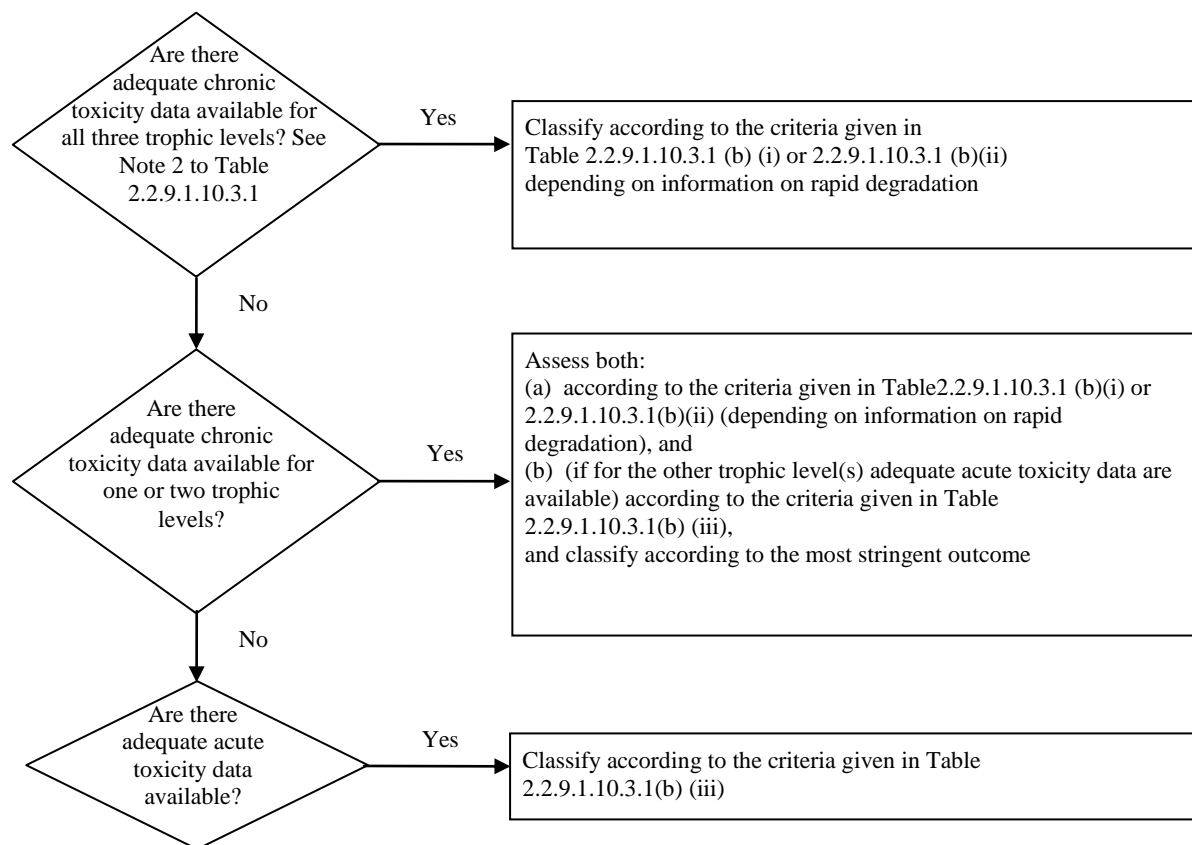
NOTE 3: Where the algal toxicity ErC₅₀ (= EC₅₀ (growth rate)) falls more than 100 times below the next most sensitive species and results in a classification based solely on this effect, consideration shall be given to whether this toxicity is representative of the toxicity to

aquatic plants. Where it can be shown that this is not the case, professional judgment shall be used in deciding if classification shall be applied. Classification shall be based on the ErC_{50} . In circumstances where the basis of the EC_{50} is not specified and no ErC_{50} is recorded, classification shall be based on the lowest EC_{50} available.

NOTE 4: Lack of rapid degradability is based on either a lack of ready biodegradability or other evidence of lack of rapid degradation. When no useful data on degradability are available, either experimentally determined or estimated data, the substance shall be regarded as not rapidly degradable.

NOTE 5: Potential to bioaccumulate, based on an experimentally derived $BCF \geq 500$ or, if absent, a $\log K_{ow} \geq 4$ provided $\log K_{ow}$ is an appropriate descriptor for the bioaccumulation potential of the substance. Measured $\log K_{ow}$ values take precedence over estimated values and measured BCF values take precedence over $\log K_{ow}$ values.

Figure 2.2.9.1.10.3.1: Categories for substances long-term hazardous to the aquatic environment



2.2.9.1.10.3.2 The classification scheme in Table 2.2.9.1.10.3.2 below summarizes the classification criteria for substances.

Table 2.2.9.1.10.3.2: Classification scheme for substances hazardous to the aquatic environment

Classification categories			
Acute hazard (see Note 1)	Long-term hazard (see Note 2)		
	Adequate chronic toxicity data available		Adequate chronic toxicity data not available (see Note 1)
	Non-rapidly degradable substances (see Note 3)	Rapidly degradable substances (see Note 3)	
Category: Acute 1	Category: Chronic 1	Category: Chronic 1	Category: Chronic 1
$L(E)C_{50} \leq 1.00$	$NOEC \text{ or } EC_x \leq 0.1$	$NOEC \text{ or } EC_x \leq 0.01$	$L(E)C_{50} \leq 1.00$ and lack of rapid degradability and/or $BCF \geq 500$ or, if absent $\log K_{ow} \geq 4$
	Category: Chronic 2	Category: Chronic 2	Category: Chronic 2
	$0.1 < NOEC \text{ or } EC_x \leq 1$	$0.01 < NOEC \text{ or } EC_x \leq 0.1$	$1.00 < L(E)C_{50} \leq 10.0$ and lack of rapid degradability and/or $BCF \geq 500$ or, if absent $\log K_{ow} \geq 4$

NOTE 1: Acute toxicity band based on $L(E)C_{50}$ values in mg/l for fish, crustacea and/or algae or other aquatic plants (or Quantitative Structure Activity Relationships (QSAR) estimation if no experimental data¹⁵).

¹⁵ Special guidance is provided in Chapter 4.1, paragraph 4.1.2.13 and Annex 9, Section A9.6 of the GHS.

NOTE 2: *Substances are classified in the various chronic categories unless there are adequate chronic toxicity data available for all three trophic levels above the water solubility or above 1 mg/l. ("Adequate" means that the data sufficiently cover the endpoint of concern. Generally this would mean measured test data, but in order to avoid unnecessary testing it can on a case by case basis also be estimated data, e.g. (Q)SAR, or for obvious cases expert judgment).*

NOTE 3: *Chronic toxicity band based on NOEC or equivalent EC_x values in mg/l for fish or crustacea or other recognized measures for chronic toxicity.*

2.2.9.1.10.4 Mixtures classification categories and criteria

- 2.2.9.1.10.4.1 The classification system for mixtures covers the classification categories which are used for substances, meaning categories Acute 1 and Chronic 1 and 2. In order to make use of all available data for purposes of classifying the aquatic environmental hazards of the mixture, the following assumption is made and is applied where appropriate:

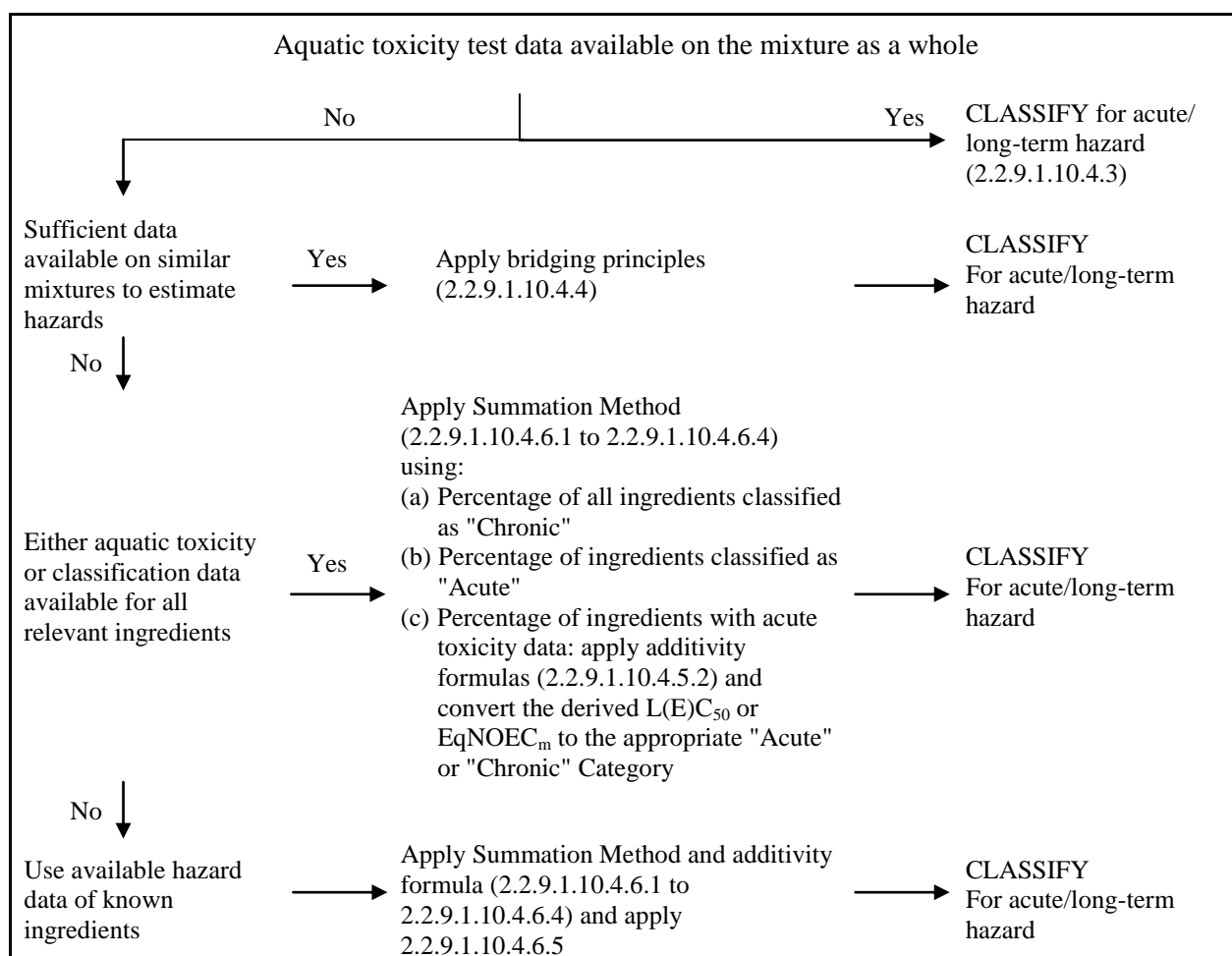
The "relevant ingredients" of a mixture are those which are present in a concentration equal to or greater than 0.1% (by mass) for ingredients classified as Acute and/or Chronic 1 and equal to or greater than 1% for other ingredients, unless there is a presumption (e.g. in the case of highly toxic ingredients) that an ingredient present at less than 0.1% can still be relevant for classifying the mixture for aquatic environmental hazards.

- 2.2.9.1.10.4.2 The approach for classification of aquatic environmental hazards is tiered, and is dependent upon the type of information available for the mixture itself and for its ingredients. Elements of the tiered approach include:

- (a) Classification based on tested mixtures;
- (b) Classification based on bridging principles;
- (c) The use of "summation of classified ingredients" and/or an "additivity formula".

Figure 2.2.9.1.10.4.2 below outlines the process to be followed.

Figure 2.2.9.1.10.4.2: Tiered approach to classification of mixtures for acute and long-term aquatic environmental hazards



2.2.9.1.10.4.3 Classification of mixtures when toxicity data are available for the complete mixture

2.2.9.1.10.4.3.1 When the mixture as a whole has been tested to determine its aquatic toxicity, this information shall be used for classifying the mixture according to the criteria that have been agreed for substances. The classification is normally based on the data for fish, crustacea and algae/plants (see 2.2.9.1.10.2.3 and 2.2.9.1.10.2.4). When adequate acute or chronic data for the mixture as a whole are lacking, "bridging principles" or "summation method" shall be applied (see 2.2.9.1.10.4.4 to 2.2.9.1.10.4.6).

2.2.9.1.10.4.3.2 The long-term hazard classification of mixtures requires additional information on degradability and in certain cases bioaccumulation. There are no degradability and bioaccumulation data for mixtures as a whole. Degradability and bioaccumulation tests for mixtures are not used as they are usually difficult to interpret, and such tests may be meaningful only for single substances.

2.2.9.1.10.4.3.3 Classification for category Acute 1

- (a) When there are adequate acute toxicity test data (LC_{50} or EC_{50}) available for the mixture as a whole showing $L(E)C_{50} \leq 1$ mg/l:

Classify the mixture as Acute 1 in accordance with Table 2.2.9.1.10.3.1 (a);

- (b) When there are acute toxicity test data ($LC_{50}(s)$ or $EC_{50}(s)$) available for the mixture as a whole showing $L(E)C_{50}(s) > 1 \text{ mg/l}$, or above the water solubility:

No need to classify for acute hazard under ADR.

2.2.9.1.10.4.3.4 Classification for categories Chronic 1 and 2

- (a) When there are adequate chronic toxicity data (EC_x or NOEC) available for the mixture as a whole showing EC_x or NOEC of the tested mixture $\leq 1 \text{ mg/l}$:
- (i) classify the mixture as Chronic 1 or 2 in accordance with Table 2.2.9.1.10.3.1 (b) (ii) (rapidly degradable) if the available information allows the conclusion that all relevant ingredients of the mixture are rapidly degradable;
- (ii) classify the mixture as Chronic 1 or 2 in all other cases in accordance with Table 2.2.9.1.10.3.1 (b) (i) (non-rapidly degradable);
- (b) When there are adequate chronic toxicity data (EC_x or NOEC) available for the mixture as a whole showing $EC_x(s)$ or NOEC(s) of the tested mixture $> 1 \text{ mg/l}$ or above the water solubility:

No need to classify for long-term hazard under ADR.

2.2.9.1.10.4.4 Classification of mixtures when toxicity data are not available for the complete mixture: bridging principles

2.2.9.1.10.4.4.1 Where the mixture itself has not been tested to determine its aquatic environmental hazard, but there are sufficient data on the individual ingredients and similar tested mixtures to adequately characterise the hazards of the mixture, these data shall be used in accordance with the following agreed bridging rules. This ensures that the classification process uses the available data to the greatest extent possible in characterising the hazards of the mixture without the necessity for additional testing in animals.

2.2.9.1.10.4.4.2 Dilution

Where a new mixture is formed by diluting a tested mixture or a substance with a diluent which has an equivalent or lower aquatic hazard classification than the least toxic original ingredient and which is not expected to affect the aquatic hazards of other ingredients, then the resulting mixture shall be classified as equivalent to the original tested mixture or substance. Alternatively, the method explained in 2.2.9.1.10.4.5 may be applied.

2.2.9.1.10.4.4.3 Batching

The aquatic hazard classification of a tested production batch of a mixture shall be assumed to be substantially equivalent to that of another untested production batch of the same commercial product when 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 untested batch has changed. If the latter occurs, new classification is necessary.

2.2.9.1.10.4.4.4 Concentration of mixtures which are classified with the most severe classification categories (Chronic 1 and Acute 1)

If a tested mixture is classified as Chronic 1 and/or Acute 1, and the ingredients of the mixture which are classified as Chronic 1 and/or Acute 1 are further concentrated, the more concentrated untested mixture shall be classified with the same classification category as the original tested mixture without additional testing.

2.2.9.1.10.4.4.5 Interpolation within one toxicity category

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

2.2.9.1.10.4.4.6 Substantially similar mixtures

Given the following:

- (a) Two mixtures:
 - (i) A + B;
 - (ii) C + B;
- (b) The concentration of ingredient B is essentially the same in both mixtures;
- (c) The concentration of ingredient A in mixture (i) equals that of ingredient C in mixture (ii);
- (d) Data on aquatic hazards for A and C are available and are substantially equivalent, i.e. they are in the same hazard category and are not expected to affect the aquatic toxicity of B.

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

2.2.9.1.10.4.5 Classification of mixtures when toxicity data are available for all ingredients or only for some ingredients of the mixture

2.2.9.1.10.4.5.1 The classification of a mixture shall be based on summation of the concentrations of its classified ingredients. The percentage of ingredients classified as "Acute" or "Chronic" will feed straight into the summation method. Details of the summation method are described in 2.2.9.1.10.4.6.1 to 2.2.9.1.10.4.6.4.

2.2.9.1.10.4.5.2 Mixtures may be made of a combination of both ingredients that are classified (as Acute 1 and/or Chronic 1, 2) and those for which adequate toxicity test data are available. When adequate toxicity data are available for more than one ingredient in the mixture, the combined toxicity of those ingredients shall be calculated using the following additivity formulas (a) or (b), depending on the nature of the toxicity data:

- (a) Based on acute aquatic toxicity:

$$\frac{\sum C_i}{L(E)C_{50m}} = \sum_n \frac{C_i}{L(E)C_{50i}}$$

where:

- C_i = concentration of ingredient i (mass percentage);
- $L(E)C_{50i}$ = LC_{50} or EC_{50} for ingredient i (mg/l);
- n = number of ingredients, and i is running from 1 to n;
- $L(E)C_{50m}$ = $L(E)C_{50}$ of the part of the mixture with test data;

The calculated toxicity shall be used to assign that portion of the mixture an acute hazard category which is then subsequently used in applying the summation method;

- (b) Based on chronic aquatic toxicity:

$$\frac{\sum C_i + \sum C_j}{EqNOEC_m} = \sum_n \frac{C_i}{NOEC_i} + \sum_n \frac{C_j}{0.1 \cdot NOEC_j}$$

where:

- C_i = concentration of ingredient i (mass percentage) covering the rapidly degradable ingredients;
 C_j = concentration of ingredient j (mass percentage) covering the non rapidly degradable ingredients;
 $NOEC_i$ = NOEC (or other recognized measures for chronic toxicity) for ingredient i covering the rapidly degradable ingredients, in mg/l;
 $NOEC_j$ = NOEC (or other recognized measures for chronic toxicity) for ingredient j covering the non-rapidly degradable ingredients, in mg/l;
 n = number of ingredients, and i and j are running from 1 to n;
 $EqNOEC_m$ = equivalent NOEC of the part of the mixture with test data;

The equivalent toxicity thus reflects the fact that non-rapidly degrading substances are classified one hazard category level more "severe" than rapidly degrading substances.

The calculated equivalent toxicity shall be used to assign that portion of the mixture a long-term hazard category, in accordance with the criteria for rapidly degradable substances (Table 2.2.9.1.10.3.1 (b) (ii)), which is then subsequently used in applying the summation method.

2.2.9.1.10.4.5.3 When applying the additivity formula for part of the mixture, it is preferable to calculate the toxicity of this part of the mixture using for each ingredient toxicity values that relate to the same taxonomic group (i.e. fish, crustacea or algae) and then to use the highest toxicity (lowest value) obtained (i.e. use the most sensitive of the three groups). However, when toxicity data for each ingredient are not available in the same taxonomic group, the toxicity value of each ingredient 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) is used. The calculated acute and chronic toxicity shall then be used to classify this part of the mixture as Acute 1 and/or Chronic 1 or 2 using the same criteria described for substances.

2.2.9.1.10.4.5.4 If a mixture is classified in more than one way, the method yielding the more conservative result shall be used.

2.2.9.1.10.4.6 Summation method

2.2.9.1.10.4.6.1 Classification procedure

In general a more severe classification for mixtures overrides a less severe classification, e.g. a classification with Chronic 1 overrides a classification with Chronic 2. As a consequence the classification procedure is already completed if the results of the classification is Chronic 1. A more severe classification than Chronic 1 is not possible; therefore, it is not necessary to pursue the classification procedure further.

2.2.9.1.10.4.6.2 Classification for category Acute 1

2.2.9.1.10.4.6.2.1 First, all ingredients classified as Acute 1 are considered. If the sum of the concentrations (in %) of these ingredients is greater than or equal to 25% the whole mixture shall be classified as Acute 1. If the result of the calculation is a classification of the mixture as Acute 1, the classification process is completed.

2.2.9.1.10.4.6.2.2 The classification of mixtures for acute hazards based on this summation of the concentrations of classified ingredients is summarized in Table 2.2.9.1.10.4.6.2.2 below.

Table 2.2.9.1.10.4.6.2.2: Classification of a mixture for acute hazards based on summation of the concentrations of classified ingredients

Sum of the concentrations (in %) of ingredients classified as:	Mixture classified as:
Acute 1 $\times M^a \geq 25\%$	Acute 1

^a For explanation of the M factor, see 2.2.9.1.10.4.6.4.

2.2.9.1.10.4.6.3 Classification for categories Chronic 1 and 2

2.2.9.1.10.4.6.3.1 First, all ingredients classified as Chronic 1 are considered. If the sum of the concentrations (in %) of these ingredients is greater than or equal to 25% the mixture shall be classified as Chronic 1. If the result of the calculation is a classification of the mixture as Chronic 1 the classification procedure is completed.

2.2.9.1.10.4.6.3.2 In cases where the mixture is not classified as Chronic 1, classification of the mixture as Chronic 2 is considered. A mixture shall be classified as Chronic 2 if 10 times the sum of the concentrations (in %) of all ingredients classified as Chronic 1 plus the sum of the concentrations (in %) of all ingredients classified as Chronic 2 is greater than or equal to 25%. If the result of the calculation is classification of the mixture as Chronic 2, the classification process is completed.

2.2.9.1.10.4.6.3.3 The classification of mixtures for long-term hazards based on this summation of the concentrations of classified ingredients is summarized in Table 2.2.9.1.10.4.6.3.3 below.

Table 2.2.9.1.10.4.6.3.3: Classification of a mixture for long-term hazards based on summation of the concentrations of classified ingredients

Sum of the concentrations (in %) of ingredients classified as:	Mixture classified as:
Chronic 1 $\times M^a \geq 25\%$	Chronic 1
$(M \times 10 \times \text{Chronic 1}) + \text{Chronic 2} \geq 25\%$	Chronic 2

^a For explanation of the M factor, see 2.2.9.1.10.4.6.4.

2.2.9.1.10.4.6.4 Mixtures with highly toxic ingredients

Acute 1 or Chronic 1 ingredients with acute toxicities well below 1 mg/l and/or chronic toxicities well below 0.1 mg/l (if non-rapidly degradable) and 0.01 mg/l (if rapidly degradable) may influence the toxicity of the mixture and are given increased weight in applying the summation method. When a mixture contains ingredients classified as acute or Chronic 1, the tiered approach described in 2.2.9.1.10.4.6.2 and 2.2.9.1.10.4.6.3 shall be applied using a weighted sum by multiplying the concentrations of Acute 1 and Chronic 1 ingredients by a factor, instead of merely adding up the percentages. This means that the concentration of "Acute 1" in the left column of Table 2.2.9.1.10.4.6.2.2 and the concentration of "Chronic 1" in the left column of Table 2.2.9.1.10.4.6.3.3 are multiplied by the appropriate multiplying factor. The multiplying factors to be applied to these ingredients are defined using the toxicity value, as summarised in Table 2.2.9.1.10.4.6.4 below. Therefore, in order to classify a mixture containing Acute 1 and/or Chronic 1 ingredients, the classifier needs to be informed of the value of the M factor in order to apply the summation method. Alternatively, the additivity formula (see 2.2.9.1.10.4.5.2) may be used when toxicity data are available for all highly toxic ingredients in the mixture and there is convincing evidence that all other ingredients,

including those for which specific acute and/or chronic toxicity data are not available, are of low or no toxicity and do not significantly contribute to the environmental hazard of the mixture.

Table 2.2.9.1.10.4.6.4: Multiplying factors for highly toxic ingredients of mixtures

Acute toxicity	M factor	Chronic toxicity	M factor	
L(E)C ₅₀ value		NOEC value	NRD ^a ingredients	RD ^b ingredients
0.1 < L(E)C ₅₀ ≤ 1	1	0.01 < NOEC ≤ 0.1	1	–
0.01 < L(E)C ₅₀ ≤ 0.1	10	0.001 < NOEC ≤ 0.01	10	1
0.001 < L(E)C ₅₀ ≤ 0.01	100	0.0001 < NOEC ≤ 0.001	100	10
0.0001 < L(E)C ₅₀ ≤ 0.001	1 000	0.00001 < NOEC ≤ 0.0001	1 000	100
0.00001 < L(E)C ₅₀ ≤ 0.0001	10 000	0.000001 < NOEC ≤ 0.00001	10 000	1 000
(continue in factor 10 intervals)		(continue in factor 10 intervals)		

^a Non-rapidly degradable.

^b Rapidly degradable.

2.2.9.1.10.4.6.5 Classification of mixtures with ingredients without any useable information

In the event that no useable information on acute and/or chronic aquatic toxicity is available for one or more relevant ingredients, it is concluded that the mixture cannot be attributed (a) definitive hazard category(ies). In this situation the mixture shall be classified based on the known ingredients only with the additional statement that: "x percent of the mixture consists of ingredient(s) of unknown hazard to the aquatic environment.

2.2.9.1.10.5 Substances or mixtures classified as environmentally hazardous substances (aquatic environment) on the basis of Regulation 1272/2008/EC¹⁶

If data for classification according to the criteria of 2.2.9.1.10.3 and 2.2.9.1.10.4 are not available, a substance or mixture:

- (a) Shall be classified as an environmentally hazardous substance (aquatic environment) if it has to be assigned category(ies) Aquatic Acute 1, Aquatic Chronic 1 or Aquatic Chronic 2 according to Regulation 1272/2008/EC¹⁶ or, if still relevant according to the said Regulation, risk phrase(s) R50, R50/53 or R51/53 according to the Directives 67/548/EEC³ or 1999/45/EC⁴;
- (b) May be regarded as not being an environmentally hazardous substance (aquatic environment) if it does not have to be assigned such a risk phrase or category according to the said Directives or Regulation.

³ Council Directive 67/548/EEC of 27 June 1967 on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances (Official Journal of the European Communities No. L 196 of 16 August 1967).

⁴ Directive 1999/45/EC of the European Parliament and of the Council of 31 May 1999 concerning the approximation of the laws, regulations and administrative provisions of the Member States relating to the classification, packaging and labelling of dangerous preparations (Official Journal of the European Communities No. L 200 of 30 July 1999).

¹⁶ Regulation 1272/2008/EC of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures (Official Journal of the European Union No. L 353 of 30 December 2008).

- 2.2.9.1.10.6 Assignment of substances or mixtures classified as environmentally hazardous substances (aquatic environment) according to the provisions in 2.2.9.1.10.3, 2.2.9.1.10.4 or 2.2.9.1.10.5

Substances or mixtures classified as environmentally hazardous substances (aquatic environment), not otherwise classified under ADR shall be designated:

UN No. 3077 ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S.; or

UN No. 3082 ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S.

They shall be assigned to packing group III.

Genetically modified microorganisms or organisms

- 2.2.9.1.11 Genetically modified microorganisms (GMMOs) and genetically modified organisms (GMOs) are microorganisms and organisms in which genetic material has been purposely altered through genetic engineering in a way that does not occur naturally. They are assigned to Class 9 (UN No. 3245) if they do not meet the definition of toxic substances or of infectious substances, but are capable of altering animals, plants or microbiological substances in a way not normally the result of natural reproduction.

NOTE 1: *GMMOs and GMOs which are infectious are substances of Class 6.2, UN Nos. 2814, 2900 or 3373.*

NOTE 2: *GMMOs or GMOs are not subject to the provisions of ADR when authorized for use by the competent authorities of the countries of origin, transit and destination¹⁷.*

NOTE 3: *Live animals shall not be used to carry genetically modified microorganisms classified in Class 9 unless the substance can be carried no other way. Genetically modified live animals shall be carried under terms and conditions of the competent authorities of the countries of origin and destination.*

- 2.2.9.1.12 (Deleted)

Elevated temperature substances

- 2.2.9.1.13 Elevated temperature substances include substances which are carried or handed over for carriage in the liquid state at or above 100 °C and, in the case of those with a flash-point, below their flash-point. They also include solids which are carried or handed over for carriage at or above 240 °C.

NOTE: *Elevated temperature substances may be assigned to Class 9 only if they do not meet the criteria of any other class.*

Other substances presenting a danger during carriage but not meeting the definitions of another class.

- 2.2.9.1.14 The following other miscellaneous substances not meeting the definitions of another class are assigned to Class 9:

Solid ammonia compounds having a flash-point below 60 °C;

Low hazard dithionites;

Highly volatile liquids;

Substances emitting noxious fumes;

¹⁷ See in particular Part C of Directive 2001/18/EC of the European Parliament and of the Council on the deliberate release into the environment of genetically modified organisms and repealing Council Directive 90/220/EEC (Official Journal of the European Communities, No. L 106, of 17 April 2001, pp. 8-14), which sets out the authorization procedures for the European Community.

Substances containing allergens;
Chemical kits and first aid kits;
Electric double layer capacitors (with an energy storage capacity greater than 0.3 Wh)

NOTE: *UN No. 1845 carbon dioxide, solid (dry ice)¹⁸, UN No. 2071 ammonium nitrate fertilizers, UN No. 2216 fish meal (fish scrap), stabilized, UN No. 2807 magnetized material, UN No. 3166 engine, internal combustion or 3166 vehicle, flammable gas powered or 3166 vehicle, flammable liquid powered or 3166 engine, fuel cell, flammable gas powered or 3166 engine, fuel cell, flammable liquid powered or 3166 vehicle, fuel cell, flammable gas powered or 3166 vehicle, fuel cell, flammable liquid powered, UN No. 3171 battery-powered vehicle or 3171 battery-powered equipment (wet battery) (see also the NOTE at the end of 2.2.9.1.7), UN No. 3334 aviation regulated liquid, n.o.s., UN No. 3335 aviation regulated solid, n.o.s. and UN No. 3363 dangerous goods in machinery or dangerous goods in apparatus listed in the UN Model Regulations, are not subject to the provisions of ADR.*

Assignment of the packing groups

2.2.9.1.15 When indicated in column (4) of Table A of Chapter 3.2, substances and articles of Class 9 are assigned to one of the following packing groups according to their degree of danger:

Packing group II: substances presenting medium danger;
Packing group III: substances presenting low danger.

2.2.9.2 *Substances and articles not accepted for carriage*

The following substances and articles shall not be accepted for carriage:

- Lithium batteries which do not meet the relevant conditions of special provisions 188, 230, 310 or 636 of Chapter 3.3;
- Uncleaned empty containment vessels for apparatus such as transformers, condensers and hydraulic apparatus containing substances assigned to UN Nos. 2315, 3151, 3152 or 3432.

¹⁸ For UN No. 1845 carbon dioxide, solid (dry ice) used as a coolant, see 5.5.3.

2.2.9.3

List of entries

Substances which, on inhalation as fine dust, may endanger health	M1	<p>2212 ASBESTOS, AMPHIBOLE (amosite, tremolite, actinolite, anthophyllite, crocidolite)</p> <p>2590 ASBESTOS, CHRYSOTILE</p> <p>2212 BLUE ASBESTOS (crocidolite) or</p> <p>2212 BROWN ASBESTOS (amosite, miosorite)</p> <p>2590 WHITE ASBESTOS (chrysotile, actinolite, anthophyllite, tremolite)</p>
Substances and apparatus which, in the event of fire, may form dioxins	M2	<p>2315 POLYCHLORINATED BIPHENYLS, LIQUID</p> <p>3432 POLYCHLORINATED BIPHENYLS, SOLID</p> <p>3151 POLYHALOGENATED BIPHENYLS, LIQUID or</p> <p>3151 POLYHALOGENATED TERPHENYLS, LIQUID</p> <p>3152 POLYHALOGENATED BIPHENYLS, SOLID or</p> <p>3152 POLYHALOGENATED TERPHENYLS, SOLID</p>
Substances evolving flammable vapour	M3	<p>2211 POLYMERIC BEADS, EXPANDABLE, evolving flammable vapour</p> <p>3314 PLASTICS MOULDING COMPOUND in dough, sheet or extruded rope form evolving flammable vapour</p>
Lithium batteries	M4	<p>3090 LITHIUM METAL BATTERIES (including lithium alloy batteries)</p> <p>3091 LITHIUM METAL BATTERIES CONTAINED IN EQUIPMENT (including lithium alloy batteries) or</p> <p>3091 LITHIUM METAL BATTERIES PACKED WITH EQUIPMENT (including lithium alloy batteries)</p> <p>3480 LITHIUM ION BATTERIES (including lithium ion polymer batteries)</p> <p>3481 LITHIUM ION BATTERIES CONTAINED IN EQUIPMENT (including lithium ion polymer batteries) or</p> <p>3481 LITHIUM ION BATTERIES PACKED WITH EQUIPMENT (including lithium ion polymer batteries)</p>
Live-saving appliances	M5	<p>2990 LIFE-SAVING APPLIANCES, SELF-INFLATING</p> <p>3072 LIFE-SAVING APPLIANCES NOT SELF-INFLATING containing dangerous goods as equipment</p> <p>3268 SAFETY DEVICES, electrically initiated</p> <p>3268 AIR-BAG INFLATORS or</p> <p>3268 AIR-BAG MODULES or</p> <p>3268 SEAT-BELT PRETENSIONERS</p>
Environmentally hazardous substances	M6	<p>pollutant to the aquatic environment, liquid</p> <p>3082 ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S.</p>
	M7	<p>pollutant to the aquatic environment, solid</p> <p>3077 ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S.</p>
Elevated temperature substances	M8	<p>genetically modified micro-organisms and organisms</p> <p>3245 GENETICALLY MODIFIED MICROORGANISMS or</p> <p>3245 GENETICALLY MODIFIED ORGANISMS</p>
	M9	<p>liquid</p> <p>3257 ELEVATED TEMPERATURE LIQUID, N.O.S., at or above 100 °C and below its flash-point (including molten metal, molten salts, etc.)</p>
	M10	<p>solid</p> <p>3258 ELEVATED TEMPERATURE SOLID, N.O.S., at or above 240 °C</p>
Other substances or articles presenting a danger during carriage, but not meeting the definitions of another class	M11	<p>No collective entry available. Only substances listed in Table A of Chapter 3.2 are subject to the provisions for Class 9 under this classification code, as follows:</p> <p>1841 ACETALDEHYDE AMMONIA</p> <p>1931 ZINC DITHIONITE (ZINC HYDROSULPHITE)</p> <p>1941 DIBROMODIFLUOROMETHANE</p> <p>1990 BENZALDEHYDE</p>

2969 CASTOR BEANS, or 2969 CASTOR MEAL, or 2969 CASTOR POMACE, or 2969 CASTOR FLAKE 3316 CHEMICAL KIT, or 3316 FIRST AID KIT 3359 FUMIGATED UNIT 3499 <u>CAPACITOR, ELECTRIC DOUBLE LAYER (with an energy storage capacity greater than 0.3Wh)</u> CAPACITOR, electric double layer (with an energy storage capacity greater than 0.3 Wh) <u>3508 CAPACITOR, ASYMMETRIC (with an energy storage capacity greater than 0.3Wh)</u> <u>3509 PACKAGINGS, DISCARDED, EMPTY, UNCLEANED</u>
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CHAPTER 2.3

TEST METHODS

2.3.0 General

Unless otherwise provided for in Chapter 2.2 or in this Chapter, the test methods to be used for the classification of dangerous goods are those described in the Manual of Tests and Criteria.

2.3.1 Exudation test for blasting explosives of Type A

- 2.3.1.1 Blasting explosives of type A (UN No. 0081) shall, if they contain more than 40% liquid nitric ester, in addition to the testing specified in the Manual of Tests and Criteria, satisfy the following exudation test.
- 2.3.1.2 The apparatus for testing blasting explosive for exudation (figs. 1 to 3) consists of a hollow bronze cylinder. This cylinder, which is closed at one end by a plate of the same metal, has an internal diameter of 15.7 mm and a depth of 40 mm. It is pierced by 20 holes 0.5 mm in diameter (four sets of five holes) on the circumference. A bronze piston, cylindrically fashioned over a length of 48 mm and having a total length of 52 mm, slides into the vertically placed cylinder. The piston, whose diameter is 15.6 mm, is loaded with a mass of 220 g so that a pressure of 120 kPa (1.20 bar) is exerted on the base of the cylinder.
- 2.3.1.3 A small plug of blasting explosive weighing 5 to 8 g, 30 mm long and 15 mm in diameter, is wrapped in very fine gauze and placed in the cylinder; the piston and its loading mass are then placed on it so that the blasting explosive is subjected to a pressure of 120 kPa (1.20 bar). The time taken for the appearance of the first signs of oily droplets (nitroglycerine) at the outer orifices of the cylinder holes is noted.
- 2.3.1.4 The blasting explosive is considered satisfactory if the time elapsing before the appearance of the liquid exudations is more than five minutes, the test having been carried out at a temperature of 15 °C to 25 °C.

Test of blasting explosive for exudation

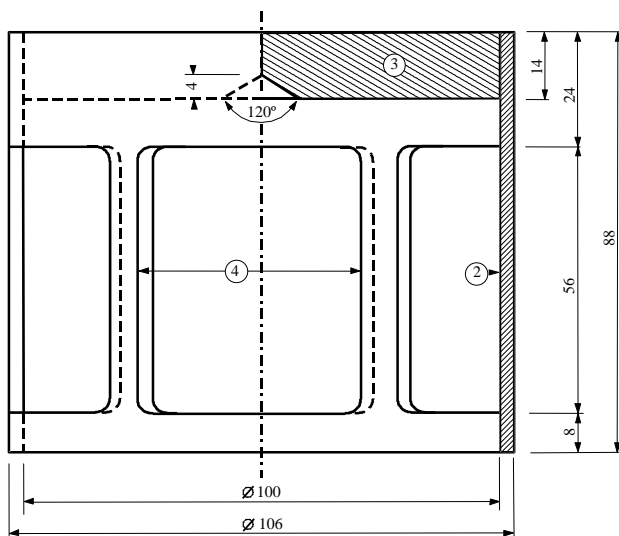


Fig.1: Bell-form charge, mass 2220 g, capable of being suspended from a bronze piston

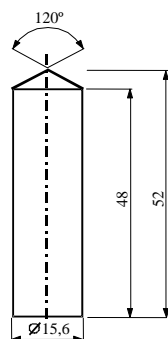


Fig.2: Cylindrical bronze piston, dimensions in mm

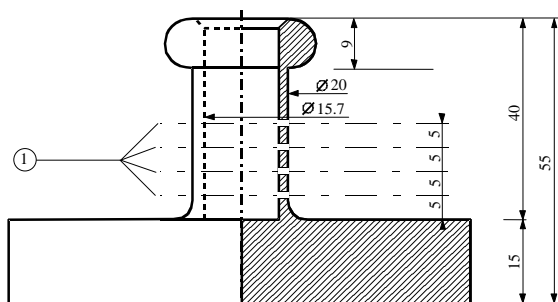


Fig.3: Hollow bronze cylinder, closed at one end; Plan and cut dimensions in mm

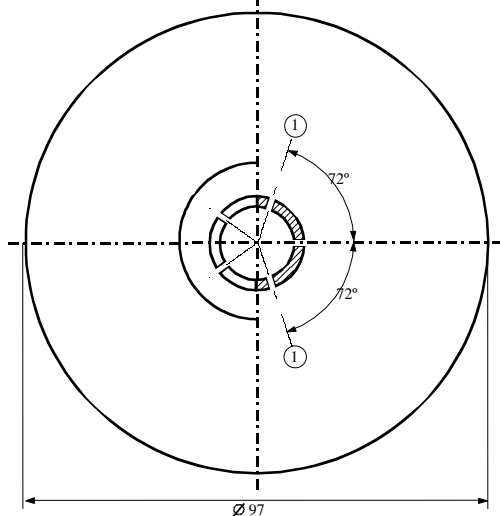


Fig. 1 to 3

- (1) 4 series of 5 holes at 0.5 N
- (2) copper
- (3) iron plate with centre cone at the inferior face
- (4) 4 openings, approximately 46x56, set at even intervals on the periphery

2.3.2 Tests relating to nitrated cellulose mixtures of Class 4.1

- 2.3.2.1 Nitrocellulose heated for half an hour at 132 °C shall not give off visible yellowish-brown nitrous fumes (nitrous gases). The ignition temperature shall be above 180 °C. See 2.3.2.3 to 2.3.2.8, 2.3.2.9 (a) and 2.3.2.10 below.
- 2.3.2.2 3 g of plasticized nitrocellulose, heated for one hour at 132 °C, shall not give off visible yellowish-brown nitrous fumes (nitrous gases). The ignition temperature shall be above 170 °C. See 2.3.2.3 to 2.3.2.8, 2.3.2.9 (b) and 2.3.2.10 below.
- 2.3.2.3 The test procedures set out below are to be applied when differences of opinion arise as to the acceptability of substances for carriage by road.
- 2.3.2.4 If other methods or test procedures are used to verify the conditions of stability prescribed above in this section, those methods shall lead to the same findings as could be reached by the methods specified below.
- 2.3.2.5 In carrying out the stability tests by heating described below, the temperature of the oven containing the sample under test shall not deviate by more than 2 °C from the prescribed temperature; the prescribed duration of a 30-minute or 60-minute test shall be observed to within two minutes. The oven shall be such that the required temperature is restored not more than five minutes after insertion of the sample.
- 2.3.2.6 Before undergoing the tests in 2.3.2.9 and 2.3.2.10, the samples shall be dried for not less than 15 hours at the ambient temperature in a vacuum desiccator containing fused and granulated calcium chloride, the sample substance being spread in a thin layer; for this purpose, substances which are neither in powder form nor fibrous shall be ground, or grated, or cut into small pieces. The pressure in the desiccator shall be brought below 6.5 kPa (0.065 bar).
- 2.3.2.7 Before being dried as prescribed in 2.3.2.6 above, substances conforming to 2.3.2.2 shall undergo preliminary drying in a well-ventilated oven, with its temperature set at 70 °C, until the loss of mass per quarter-hour is less than 0.3% of the original mass.
- 2.3.2.8 Weakly nitrated nitrocellulose conforming to 2.3.2.1 shall first undergo preliminary drying as prescribed in 2.3.2.7 above; drying shall then be completed by keeping the nitrocellulose for at least 15 hours over concentrated sulphuric acid in a desiccator.

2.3.2.9 Test of chemical stability under heat

(a) *Test of the substance listed in paragraph 2.3.2.1 above.*

(i) In each of two glass test tubes having the following dimensions:

length	350 mm
internal diameter	16 mm
thickness of wall	1.5 mm

is placed 1 g of substance dried over calcium chloride (if necessary the drying shall be carried out after reducing the substance to pieces weighing not more than 0.05 g each).

Both test tubes, completely covered with loose-fitting closures, are then so placed in an oven that at least four-fifths of their length is visible, and are kept at a constant temperature of 132 °C for 30 minutes. It is observed whether nitrous gases in the form of yellowish-brown fumes clearly visible against a white background are given off during this time;

(ii) In the absence of such fumes the substance is deemed to be stable;

- (b) *Test of plasticized nitrocellulose (see 2.3.2.2)*
- (i) 3 g of plasticized nitrocellulose are placed in glass test tubes, similar to those referred to in (a), which are then placed in an oven kept at a constant temperature of 132 °C;
 - (ii) The test tubes containing the plasticized nitrocellulose are kept in the oven for one hour. During this time no yellowish-brown nitrous fumes (nitrous gases) shall be visible. Observation and appraisal as in (a).

2.3.2.10 Ignition temperature (see 2.3.2.1 and 2.3.2.2)

- (a) The ignition temperature is determined by heating 0.2 g of substance enclosed in a glass test tube immersed in a Wood's alloy bath. The test tube is placed in the bath when the latter has reached 100 °C. The temperature of the bath is then progressively increased by 5 °C per minute;
- (b) The test tubes must have the following dimensions:

length	125 mm
internal diameter	15 mm
thickness of wall	0.5 mm

and shall be immersed to a depth of 20 mm;
- (c) The test shall be repeated three times, the temperature at which ignition of the substance occurs, i.e., slow or rapid combustion, deflagration or detonation, being noted each time;
- (d) The lowest temperature recorded in the three tests is the ignition temperature.

2.3.3 Tests relating to flammable liquids of Classes 3, 6.1 and 8

2.3.3.1 Determination of flash-point

2.3.3.1.1 The following methods for determining the flash-point of flammable liquids may be used:

International standards:

ISO 1516 (Determination of flash/no flash – Closed cup equilibrium method)
 ISO 1523 (Determination of flash point – Closed cup equilibrium method)
 ISO 2719 (Determination of flash point – Pensky-Martens closed cup method)
 ISO 13736 (Determination of flash point – Abel closed-cup method)
 ISO 3679 (Determination of flash point – Rapid equilibrium closed cup method)
 ISO 3680 (Determination of flash/no flash – Rapid equilibrium closed cup method)

National standards:

American Society for Testing Materials International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, Pennsylvania, USA 19428-2959:

ASTM D3828-07a, Standard Test Methods for Flash Point by Small Scale Closed-Cup Tester
 ASTM D56-05, Standard Test Method for Flash Point by Tag Closed-Cup Tester
 ASTM D3278-96(2004)e1, Standard Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus
 ASTM D93-08, Standard Test Methods for Flash Point by Pensky-Martens Closed-Cup Tester

Association française de normalisation, AFNOR, 11, rue de Pressensé, F-93571 La Plaine Saint-Denis Cedex:

French standard NF M 07 - 019

French standards NF M 07 - 011 / NF T 30 - 050 / NF T 66 - 009

French standard NF M 07 - 036

Deutsches Institut für Normung, Burggrafenstr. 6, D-10787 Berlin:

Standard DIN 51755 (flash-points below 65 °C)

State Committee of the Council of Ministers for Standardization, RUS-113813, GSP, Moscow, M-49 Leninsky Prospect, 9:

GOST 12.1.044-84

2.3.3.1.2 To determine the flash-point of paints, gums and similar viscous products containing solvents, only apparatus and test methods suitable for determining the flash-point for viscous liquids shall be used, in accordance with the following standards:

- (a) International Standard ISO 3679: 1983;
- (b) International Standard ISO 3680: 1983;
- (c) International Standard ISO 1523: 1983;
- (d) International standards EN ISO 13736 and EN ISO 2719, Method B.

2.3.3.1.3 The standards listed in 2.3.3.1.1 shall only be used for flash-point ranges which are specified therein. The possibility of chemical reactions between the substance and the sample holder shall be considered when selecting the standard to be used. The apparatus shall, as far as is consistent with safety, be placed in a draught-free position. For safety, a method utilizing a small sample size, around 2 ml, shall be used for organic peroxides and self-reactive substances (also known as "energetic" substances), or for toxic substances.

2.3.3.1.4 When the flash-point, determined by a non-equilibrium method is found to be 23 ± 2 °C or 60 ± 2 °C, it shall be confirmed for each temperature range by an equilibrium method.

2.3.3.1.5 In the event of a dispute as to the classification of a flammable liquid, the classification proposed by the consignor shall be accepted if a check-test of the flash-point, yields a result not differing by more than 2 °C from the limits (23 °C and 60 °C respectively) stated in 2.2.3.1. If the difference is more than 2 °C, a second check-test shall be carried out, and the lowest figure of the flash-points obtained in either check-test shall be adopted.

2.3.3.2 *Determination of initial boiling point*

The following methods for determining the initial boiling point of flammable liquids may be used:

International standards:

ISO 3924 (Petroleum products – Determination of boiling range distribution – Gas chromatography method)

ISO 4626 (Volatile organic liquids – Determination of boiling range of organic solvents used as raw materials)

ISO 3405 (Petroleum products – Determination of distillation characteristics at atmospheric pressure)

National standards:

American Society for Testing Materials International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, Pennsylvania, USA 19428-2959:

ASTM D86-07a, Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure

ASTM D1078-05, Standard Test Method for Distillation Range of Volatile Organic Liquids

Further acceptable methods:

Method A.2 as described in Part A of the Annex to Commission Regulation (EC) No 440/2008¹.

2.3.3.3 ***Test for determining peroxide content***

To determine the peroxide content of a liquid, the procedure is as follows:

A quantity p (about 5 g, weighed to the nearest 0.01 g) of the liquid to be titrated is placed in an Erlenmeyer flask; 20 cm³ of acetic anhydride and about 1 g of powdered solid potassium iodide are added; the flask is shaken and, after 10 minutes, heated for 3 minutes to about 60 °C. When it has been left to cool for 5 minutes, 25 cm³ of water are added. After this, it is left standing for half an hour, then the liberated iodine is titrated with a decinormal solution of sodium thiosulphate, no indicator being added; complete discoloration indicates the end of the reaction. If n is the number of cm³ of thiosulphate solution required, the percentage of peroxide (calculated as H₂O₂) present in the sample is obtained by the formula:

$$\frac{17n}{100p}$$

2.3.4 **Test for determining fluidity**

To determine the fluidity of liquid, viscous or pasty substances and mixtures, the following test method shall be used.

2.3.4.1 ***Test apparatus***

Commercial penetrometer conforming to ISO 2137:1985, with a guide rod of 47.5 g ± 0.05 g; sieve disc of duralumin with conical bores and a mass of 102.5 g ± 0.05 g (see Figure 1); penetration vessel with an inside diameter of 72 mm to 80 mm for reception of the sample.

2.3.4.2 ***Test procedure***

The sample is poured into the penetration vessel not less than half an hour before the measurement. The vessel is then hermetically closed and left standing until the measurement. The sample in the hermetically closed penetration vessel is heated to 35 °C ± 0.5 °C and is placed on the penetrometer table immediately prior to measurement (not more than two minutes). The point S of the sieve disc is then brought into contact with the surface of the liquid and the rate of penetration is measured.

¹ Commission Regulation (EC) No 440/2008 of 30 May 2008 laying down test methods pursuant to Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) (Official Journal of the European Union, No. L 142 of 31.05.2008, p.1-739 and No. L 143 of 03.06.2008, p.55).

2.3.4.3

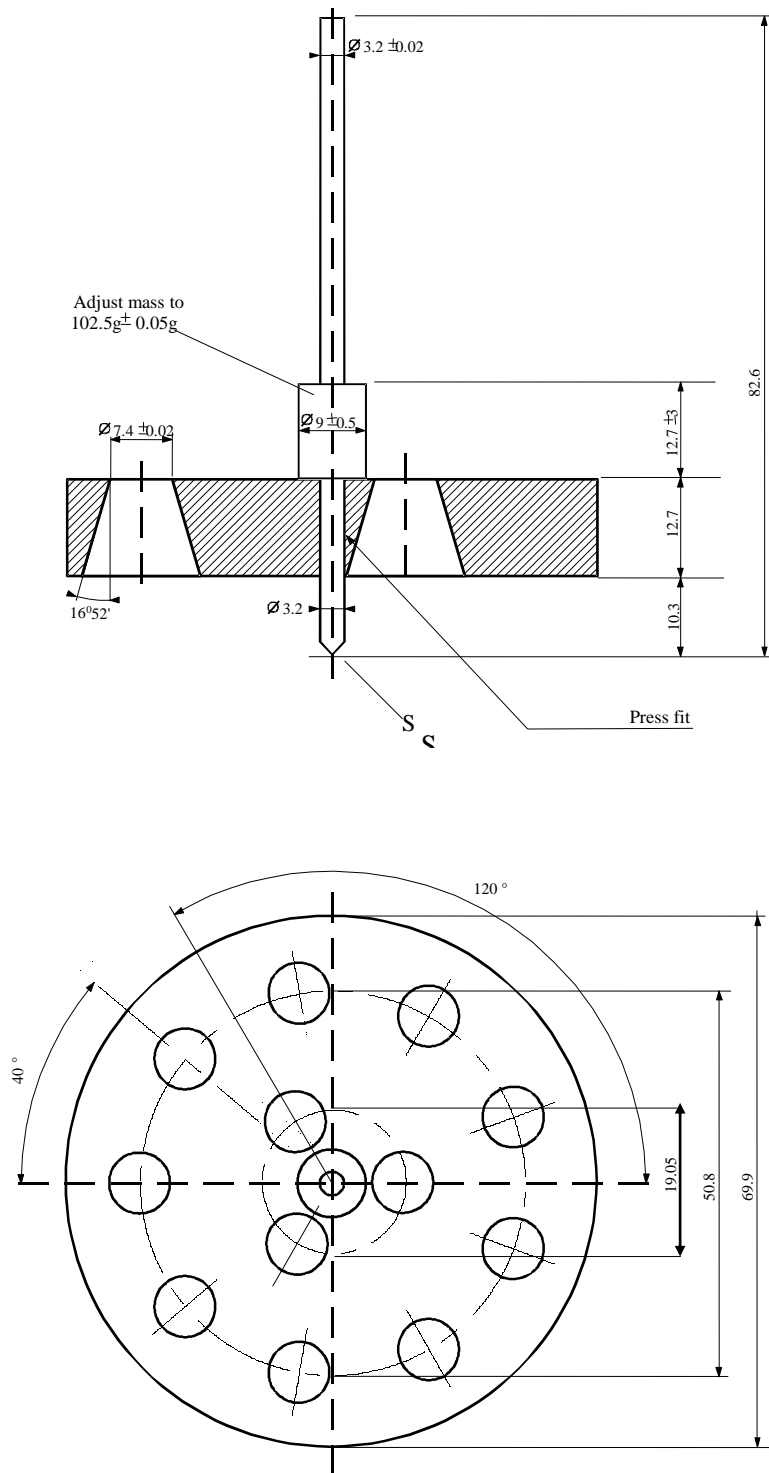
Evaluation of test results

A substance is pasty if, after the centre S has been brought into contact with the surface of the sample, the penetration indicated by the dial gauge:

- (a) after a loading time of $5 \text{ s} \pm 0.1 \text{ s}$, is less than $15.0 \text{ mm} \pm 0.3 \text{ mm}$; or
- (b) after a loading time of $5 \text{ s} \pm 0.1 \text{ s}$, is greater than $15.0 \text{ mm} \pm 0.3 \text{ mm}$, but the additional penetration after another $55 \text{ s} \pm 0.5 \text{ s}$ is less than $5.0 \text{ mm} \pm 0.5 \text{ mm}$.

NOTE: *In the case of samples having a flow point, it is often impossible to produce a steady level surface in the penetration vessel and, hence, to establish satisfactory initial measuring conditions for the contact of the point S. Furthermore, with some samples, the impact of the sieve disc can cause an elastic deformation of the surface and, in the first few seconds, simulate a deeper penetration. In all these cases, it may be appropriate to make the evaluation in paragraph (b) above.*

Figure 1 – Penetrometer



Tolerances not specified are ± 0.1 mm.

2.3.5

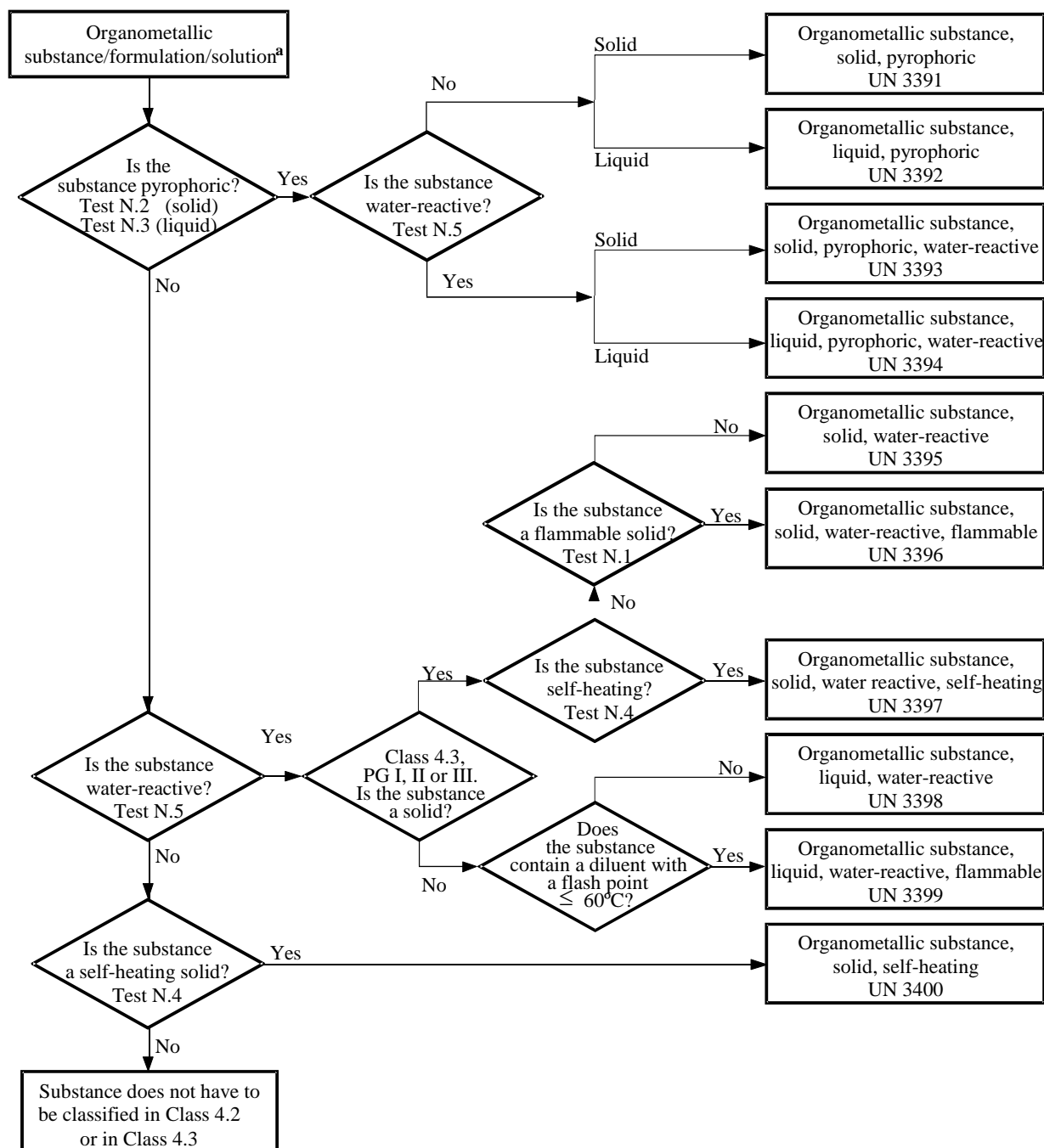
Classification of organometallic substances in Classes 4.2 and 4.3

Depending on their properties as determined in accordance with tests N.1 to N.5 of the Manual of Tests and Criteria, Part III, section 33, organometallic substances may be classified in Class 4.2 or 4.3, as appropriate, in accordance with the flowchart scheme given in Figure 2.3.5.

NOTE 1: *Depending on their other properties and on the precedence of hazard table (see 2.1.3.10), organometallic substances may have to be classified in other classes as appropriate.*

NOTE 2: *Flammable solutions with organometallic compounds in concentrations which are not liable to spontaneous combustion or, in contact with water, do not emit flammable gases in dangerous quantities, are substances of Class 3.*

Figure 2.3.5: Flowchart scheme for the classification of organometallic substances in Classes 4.2 and 4.3 ^b



^a If applicable and testing is relevant, taking into account reactivity properties, class 6.1 and 8 properties should be considered according to the precedence of hazard table of 2.1.3.10.

^b Test methods N.1 to N.5 can be found in the Manual of Tests and Criteria, Part III, Section 33.