2.2.52 Class 5.2 Organic peroxides

2.2.52.1 Criteria

2.2.52.1.1 The heading of Class 5.2 covers organic peroxides and formulations of organic peroxides.

2.2.52.1.2 The substances of Class 5.2 are subdivided as follows:

P1 Organic peroxides, not temperature controlled;
P2 Organic peroxides, temperature-controlled.

Definition

2.2.52.1.3 *Organic peroxides* are organic substances which contain the bivalent -O-O- structure and may be considered derivatives of hydrogen peroxide, where one or both of the hydrogen atoms have been replaced by organic radicals.

Properties

2.2.52.1.4 Organic peroxides are liable to exothermic decomposition at normal or elevated temperatures. The decomposition can be initiated by heat, contact with impurities (e.g. acids, heavy-metal compounds, amines), friction or impact. The rate of decomposition increases with temperature and varies with the organic peroxide formulation. Decomposition may 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 may decompose explosively, particularly if confined. This characteristic may be modified by the addition of diluents or by the use of appropriate packagings. Many organic peroxides burn vigorously. Contact of organic peroxides with the eyes is to be avoided. Some organic peroxides will cause serious injury to the cornea, even after brief contact, or will be corrosive to the skin.

***NOTE**: Test methods for determining the flammability of organic peroxides are set out in the Manual of Tests and Criteria, Part III, sub-section 32.4. Because organic peroxides may react vigorously when heated, it is recommended to determine their flash-point using small sample sizes such as described in ISO 3679:1983.*

Classification

2.2.52.1.5 Any organic peroxide shall be considered for classification in Class 5.2 unless the organic peroxide formulation contains:

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

***NOTE:** The available oxygen content (%) of an organic peroxide formulation is given by the formula*

$$16 \times \sum (n_i \times c_i / m_i)$$

where:

n_i: *number of peroxygen groups per molecule of organic peroxide i;*

c_i : concentration (mass %) of organic peroxide i; and
m_i: molecular mass of organic peroxide i.

2.2.52.1.6 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 is not accepted for carriage in the packaging in which it is tested, to type G, which is not subject to the provisions of Class 5.2. The classification of types B to F is directly related to the maximum quantity allowed in one packaging. The principles to be applied to the classification of substances not listed in 2.2.52.4 are set out in the Manual of Tests and Criteria, Part II.

2.2.52.1.7 Organic peroxides and formulations of organic peroxides which have already been classified and assigned to the appropriate generic entry are listed in 2.2.52.4 together with the applicable UN number, packing method and where appropriate, control and emergency temperatures.

These generic entries specify:

- the type (B to F) of organic peroxide (see 2.2.52.1.6 above);
- physical state (liquid/solid); and
- temperature control (when required), see 2.2.52.1.15 to 2.2.52.1.18.

Mixtures of these formulations may be classified as the same type of organic peroxide as that of the most dangerous component and be transported under the conditions of transport given for this type. However, as two stable components can form a thermally less stable mixture, the self-accelerating decomposition temperature (SADT) of the mixture shall be determined and, if necessary, the control and emergency temperatures derived from the SADT in accordance paragraph 2.2.52.1.16.

2.2.52.1.8 Classification of organic peroxides, formulations or mixtures of organic peroxides not listed in 2.2.52.4 and assignment to a collective entry shall be made by the competent authority of the country of origin. The statement of approval shall contain the classification and the relevant transport conditions. If the country of origin is not a party to ADR, the classification and conditions of carriage shall be recognized by the competent authority of the first ADR country reached by the consignment.

2.2.52.1.9 Samples of organic peroxides or formulations of organic peroxides not listed in 2.2.52.4, for which a complete set of test results is not available and which are to be carried for further testing or evaluation, shall be assigned to one of the appropriate entries for organic peroxides type C provided the following conditions are met:

- the available data indicate that the sample would be no more dangerous than organic peroxides type B;

- the sample is packaged in accordance with packing method OP2 and the quantity per transport unit is limited to 10 kg;

- 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.

Desensitization of organic peroxides

2.2.52.1.10 In order to ensure safety during carriage, organic peroxides are in many cases desensitized by organic liquids or solids, inorganic solids or water. Where a percentage of a substance is stipulated, this refers to the percentage by mass, rounded to the nearest whole number. In general, desensitization shall be such that, in case of spillage, the organic peroxide will not concentrate to a dangerous extent.

2.2.52.1.11 Unless otherwise stated for the individual organic peroxide formulation, the following definition(s) shall apply to diluents used for desensitization:

- diluents type A are organic liquids which are compatible with the organic peroxide and which have a boiling point of not less than 150 °C. Type A diluents may be used for desensitizing all organic peroxides.

- diluents type B are organic liquids which are compatible with the organic peroxide and which have a boiling point of less than 150 °C but not less than 60 °C and a flash-point of not less than 5 °C.

Type B diluents may be used for desensitization of all organic peroxides provided that the boiling point of the liquid is at least 60 °C higher than the SADT in a 50 kg package.

2.1.52.1.12 Diluents, other than type A or type B, may be added to organic peroxide formulations as listed in 2.2.52.4 provided that they are compatible. However, replacement of all or part of a type A or type B diluent by another diluent with differing properties requires that the organic peroxide formulation be re-assessed in accordance with the normal acceptance procedure for Class 5.2.

2.2.52.1.13 Water may only be used for the desensitization of organic peroxides which are listed in 2.2.52.4 or in the competent authority decision according to 2.2.52.1.8 as being "with water" or "as a stable dispersion in water". Samples of organic peroxides or formulations of organic peroxides not listed in 2.2.52.4 may also be desensitized with water provided the requirements of 2.2.52.1.9 are met.

2.2.52.1.14 Organic and inorganic solids may be used for desensitization of organic peroxides provided that they are compatible. Compatible liquids and solids are those which have no detrimental influence on the thermal stability and hazard type of the organic peroxide formulation.

Temperature control requirements

2.2.52.1.15 Certain organic peroxides may only be carried under temperature-controlled conditions. The control temperature is the maximum temperature at which the organic peroxide can be safely carried. It is assumed that the temperature of the immediate surroundings of a package only exceeds 55 °C during carriage for a relatively short time in a 24 hour period. In the event of loss of temperature control, it may be necessary to implement emergency procedures. The emergency temperature is the temperature at which such procedures shall be implemented.

2.2.52.1.16 The control and emergency temperatures are derived from the SADT which is defined as the lowest temperature at which self-accelerating decomposition may occur with a substance in the packaging as used during carriage (see table 1). The SADT shall be determined in order to decide whether a substance shall be subjected to temperature control during carriage. Provisions for the determination of the SADT are given in the Manual of Tests and Criteria, Part II, sections 20 and 28.4.

Table 1. Derivation of control and emergency temperatures

SADT	Control temperature	Emergency temperature
20 °C or less	20 °C below SADT	10 °C below SADT
over 20 °C to 35 °C	15 °C below SADT	10 °C below SADT
over 35 °C	10 °C below SADT	5 °C below SADT

2.2.52.1.17 The following organic peroxides shall be subject to temperature control during carriage:

- organic peroxides types B and C with an SADT # 50 °C;
- organic peroxides type D showing a medium effect when heated under confinement with an SADT # 50 °C or showing a low or no effect when heated under confinement with an SADT # 45 °C; and
- organic peroxides types E and F with an SADT # 45 °C.

***NOTE**: Provisions for the determination of the effects of heating under confinement are given in the Manual of Tests and Criteria, Part II, Chapter 20 and section 28.4.*

2.2.52.1.18 Where applicable, control and emergency temperatures are listed in 2.2.52.4. The actual temperature during carriage may be lower than the control temperature but shall be selected so as to avoid dangerous separation of phases.

2.2.52.2 Substances not accepted for carriage

Organic peroxides, type A, shall not be accepted for carriage under the provisions of Class 5.2 [see Manual of Tests and Criteria, Part II, paragraph 20.4.3 (a)].

2.2.52.3 List of substances

Not temperature controlled — **P1**

	ORGANIC PEROXIDE TYPE A, LIQUID	} Not accepted for carriage, see 2.2.52.2
	ORGANIC PEROXIDE TYPE A, SOLID	
3101	ORGANIC PEROXIDE TYPE B, LIQUID	
3102	ORGANIC PEROXIDE TYPE B, SOLID	
3103	ORGANIC PEROXIDE TYPE C, LIQUID	
3104	ORGANIC PEROXIDE TYPE C, SOLID	
3105	ORGANIC PEROXIDE TYPE D, LIQUID	
3106	ORGANIC PEROXIDE TYPE D, SOLID	
3107	ORGANIC PEROXIDE TYPE E, LIQUID	
3108	ORGANIC PEROXIDE TYPE E, SOLID	
3109	ORGANIC PEROXIDE TYPE F, LIQUID	
3110	ORGANIC PEROXIDE TYPE F, SOLID	
	ORGANIC PEROXIDE TYPE G, LIQUID	} Not subject to the provisions of Class 5.2, see 2.2.52.1.6
	ORGANIC PEROXIDE TYPE G, SOLID	

Temperature controlled — **P2**

3111	ORGANIC PEROXIDE TYPE B, LIQUID, TEMPERATURE CONTROLLED
3112	ORGANIC PEROXIDE TYPE B, SOLID, TEMPERATURE CONTROLLED
3113	ORGANIC PEROXIDE TYPE C, LIQUID, TEMPERATURE CONTROLLED
3114	ORGANIC PEROXIDE TYPE C, SOLID, TEMPERATURE CONTROLLED
3115	ORGANIC PEROXIDE TYPE D, LIQUID, TEMPERATURE CONTROLLED
3116	ORGANIC PEROXIDE TYPE D, SOLID, TEMPERATURE CONTROLLED
3117	ORGANIC PEROXIDE TYPE E, LIQUID, TEMPERATURE CONTROLLED
3118	ORGANIC PEROXIDE TYPE E, SOLID, TEMPERATURE CONTROLLED
3119	ORGANIC PEROXIDE TYPE F, LIQUID, TEMPERATURE CONTROLLED
3120	ORGANIC PEROXIDE TYPE F, SOLID, TEMPERATURE CONTROLLED

2.2.52.4 List of currently assigned organic peroxides

ORGANIC PEROXIDE	Concentration (%)	Diluent type A (%)	Diluent type B (%) 1)	Inert solid (%)	Water (%)	Packing Method	Control Temperature (°C)	Emergency Temperature (°C)	Number (Generic entry)	Subsidiary risks and remarks
ACETYL ACETONE PEROXIDE	# 42	$ 48			$ 8	OP7			3105	2)
"	# 32 as a paste					OP7			3106	20)
ACETYL BENZOYL PEROXIDE	# 45	$ 55				OP7			3105	
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				OP8			3107	
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 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					OP7			3105	
"	# 42			$ 58		OP7			3106	
n-BUTYL-4,4-DI-(tert-BUTYLPEROXY)VALERATE	> 52 - 100					OP5			3103	
"	# 52			$ 48		OP7			3106	
"	# 42			$ 58		OP8			3108	
tert-BUTYL HYDROPEROXIDE	> 79 - 90				$ 10	OP5			3103	13)
"	# 80	$ 20				OP7			3105	4) 13)
"	# 79				> 14	OP8			3107	13) 23)
"	# 72				$ 28	OP8, N, M			3109	13)
tert-BUTYL HYDROPEROXIDE + DI-tert-BUTYLPEROXIDE	< 82 +> 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 MONOPEROXYPHTHALATE	# 100					OP5			3102	3)

ORGANIC PEROXIDE	Concentration (%)	Diluent type A (%)	Diluent type B (%) 1)	Inert solid (%)	Water (%)	Packing Method	Control Temperature (°C)	Emergency Temperature (°C)	Number (Generic entry)	Subsidiary risks and remarks
tert-BUTYL PEROXYACETATE	> 52 - 77	$ 23				OP5			3101	3)
"	> 32 - 52	$ 48				OP6			3103	
"	# 32	$ 68				OP8,N			3109	
" (in tanks)	# 32		$ 68			M	+30	+35	3119	
"	# 22		$ 78			OP8			3109	25)
tert-BUTYL PEROXYBENZOATE	> 77 - 100	< 22				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	
tert-BUTYL PEROXYDIETHYLACETATE + tert-BUTYL PEROXYBENZOATE	# 33 + # 33	$ 33				OP7			3105	
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	
" (in IBCs)	# 32		$ 68			N	+30	+35	3119	
" (in tanks)	# 32		$ 68			M	+15	+20	3119	
tert-BUTYL PEROXY-2-ETHYLHEXANOATE + 2,2-DI-(tert-BUTYLPEROXY)BUTANE	# 12 + # 14	>14		$ 60		OP7			3106	
"	# 31 + # 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	

ORGANIC PEROXIDE	Concentration (%)	Diluent type A (%)	Diluent type B (%) 1)	Inert solid (%)	Water (%)	Packing Method	Control Temperature (°C)	Emergency Temperature (°C)	Number (Generic entry)	Subsidiary risks and remarks
tert-BUTYL PEROXYNEODECANOATE	> 77 - 100					OP7	-5	+5	3115	
"	# 77		$ 23			OP7	0	+10	3115	
" (in IBCs)	# 42 as a stable dispersion in water					N	-5	+5	3119	
"	# 52 as a stable dispersion in water					OP8	0	+10	3117	
"	# 42 as a stable dispersion in water(frozen)					OP8	0	+10	3118	
"	# 32	$ 68				OP8, N	0	+10	3119	
tert-BUTYL PEROXYNEOHEPTANOATE	# 77	$ 23				OP7	0	+10	3115	
3-tert-BUTYLPEROXY-3-PHENYLPHTHALIDE	#100					OP7			3106	
tert-BUTYL PEROXYPIVALATE	> 67 - 77	$ 23				OP5	0	+10	3113	
"	> 27 - 67		$ 33			OP7	0	+10	3115	
"	# 27		$ 73			OP8	+30	+35	3119	
" (in IBCs)	# 27		$ 73			N	+10	+15	3119	
" (in tanks)	# 27		$ 73			M	+5	+10	3119	
tert-BUTYLPEROXY STEARYLCARBONATE	#100					OP7			3106	
tert-BUTYL PEROXY-3,5,5-TRIMETHYLHEXANOATE	> 32 - 100					OP7			3105	
"	# 32	$ 68				OP8,N			3109	
" (in tanks)	# 32		$ 68			M	+35	+40	3119	
3-CHLOROPEROXYBENZOIC ACID	> 57 - 86			$ 14		OP1			3102	3)
"	# 57			$ 3	$ 40	OP7			3106	
"	# 77			$ 6	$ 17	OP7			3106	
CUMYL HYDROPEROXIDE	> 90 - 98	# 10				OP8			3107	13)
"	# 90	$ 10				OP8, M			3109	13) 18)
CUMYL PEROXYNEODECANOATE	# 77		$ 23			OP7	-10	0	3115	
"	# 52 as a stable dispersion in water					OP8	-10	0	3119	
" (in IBCs)	# 52 as a stable dispersion in water					N	-15	-5	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	
DIACETONE ALCOHOL PEROXIDES	# 57		$ 26		$ 8	OP7	+40	+45	3115	6)

ORGANIC PEROXIDE	Concentration (%)	Diluent type A (%)	Diluent type B (%) 1)	Inert solid (%)	Water (%)	Packing Method	Control Temperature (°C)	Emergency Temperature (°C)	Number (Generic entry)	Subsidiary risks and remarks
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	
"	> 52 - 62 as a paste					OP7			3106	20)
"	> 35 - 52			$ 48		OP7			3106	
"	> 36 - 42	$ 18			# 40	OP8			3107	
"	> 36 - 42	$ 58				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, N			3109	
"	# 35			$ 65					Exempt	
DIBENZYL PEROXYDICARBONATE	# 87				$ 13	OP5	+25	+30	3112	3)
DI-(4-tert-BUTYLCYCLOHEXYL) PEROXYDICARBONATE	# 100					OP6	+30	+35	3114	
"	# 42 as a stable dispersion in water					OP8, N	+30	+35	3119	
DI-tert-BUTYL PEROXIDE	> 32 - 100					OP8			3107	
"	# 52		$ 48			OP8, N, M			3109	25)
DI-tert-BUTYL PEROXYAZELATE	# 52	$ 48				OP7			3105	
2,2-DI-(tert-BUTYLPEROXY)BUTANE	# 52	$ 48				OP6			3103	
1,1-DI-(tert-BUTYLPEROXY) CYCLOHEXANE	> 80 - 100					OP5			3101	3)
"	> 52 - 80	$ 20				OP5			3103	
"	> 42 - 52	$ 48				OP7			3105	
"	# 42	$ 13		$ 45		OP7			3106	
"	# 27	$ 36				OP8			3107	21)
"	# 42	$ 58				OP8, N			3109	
"	# 13	$ 13	$ 74			OP8			3109	

ORGANIC PEROXIDE	Concentration (%)	Diluent type A (%)	Diluent type B (%) 1)	Inert solid (%)	Water (%)	Packing Method	Control Temperature (°C)	Emergency Temperature (°C)	Number (Generic entry)	Subsidiary risks and remarks
DI-n-BUTYL PEROXYDICARBONATE	> 27 - 52		$ 48			OP7	-15	-5	3115	
"	# 27		$ 73			OP8	-10	0	3117	
"	# 42 as a stable dispersion in water (frozen)					OP8	-15	-5	3118	
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	
DI-(tert-BUTYLPEROXY) PHTHALATE	> 42 - 52	$ 48				OP7			3105	
"	# 52 as a paste					OP7			3106	20)
"	# 42	$ 58				OP8			3107	
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			OP7			3105	
"	# 57			$ 43		OP7			3106	
"	# 57	$ 43				OP8			3107	
"	# 32	$ 26	$ 42			OP8			3107	
DICETYL PEROXYDICARBONATE	# 100					OP7	+30	+35	3116	
"	# 42 as a stable dispersion in water					OP8, N	+30	+35	3119	
DI-4-CHLOROBENZOYL PEROXIDE	# 77				$ 23	OP5			3102	3)
"	# 52 as a paste					OP7			3106	20)
"	# 32			$ 68					Exempt	
DICUMYL PEROXIDE	> 42 - 100			# 57		OP8, M			3110	12)
"	# 52			$ 48					Exempt	
DICYCLOHEXYL PEROXYDICARBONATE	> 91 - 100					OP3	+5	+10	3112	3)
"	# 91				$ 9	OP5	+5	+10	3114	
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	

ORGANIC PEROXIDE	Concentration (%)	Diluent type A (%)	Diluent type B (%) 1)	Inert solid (%)	Water (%)	Packing Method	Control Temperature (°C)	Emergency Temperature (°C)	Number (Generic entry)	Subsidiary risks and remarks
DI-2,4-DICHLOROBE NZOYL 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	
" (in IBCs)	# 52 as a stable dispersion in water					N	-20	-10	3119	
"	# 52 as a stable dispersion in water					OP8	-15	-5	3119	
"	# 42 as a stable dispersion in water (frozen)					OP8	-15	-5	3118	
DIETHYL PEROXYDICARBONATE	# 27		$ 73			OP7	-10	0	3115	
2,2-DIHYDROPEROXYPROPANE	# 27			$ 73		OP5			3102	3)
DI-(1-HYDROXYCYCLOHEXYL) PEROXIDE	#100					OP7			3106	
DIISOBUT YRYL PEROXIDE	> 32 - 52		$ 48			OP5	-20	-10	3111	3)
"	# 32		$ 68			OP7	-20	-10	3115	
DI-ISOPROPYLBENZENE DIHYDROPEROXIDE	# 82	$ 5			$ 5	OP7			3106	24)
DIISOPROPYL PEROXYDICARBONATE	> 52 - 100					OP2	-15	-5	3112	3)
"	# 52		$ 48			OP7	-20	-10	3115	
DIISOTRIDECYL PEROXYDICARBONATE	#100					OP7	-10	0	3115	
DILAUROYL PEROXIDE	#100					OP7			3106	
"	# 42 as a stable dispersion in water					OP8, N			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 + BENZOYL (3-METHYLBENZOYL) PEROXIDE + DIBENZOYL PEROXIDE	# 20+# 18+# 4		$ 58			OP7	+35	+40	3115	
DI-(4-METHYLBENZOYL) PEROXIDE	# 52 as a paste with silicon oil				OP7			3106		
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	
"	# 52			$ 48		OP7			3106	
"	#47 as a paste					OP8			3108	
"	# 52	$ 48				OP8			3109	
"	# 77			$ 23		OP8			3108	

ORGANIC PEROXIDE	Concentration (%)	Diluent type A (%)	Diluent type B (%) 1)	Inert solid (%)	Water (%)	Packing Method	Control Temperature (°C)	Emergency Temperature (°C)	Number (Generic entry)	Subsidiary risks and remarks
2,5-DIMETHYL-2,5-DI-(tert-BUTYLPEROXY)HEXYNE-3	> 52 - 86	$ 14				OP5			3103	26)
"	# 52			$ 48		OP7			3106	
"	> 86 - 100					OP5			3101	3)
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-TRIMETHYLHEXANOYLPEROXY)HEXANE	# 77	$ 23				OP7			3105	
1,1-DIMETHYL-3-HYDROXYBUTYL PEROXYNEOHEPTANOATE	# 52	$ 48				OP8	0	+10	3117	
DIMYRISTYL PEROXYDICARBONATE	#100					OP7	+20	+25	3116	
"	# 42 as a stable dispersion in water					OP8	+20	+25	3119	
" (in IBCs)	# 42 as a stable dispersion in water					N	+15	+20	3119	
DI-(2-NEODECANOYLPEROXYISOPROPYL) BENZENE	# 52	$ 48				OP7	-10	0	3115	
DI-n-NONANOYL PEROXIDE	#100					OP7	0	+10	3116	
DI-n-OCTANOYL PEROXIDE	#100					OP5	+10	+15	3114	
DIPEROXY AZELAIC ACID	# 27			$ 73		OP7	+35	+40	3116	
DIPEROXY DODECANE DIACID	> 13 - 42			$ 58		OP7	+40	+45	3116	
"	# 13			$ 87					Exempt	
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	
DISTEARYL PEROXYDICARBONATE	# 87			$ 13		OP7			3106	
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, N	+10	+15	3119	
"	# 38	$ 62				OP8	+20	+25	3119	
" (in IBCs)	# 38	$ 62				N	+10	+15	3119	
" (in tanks)	# 38	$ 62				M	0	+5	3119	
DI-(3,5,5-TRIMETHYL-1,2-DIOXOLANYL-3) PEROXIDE	# 52 as a paste					OP7	+30	+35	3116	20)
ETHYL 3,3-DI-(tert-AMYLPEROXY)BUTYRATE	# 67	$ 33				OP7			3105	

ORGANIC PEROXIDE	Concentration (%)	Diluent type A (%)	Diluent type B (%) 1)	Inert solid (%)	Water (%)	Packing Method	Control Temperature (°C)	Emergency Temperature (°C)	Number (Generic entry)	Subsidiary risks and remarks
ETHYL 3,3-DI-(tert-BUTYLPEROXY)BUTYRATE	> 77 - 100					OP5			3103	
"	# 77	$ 23				OP7			3105	
"	# 52			$ 48		OP7			3106	
3,3,6,6,9,9-HEXAMETHYL-1,2,4,5-TETRAOXACYCLONONANE	> 52 - 100					OP4			3102	3)
"	# 52	$ 48				OP7			3105	
"	# 52			$ 48		OP7			3106	
tert-HEXYL PEROXYNEODECANOATE	# 71	$ 29				OP7	0	+10	3115	
tert-HEXYL PEROXYPIVALATE	# 72		$ 28			OP7	+10	+15	3115	
ISOPROPYL sec-BUTYL PEROXYDICARBONATE +DI-sec-BUTYL PEROXYDICARBONATE	# 32 +# 15 - 18	$ 38				OP7	-20	-10	3115	
+DI-ISOPROPYL PEROXYDICARBONATE	+ # 12 - 15									
ISOPROPYL sec-BUTYL PEROXYDICARBONATE + DI-sec-BUTYL PEROXYDICARBONATE + DI-ISOPROPYL PEROXYDICARBONATE	# 52 + # 28 + # 22					OP5	-20	-10	3111	3)
ISOPROPYLCUMYL HYDROPEROXIDE	# 72	$ 28				OP8, M			3109	13)
p-MENTHYL HYDROPEROXIDE	> 72 - 100					OP7			3105	13)
"	# 72	$ 28				OP8, M			3109	27)
METHYLCYCLOHEXANONE PEROXIDE(S)	# 67		$ 33			OP7	+35	+40	3115	
METHYL ETHYL KETONE PEROXIDE(S)	# 52	$ 48				OP5			3101	3) 8) 13)
"	# 45	$ 55				OP7			3105	9)
"	# 40	$ 60				OP8			3107	10)
"	# 37	$ 55			$ 8	OP7			3105	9)
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)
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, N			3109	13) 16) 19)
PINANYL HYDROPEROXIDE	56 - 100					OP7			3105	13)
"	< 56	> 44				OP8, M			3109	
TETRAHYDRONAPHTHYL HYDROPEROXIDE	#100					OP7			3106	

ORGANIC PEROXIDE	Concen-tration (%)	Diluent type A (%)	Diluent type B (%) 1)	Inert solid (%)	Water (%)	Packing Method	Control Tempera-ture (°C)	Emergency Tempera-ture (°C)	Number (Generic entry)	Subsidiary risks and remarks
1,1,3,3-TETRAMETHYLBUTYL HYDROPEROXIDE	# 100					OP7			3105	
1,1,3,3-TETRAMETHYLBUTYL PEROXY-2 ETHYLHEXANOATE	# 100					OP7	+20	+25	3115	
1,1,3,3- TETRAMETHYLBUTYL PEROXYNEODECANOATE	# 72		$ 28			OP7	-5	+5	3115	
"	# 52 as a stable dispersion in water					OP8, N	-5	+5	3119	
1,1,3,3- TETRAMETHYLBUTYL PEROXYPHENOACETATE	# 37		$ 63			OP7	-10	0	3115	
3,6,9-TRIETHYL-3,6,9-TRIMETHYL -1,4,7-TRIPEROXONANE	# 42	$ 58				OP7			3105	28)

Notes on 2.2.52.3:

1) Diluent type B may always be replaced by diluent type A.

2) Available oxygen # 4.7%.

3) "EXPLOSIVE" subsidiary risk label required.

4) 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 packagings allowed.

8) Available oxygen > 10%.

9) Available oxygen # 10%.

10) Available oxygen # 8.2%.

11) See 2.2.52.1.9.

12) Up to 2000 kg per receptacle assigned to ORGANIC PEROXIDE TYPE F on the basis of large scale trials.

13) "CORROSIVE" subsidiary risk label required.

14) Peroxyacetic acid formulations which fulfil the criteria of the Manual of Tests and Criteria, paragraph 20.4.3 (d).

15) Peroxyacetic acid formulations which fulfil the criteria of the Manual of Tests and Criteria, paragraph 20.4.3 (e).

16) Peroxyacetic acid formulations which fulfil the criteria of the Manual of Tests and Criteria, paragraph 20.4.3 (f).

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 $ 36%, by mass, ethylbenzene in addition to diluent type A.

22) With $ 19%, by mass, methyl isobutyl ketone in addition to diluent type A.

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 < 0.5% hydroperoxides content.

27) For concentrations more than 56%, "CORROSIVE" subsidiary risk label required.

28) Available active oxygen # 7.6% in diluent Type A having a 95% boil-off point in the range of 200 - 260 °C.

2.2.61 Class 6.1 Toxic substances

2.2.61.1 Criteria

2.2.61.1.1 The heading of Class 6.1 covers substances of which it is known by experience or regarding which it is presumed from experiments on animals that in relatively small quantities they are able by a single action or by action of short duration to cause damage to human health, or death, by inhalation, by cutaneous absorption or by ingestion.

2.2.61.1.2 Substances of Class 6.1 are subdivided as follows:

T Toxic substances without subsidiary risk

- T1 Organic, liquid
- T2 Organic, solid
- T3 Organometallic substances
- T4 Inorganic, liquid
- T5 Inorganic, solid
- T6 Liquid, used as pesticides
- T7 Solid, used as pesticides
- T8 Samples
- T9 Other toxic substances

TF Toxic substances, flammable

- TF1 Flammable, liquid
- TF2 Flammable, liquid, used as pesticides
- TF3 Toxic substances, flammable, solid

TS Toxic substances, liable to spontaneous combustion, solid

TW Toxic substances, which, in contact with water, emit flammable gases

- TW1 Liquid
- TW2 Solid

TO Toxic substances, oxidizing

- TO1 Liquid
- TO2 Solid

TC Toxic substances, corrosive

- TC1 Organic, liquid
- TC2 Organic, solid
- TC3 Inorganic, liquid
- TC4 Inorganic, solid

TFC Toxic substances, flammable, corrosive

Definitions

2.2.61.1.3 For the purposes of ADR:

LD_{50} for acute oral toxicity is that dose of the substance administered which is most likely to cause death within 14 days in one half of both male and female young adult albino rats. The number of animals tested shall be sufficient to give a statistically significant result and be in conformity with good pharmacological practice. The result is expressed in milligrams per kg body mass.

LD_{50} for acute dermal toxicity is that dose of the substance which, administered by continuous contact for 24 hours with the bare skin of albino rabbits, is most likely to cause death within 14 days in one half of the animals tested. The number of animals tested shall be sufficient to give a statistically significant result and be in conformity with good pharmacological practice. The result is expressed in milligrams per kg body mass.

LC_{50} for acute toxicity on inhalation is that concentration of vapour, mist or dust which, administered by continuous inhalation to both male and female young adult albino rats for one hour, is most likely to cause death within 14 days in one half of the animals tested. A solid substance shall be tested if at least 10% (by mass) of its total mass is likely to be dust in a respirable range, e.g. the aerodynamic diameter of that particle-fraction is 10 µm or less. A liquid substance shall be tested if a mist is likely to be generated in a leakage of the transport containment. Both for solid and liquid substances more than 90% (by mass) of a specimen prepared for inhalation toxicity shall be in the respirable range as defined above. The result is expressed in milligrams per litre of air for dusts and mists or in millilitres per cubic metre of air (parts per million) for vapours.

Classification and assignment of packing groups

2.2.61.1.4 Substances of Class 6.1 shall be classified in three packing groups according to the degree of danger they present for carriage, as follows:

- Packing group I: highly toxic substances
- Packing group II: toxic substances
- Packing group III: slightly toxic substances.

2.2.61.1.5 Substances, mixtures, solutions and articles classified in Class 6.1 are listed in table A of Chapter 3.2. The assignment of substances, mixtures and solutions not mentioned by name in table A of Chapter 3.2 to the relevant entry of sub-section 2.2.61.3 and to the relevant packing group in accordance with the provisions of Chapter 2.1, shall be made according to the following criteria in 2.2.61.1.6 to 2.2.61.1.11.

2.2.61.1.6 To assess the degree of toxicity, account shall be taken of human experience of instances of accidental poisoning, as well as special properties possessed by any individual substances: liquid state, high volatility, any special likelihood of cutaneous absorption, and special biological effects.

2.2.61.1.7 In the absence of observations on humans, the degree of toxicity shall be assessed using the available data from animal experiments in accordance with the table below:

2.2.61.1.7 (cont'd)

	Packing group	Oral toxicity LD_{50} (mg/kg)	Dermal toxicity LD_{50} (mg/kg)	Toxicity on inhalation of dusts and mists LC_{50} (mg/l)
Highly toxic	I	5	40	0.5
Toxic	II	> 5-50	> 40 - 200	> 0.5-2
Slightly toxic	III [1]	solids: > 50-200 liquids: > 50-500	> 200 - 1000	> 2-10

2.2.61.1.7.1 Where a substance exhibits different degrees of toxicity for two or more kinds of exposure, it shall be classified under the highest such degree of toxicity.

2.2.61.1.7.2 Substances meeting the criteria of Class 8 and with an inhalation toxicity of dusts and mists (LC_{50}) leading to packing group I shall only be accepted for an allocation to Class 6.1 if the toxicity through oral ingestion or dermal contact is at least in the range of packing groups I or II. Otherwise an assignment to Class 8 shall be made if appropriate (see footnote[1] in 2.2.8.1.4).

2.2.61.1.7.3 The criteria for inhalation toxicity of dusts and mists are based on LC_{50} data relating to 1-hour exposure, and where such information is available it shall be used. However, where only LC_{50} data relating to 4-hour exposure are available, such figures can be multiplied by four and the product substituted in the above criteria, i.e. LC_{50} value multiplied by four (4 hour) is considered the equivalent of LC_{50} (1 hour).

Inhalation toxicity of vapours

2.2.61.1.8 Liquids giving off toxic vapours shall be classified into the following groups where "V" is the saturated vapour concentration (in ml/m^3 of air) (volatility) at 20 °C and standard atmospheric pressure:

	Packing group	
Highly toxic	I	Where V 10 LC_{50} and LC_{50} 1 000 ml/m^3
Toxic	II	Where V LC_{50} and LC_{50} 3 000 ml/m^3 and the criteria for packing group I are not met
Slightly toxic	III	Where V 1/5 LC_{50} and LC_{50} 5 000 ml/m^3 and the criteria for packing groups I and II are not met

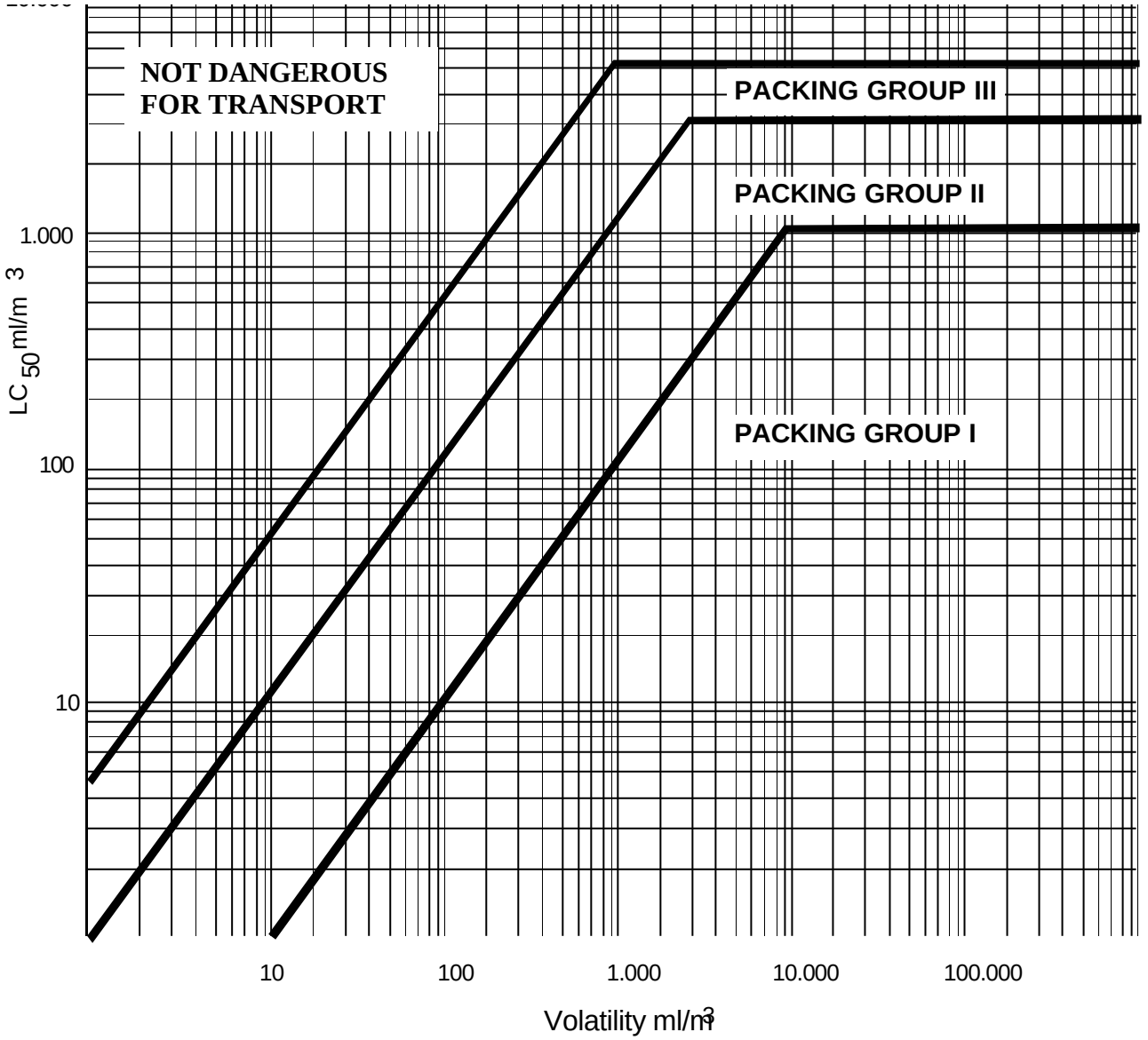
These criteria for inhalation toxicity of vapours are based on LC_{50} data relating to 1-hour exposure, and where such information is available, it shall be used.

[1] *Tear gases shall be included in packing group II even if data concerning their toxicity correspond to packing group III criteria.*

2.2.61.1.8 (cont'd)

However, where only LC_{50} data relating to 4-hour exposure to the vapours are available, such figures can be multiplied by two and the product substituted in the above criteria, i.e. LC_{50} (4 hour) × 2 is considered the equivalent of LC_{50} (1 hour).

Group borderlines inhalation toxicity of vapours



In this figure, the criteria are expressed in graphical form, as an aid to easy classification. However, due to approximations inherent in the use of graphs, substances falling on or near group borderlines shall be checked using numerical criteria.

Mixtures of liquids

2.2.61.1.9 Mixtures of liquids which are toxic on inhalation shall be assigned to packing groups according to the following criteria:

2.2.61.1.9.1 If LC_{50} is known for each of the toxic substances constituting the mixture, the packing group may be determined as follows:

(a) calculation of the LC_{50} of the mixture:

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

where f_i = molar fraction of constituent i of the mixture.
LC_{50i} = average lethal concentration of constituent i in ml/m^3.

(b) calculation of volatility of each mixture constituent:

$$V_I = P_I \times \frac{10^6}{101.3}\ ml/m^3$$

where P_i = partial pressure of constituent *i* in kPa at 20 °C and at standard atmospheric pressure.

(c) calculation of the ratio of volatility to LC_{50}:

$$R = \sum_{i=1}^{N} \frac{V_i}{LC_{50i}}$$

(d) the values calculated for LC_{50} (mixture) and R are then used to determine the packing group of the mixture:

Packing group I R 10 and LC_{50} (mixture) 1 000 ml/m^3

Packing group II R 1 and LC_{50} (mixture) 3 000 ml/m^3, if the mixture does not meet the criteria for packing group I

Packing group III R 1/5 and LC_{50} (mixture) 5 000 ml/m^3, if the mixture does not meet the criteria of packing groups I or II.

2.2.61.1.9.2 In the absence of LC_{50} data on the toxic constituent substances, the mixture may be assigned to a group based on the following simplified threshold toxicity tests. When these threshold tests are used, the most restrictive group shall be determined and used for carrying the mixture.

2.2.61.1.9.3 A mixture is assigned to packing group I only if it meets both of the following criteria:

(a) A sample of the liquid mixture is vaporized and diluted with air to create a test atmosphere of 1000 ml/m^3 vaporized mixture in air. Ten albino rats (5 male and 5 female) are exposed to the test atmosphere for 1 hour and observed for 14 days. If five or more of the animals die within the 14-day observation period, the mixture is presumed to have an LC_{50} equal to or less than 1000 ml/m^3;

(b) A sample of vapour in equilibrium with the liquid mixture is diluted with 9 equal volumes of air to form a test atmosphere. Ten albino rats (5 male and 5 female) are exposed to the test atmosphere for 1 hour and observed for 14 days. If five or more of the animals die within the 14-day observation period, the mixture is presumed to have a volatility equal to or greater than 10 times the mixture LC_{50}.

2.2.61.1.9.4 A mixture is assigned to packing group II only if it meets both of the following criteria, and does not meet the criteria for packing group I:

(a) A sample of the liquid mixture is vaporized and diluted with air to create a test atmosphere of 3000 ml/m^3 vaporized mixture in air. Ten albino rats (5 male and 5 female) are exposed to the test atmosphere for 1 hour and observed for 14 days. If five or more of the animals die within the 14-day observation period, the mixture is presumed to have an LC_{50} equal to or less than 3000 ml/m^3;

(b) A sample of the vapour in equilibrium with the liquid mixture is used to form a test atmosphere. Ten albino rats (5 male and 5 female) are exposed to the test atmosphere for 1 hour and observed for 14 days. If five or more of the animals die within the 14-day observation period, the mixture is presumed to have a volatility equal to or greater than the mixture LC_{50}.

2.2.61.1.9.5 A mixture is assigned to packing group III only if it meets both of the following criteria, and does not meet the criteria for packing groups I or II:

(a) A sample of the liquid mixture is vaporized and diluted with air to create a test atmosphere of 5000 ml/m^3 vaporized mixture in air. Ten albino rats (5 male and 5 female) are exposed to the test atmosphere for 1 hour and observed for 14 days. If five or more of the animals die within the 14-day observation period, the mixture is presumed to have an LC_{50} equal to or less than 5000 ml/m^3;

(b) The vapour concentration (volatility) of the liquid mixture is measured and if the vapour concentration is equal to or greater than 1000 ml/m^3, the mixture is presumed to have a volatility equal to or greater than 1/5 the mixture LC_{50}.

Methods for determining oral and dermal toxicity of mixtures

2.2.61.1.10 When classifying and assigning the appropriate packing group to mixtures in Class 6.1 in accordance with the oral and dermal toxicity criteria (see 2.2.61.1.3), it is necessary to determine the acute LD_{50} of the mixture.

2.2.61.1.10.1 If a mixture contains only one active substance, and the LD_{50} of that constituent is known, in the absence of reliable acute oral and dermal toxicity data on the actual mixture to be transported, the oral or dermal LD_{50} may be obtained by the following method:

$$LD_{50}\ value\ of\ preparation\ = \frac{LD_{50} value\ of\ active\ substance\ \times\ 100}{percentage\ of\ active\ substance\ by\ mass}$$

2.2.61.1.10.2 If a mixture contains more than one active constituent, there are three possible approaches that may be used to determine the oral or dermal LD_{50} of the mixture. The preferred method is to obtain reliable acute oral and dermal toxicity data on the actual mixture to be transported. If reliable, accurate data is not available, then either of the following methods may be performed:

(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 active constituents; or

(b) Apply the formula:

$$\frac{C_A}{T_A} + \frac{C_B}{T_B} + \ldots + \frac{C_Z}{T_Z} = \frac{100}{T_M}$$

where:

C = the percentage concentration of constituent A, B, ... Z in the mixture
T = the oral LD_{50} values of constituent A, B, ... Z
T_M = the oral LD_{50} value of the mixture.

NOTE: *This formula can also be used for dermal toxicities provided that this information is available on the same species for all constituents. The use of this formula does not take into account any potentiation or protective phenomena.*

Classification of pesticides

2.2.61.1.11 All active pesticide substances and their preparations for which the LC_{50} and/or LD_{50} values are known and which are classified in Class 6.1 shall be classified under appropriate packing groups in accordance with the criteria given in 2.2.61.1.6 to 2.2.61.1.9. Substances and preparations which are characterized by subsidiary risks shall be classified according to the precedence of hazard table in 2.1.3.9 with the assignment of appropriate packing groups.

2.2.61.1.11.1 If the oral or dermal LD_{50} value for a pesticide preparation is not known, but the LD_{50} value of its active substance(s) is known, the LD_{50} value for the preparation may be obtained by applying the procedures in 2.2.61.1.10.

NOTE*: LD_{50} toxicity data for a number of common pesticides may be obtained from the most current edition of the document "The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification" available from the International Programme on Chemical Safety, World Health Organisation (WHO), 1211 Geneva 27, Switzerland. While that document may be used as a source of LD_{50} data for pesticides, its classification system shall not be used for purposes of transport classification of, or assignment of packing groups to, pesticides, which shall be in accordance with the requirements of ADR.*

2.2.61.1.11.2 The proper shipping name used in the transport of the pesticide shall be selected on the basis of the active ingredient, of the physical state of the pesticide and any subsidiary risks it may exhibit (see 3.1.2).

2.2.61.1.12 If substances of Class 6.1, 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 listed under 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.*

2.2.61.1.13 On the basis of the criteria of paragraph (5), 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 requirements for this Class.

2.2.61.1.14 Substances, solutions and mixtures, with the exception of substances and preparations used as pesticides, which do not meet the criteria of Directives 67/548/EEC [2] or 88/379/EEC [3] as amended and which are not therefore classified as highly toxic, toxic or harmful according to these directives, as amended, may be considered as substances not belonging to Class 6.1.

2.2.61.2 Substances not accepted for carriage

2.2.61.2.1 Chemically unstable substances of Class 6.1 shall not be accepted for carriage unless the necessary steps have been taken to prevent their dangerous decomposition or polymerization during carriage. To this end, it shall in particular be ensured that receptacles and tanks do not contain any substance(s) likely to cause such a reaction.

2.2.61.2.2 The following substances and mixtures shall not be accepted for carriage:

- Hydrogen cyanides (stabilized or in solutions), other than UN Nos. 1051, 1613, 1614 and 3294;

- metal carbonyls, having a flash-point below 23 °C, other than UN Nos. 1295 NICKEL CARBONYL and 1994 IRON PENTACARBONYL;

- 2,3,7,8-TETRACHLORODIBENZO-P-DIOXINE (TCDD) in concentrations considered highly toxic in accordance with the criteria in 2.2.61.1.7;

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[2] *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, page 1).*

[3] *Council Directive 88/379/EEC on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous preparations (Official Journal of the European Communities No. L 187 of 16.07.1988, page 14).*

- 2249 DICHLORODIMETHYL ETHER, SYMMETRICAL;

- preparations of phosphides without additives inhibiting the emission of flammable gases.

2.2.61.3 List of collective entries

Toxic substances without subsidiary risk(s)

Organic

liquid [1,2] — **T1**

1583	CHLOROPICRIN MIXTURE, N.O.S.
1602	DYE, LIQUID, TOXIC, N.O.S., or 1602 DYE INTERMEDIATE, LIQUID, TOXIC, N.O.S.
1693	TEAR GAS SUBSTANCE, LIQUID or SOLID, N.O.S.
1851	MEDICINE, LIQUID, TOXIC, N.O.S.
2206	ISOCYANATES, TOXIC, N.O.S. or 2206 ISOCYANATE SOLUTION, TOXIC, N.O.S.
3140	ALKALOIDS, LIQUID, N.O.S. or 3140 ALKALOID SALTS, LIQUID, N.O.S.
3142	DISINFECTANT, LIQUID, TOXIC, N.O.S.
3144	NICOTINE COMPOUND, LIQUID, N.O.S. or 3144 NICOTINE PREPARATION, LIQUID, N.O.S.
3172	TOXINS, EXTRACTED FROM LIVING SOURCES, N.O.S.
3276	NITRILES, TOXIC, N.O.S
3278	ORGANOPHOSPHORUS COMPOUND, TOXIC, N.O.S.
2810	TOXIC LIQUID, ORGANIC, N.O.S.

solid [1, 2, 3] — **T2**

1544	ALKALOIDS, SOLID, N.O.S. or 1544 ALKALOID SALTS, SOLID, N.O.S.
1601	DISINFECTANT, SOLID, TOXIC, N.O.S.
1655	NICOTINE COMPOUND, SOLID, N.O.S., or 1655 NICOTINE PREPARATION, SOLID, N.O.S.
1693	TEAR GAS SUBSTANCE, LIQUID or 1693 SOLID, N.O.S.
3143	DYE, SOLID, TOXIC, N.O.S. or 3143 DYE INTERMEDIATE, SOLID, TOXIC, N.O.S.
3172	TOXINS, EXTRACTED FROM LIVING SOURCES, N.O.S.
3249	MEDICINE, SOLID, TOXIC, N.O.S.
2811	TOXIC SOLID, ORGANIC, N.O.S.

Organometallic [4,5] — **T3**

2026	PHENYLMERCURIC COMPOUND, N.O.S.
2788	ORGANOTIN COMPOUND, LIQUID, N.O.S.
3146	ORGANOTIN COMPOUND, SOLID, N.O.S.
3280	ORGANOARSENIC COMPOUND, N.O.S.
3281	METAL CARBONYLS, N.O.S
3282	ORGANOMETALLIC COMPOUND, TOXIC, N.O.S.

Inorganic

liquid [6] — **T4**

1556	ARSENIC COMPOUND, LIQUID, N.O.S., inorganic including: Arsenates, n.o.s., Arsenites, n.o.s.; and Arsenic sulphides, n.o.s.
1935	CYANIDE SOLUTION, N.O.S.
2024	MERCURY COMPOUND, LIQUID, N.O.S.
3141	ANTIMONY COMPOUND, INORGANIC, LIQUID, N.O.S.
3287	TOXIC LIQUID, INORGANIC, N.O.S.

solids [7,8] — **T5**

1549	ANTIMONY COMPOUND, INORGANIC, SOLID, N.O.S
1557	ARSENIC COMPOUND, SOLID, N.O.S., including: Arsenates, n.o.s.; Arsenites, n.o.s.; and Arsenic sulphides, n.o.s.
1564	BARIUM COMPOUND, N.O.S.
1566	BERYLLIUM COMPOUND, N.O.S.
1588	CYANIDES, INORGANIC, SOLID, N.O.S.
1707	THALLIUM COMPOUND, N.O.S.
2025	MERCURY COMPOUND, SOLID, N.O.S.
2291	LEAD COMPOUND, SOLUBLE, N.O.S.
2570	CADMIUM COMPOUND
2630	SELENATES or 2630 SELENITES
2856	FLUOROSILICATES, N.O.S.
3283	SELENIUM COMPOUND, N.O.S.
3284	TELLURIUM COMPOUND, N.O.S.
3285	VANADIUM COMPOUND, N.O.S.
3288	TOXIC SOLID, INORGANIC, N.O.S.

(cont'd on next page)

Toxic substances without subsidiary risk(s) (*cont'd*)

Pesticides	**liquid**	**T6**	2992	CARBAMATE PESTICIDE, LIQUID, TOXIC
			2994	ARSENICAL PESTICIDE, LIQUID, TOXIC
			2996	ORGANOCHLORINE PESTICIDE, LIQUID, TOXIC
			2998	TRIAZINE PESTICIDE, LIQUID, TOXIC
			3006	THIOCARBAMATE PESTICIDE, LIQUID, TOXIC
			3008	PHTHALIMIDE DERIVATIVE PESTICIDE, LIQUID, TOXIC
			3010	COPPER BASED PESTICIDE, LIQUID, TOXIC
			3012	MERCURY BASED PESTICIDE, LIQUID, TOXIC
			3014	SUBSTITUTED NITROPHENOL PESTICIDE, LIQUID, TOXIC
			3016	BIPYRIDILIUM PESTICIDE, LIQUID, TOXIC
			3018	ORGANOPHOSPHORUS PESTICIDE, LIQUID, TOXIC
			3020	ORGANOTIN PESTICIDE, LIQUID, TOXIC
			3026	COUMARIN DERIVATIVE PESTICIDE, LIQUID, TOXIC
			3348	PHENOXYACETIC ACID DERIVATIVE PESTICIDE, LIQID, TOXIC
			3352	PYRETHROID PESTICIDE, LIQUID, TOXIC
			2902	PESTICIDE, LIQUID, TOXIC, N.O.S.
	solid	**T7**	3048	ALUMINIUM PHOSPHIDE PESTICIDE
			2757	CARBAMATE PESTICIDE, SOLID, TOXIC
			2759	ARSENICAL PESTICIDE, SOLID, TOXIC
			2761	ORGANOCHLORINE PESTICIDE, SOLID, TOXIC
			2763	TRIAZINE PESTICIDE, SOLID, TOXIC
			2771	DITHIOCARBAMATE PESTICIDE, SOLID, TOXIC
			2775	COPPER BASED PESTICIDE, SOLID, TOXIC
			2777	MERCURY BASED PESTICIDE, SOLID, TOXIC
			2779	SUBSTITUTED NITROPHENOL PESTICIDE, SOLID, TOXIC
			2781	BIPYRIDILIUM PESTICIDE, SOLID, TOXIC
			2783	ORGANOPHOSPHORUS PESTICIDE, SOLID, TOXIC
			2786	ORGANOTIN PESTICIDE, SOLID, TOXIC
			3027	COUMARIN DERIVATIVE PESTICIDE, SOLID, TOXIC
			3345	PHENOXYACETIC ACID DERIVATIVE PESTICIDE, SOLID, TOXIC
			3349	PYRETHROID PESTICIDE, SOLID, TOXIC
			2588	PESTICIDE, SOLID, TOXIC, N.O.S.
Samples		**T8**	3243	CHEMICAL SAMPLE, TOXIC liquid or solid.
Other toxic substances[9]		**T9**	3315	SOLIDS CONTAINING TOXIC LIQUID, N.O.S.

(cont'd on next page)

Toxic substances with subsidiary risk(s)

Liquid, flammable
TF

liquid	**TF1** [10,11]	3071 MERCAPTANS, LIQUID, TOXIC, FLAMMABLE, N.O.S. or 3071 MERCAPTAN MIXTURE, LIQUID, TOXIC, FLAMMABLE, N.O.S. 3080 ISOCYANATES, TOXIC, FLAMMABLE, N.O.S. or 3080 ISOCYANATE SOLUTION, TOXIC, FLAMMABLE, N.O.S. 3275 NITRILES, TOXIC, FLAMMABLE, N.O.S. 3279 ORGANOPHOSPHORUS COMPOUND, TOXIC, FLAMMABLE, N.O.S. 2929 TOXIC LIQUID, FLAMMABLE, ORGANIC, N.O.S.
Pesticides, liquid (flash-point not less than 23 °C)	**TF2**	2991 CARBAMATE PESTICIDE, LIQUID, TOXIC, FLAMMABLE 2993 ARSENICAL PESTICIDE, LIQUID, TOXIC, FLAMMABLE 2995 ORGANOCHLORINE PESTICI DE, LIQUID, TOXIC, FLAMMABLE 2997 TRIAZINE PESTICIDE, LIQUID, TOXIC, FLAMMABLE 3005 THIOCARBAMATE PESTICIDE, LIQUID, TOXIC, FLAMMABLE 3009 COPPER BASED PESTICIDE, LIQUID, TOXIC, FLAMMA BLE 3011 MERCURY BASED PESTICIDE, LIQUID, TOXIC, FLAMMABLE 3013 SUBSTITUTED NITROPHENOL PESTICIDE, LIQUID, TOXIC, FLAMMABLE 3015 BIPYRIDILIUM PESTICIDE, LIQUID, TOXIC, FLAMMABLE 3017 ORGANOPHOSPHORUS PESTICIDE, LIQUID, TOXIC, FLAMMABLE 3019 ORGANOTIN PESTICIDE, LIQUID, TOXIC, FLAMMABLE 3025 COUMARIN DERIVATIVE PESTICIDE, LIQUID, TOXIC, FLAMMABLE 3347 PHENOXYACETIC ACID DERIVATIVE PESTICIDE, LIQUID, TOXIC, FLAMMABLE 3351 PYRETHROID PESTICIDE, LIQUID, TOXIC, FLAMMABLE
solid	**TF3**	2903 PESTICIDE, LIQUID, TOXIC, FLAMMABLE, N.O.S. 2930 TOXIC SOLID, FLAMMABLE, ORGANIC, N.O.S.

Solid, self-heating [4]
TS

		3124 TOXIC SOLID, SELF-HEATING, N.O.S.

Water-reactive [5]
TW

liquid	**TW1**	3123 TOXIC LIQUID, WATER-REACTIVE, N.O.S.
solid [14]	**TW2**	3125 TOXIC SOLID, WATER-REACTIVE, N.O.S.

Oxidizing [12]
TO

liquid	**TO1**	3122 TOXIC LIQUID, OXIDIZING, N.O.S.
solid	**TO2**	3086 TOXIC SOLID, OXIDIZING, N.O.S.

Corrosive [13]
TC

organic	**liquid**	**TC1**	3277 CHLOROFORMATES, TOXIC, CORROSIVE, N.O.S. 2927 TOXIC LIQUID, CORROSIVE, ORGANIC, N.O.S.
	solid	**TC2**	2928 TOXIC SOLID, CORROSIVE, ORGANIC, N.O.S.
inorganic	**liquid**	**TC3**	3289 TOXIC LIQUID, CORROSIVE, INORGANIC, N.O.S.
	solid	**TC4**	3290 TOXIC SOLID, CORROSIVE, INORGANIC, N.O.S.

Flammable, corrosive
TFC

		2742 CHLOROFORMATES, TOXIC, CORROSIVE, FLAMMABLE, N.O.S. (no general n.o.s. entry available, classification according to table of precedence of hazard in 2.1.3.9)).

***NOTES**:*

[1] *Substances and preparations containing alkaloids or nicotine used as pesticides shall be classified under UN No. 2588 PESTICIDES, SOLID, TOXIC, N.O.S., UN No. 2902 PESTICIDES, LIQUID, TOXIC, N.O.S. or UN No. 2903 PESTICIDES, LIQUID, TOXIC, FLAMMABLE, N.O.S.*

[2] *Pharmaceutical products ready for use, e.g. cosmetics, drugs and medicines, which are substances manufactured and packed in packagings of a type intended for retail sale or distribution for personal or household consumption, which would otherwise be active substances intended for laboratories and experiments and for the manufacture of pharmaceutical products, are not subject to the provisions of ADR.*

[3] *Active substances and triturations or mixtures of substances intended for laboratories and experiments and for the manufacture of pharmaceutical products with other substances shall be classified according to their toxicity (see 2.2.61.1.7 to 2.2.61.1.11).*

[4] *Self-heating substances, slightly toxic and spontaneously combustible, and organometallic compounds, are substances of Class 4.2.*

[5] *Water-reactive substances, slightly toxic, and water-reactive organometallic compounds, are substances of Class 4.3.*

[6] *Mercury fulminate, wetted with not less than 20% water, or mixture of alcohol and water by mass is a substance of Class 1, UN No. 0135.*

[7] *Ferricyanides, ferrocyanides, alkaline thiocyanates and ammonium thiocyanates are not subject to the provisions of ADR.*

[8] *Lead salts and lead pigments which, when mixed in a ratio of 1:1,000 with 0.07M hydrochloric acid and stirred for one hour at a temperature of 23 °C ± 2 °C, exhibit a solubility of 5% or less, are not subject to the provisions of ADR.*

[9] *Mixtures of solids which are not subject to the provisions of ADR, and toxic liquids, may be carried under UN No. 3243 without first applying the classification criteria of Class 6.1, provided there is no free liquid visible at the time the substance is loaded or at the time the packaging or transport unit is closed. Each packaging shall correspond to a design type that has passed a leakproofness test at the packing group II level. This entry shall not be used for solids containing a packing group I liquid.*

[10] *Highly toxic or toxic, flammable liquids having a flash-point below 23 °C excluding substances which are highly toxic on inhalation, i.e. UN Nos. 1051, 1092, 1098, 1143, 1163, 1182, 1185, 1238, 1239, 1244, 1251, 1259, 1613, 1614, 1994, 1695, 2334, 2382, 2407, 2438, 2480, 2482, 2484, 2485, 2606, 2929, 3279 and 3294 are substances of Class 3.*

[11] *Flammable liquids, slightly toxic, with the exception of substances and preparations used as pesticides, having a flash-point between 23 °C and 61 °C inclusive, are substances of Class 3.*

[12] *Oxidizing substances, slightly toxic, are substances of Class 5.1.*

[13] *Substances slightly toxic and slightly corrosive, are substances of Class 8.*

[14] *Phosphide pesticides assigned to UN Nos. 1360, 1397, 1432, 1714, 2011 and 2013 are substances of Class 4.3.*

2.2.62 Class 6.2 Infectious substances

2.2.62.1 Criteria

2.2.62.1.1 The heading of Class 6.2 covers infectious substances. Infectious substances are those substances known or reasonably expected to contain pathogens. Pathogens are defined as micro-organisms (including bacteria, viruses, rickettsia, parasites, fungi) or recombinant micro-organisms (hybrid or mutant), that are known or reasonably expected to cause infectious disease in animals or humans.

For the purposes of this Class, viruses, micro-organisms as well as articles contaminated with these shall be considered as substances of this Class.

NOTE 1*: However, they are not subject to the requirements applicable to this Class if they are unlikely to cause human or animal disease.*

NOTE 2*: Infectious substances are subject to the requirements applicable to this Class only if they are capable of spreading disease to humans or animals when exposure to them occurs.*

NOTE 3: *Genetically modified micro-organisms and organisms, biological products, diagnostic specimens and infected live animals shall be assigned to this Class if they meet the conditions for this Class.*

NOTE 4: *Toxins from plant, animal or bacterial sources which do not contain any infectious substances or organisms or which are not contained in them are substances of Class 6.1, UN No. 3172.*

2.2.62.1.2 Substances of Class 6.2 are subdivided as follows:

I.1 Infectious substances affecting humans

I.2 Infectious substances affecting animals only

I.3 Clinical waste

Definitions and classification

2.2.62.1.3 Infectious substances shall be classified in Class 6.2 and assigned to UN Nos. 2814 or 2900, as appropriate, on the basis of their allocation to one of three risk groups based on criteria developed by the World Health Organization (WHO) and published in the WHO "*Laboratory Biosafety Manual*, second edition (1993)". A risk group is characterized by the pathogenicity of the organism, the mode and relative ease of transmission, the degree of risk to both an individual and a community, and the reversibility of the disease through the availability of known and effective preventive agents and treatment.

The criteria for each risk group according to the level of risk are as follows:

(a) Risk group 4: a pathogen that usually causes serious human or animal disease and that can be readily transmitted from one individual to another, directly or indirectly, and for which effective treatment and preventive measures are not usually available (i.e., high individual and community risk).

(b) Risk group 3: a pathogen that usually causes serious human or animal disease but does not ordinarily spread from one infected individual to another, and for which effective treatment and preventive measures are available (i.e. high individual risk and low community risk).

(c) Risk group 2: a pathogen that can cause human or animal disease but is unlikely to be a serious hazard, and, while capable of causing serious infection on exposure, for which effective treatment and preventive measures are available and the risk of spread of infection is limited (i.e. moderate individual risk and low community risk).

NOTE: *Risk group 1 includes micro-organisms that are unlikely to cause human or animal disease (i.e. no, or very low, individual or community risk). Substances containing only such micro-organisms are not considered infectious substances for the purposes of these provisions.*

2.2.62.1.4 Infectious substances affecting animals only (group I2 in 2.2.62.1.2) and of risk group 2 are assigned to packing group II.

2.2.62.1.5 *Biological products* are those products derived from living organisms, that are manufactured and distributed in accordance with the requirements of national governmental authorities which may have special licensing requirements, and are used either for prevention, treatment, or diagnosis of disease in humans or animals, or for development, experimental or investigational purposes related thereto. They include, but are not limited to, finished or unfinished products such as vaccines and diagnostic products.

For the purposes of ADR, biological products are divided into the following groups:

(a) Those which contain pathogens in risk group 1; those which contain pathogens under such conditions that their ability to produce disease is very low to none; and those known not to contain pathogens. Substances in this group are not considered infectious substances for the purposes of ADR;

(b) Those manufactured and packaged in accordance with the requirements of national governmental health authorities and transported for the purposes of final packaging or distribution, and use for personal health care by medical professionals or individuals. Substances in this group are not subject to the regulations applicable to Class 6.2;

(c) Those known or reasonably expected to contain pathogens in risk groups 2, 3, or 4 and which do not meet the criteria of (b) above. Substances in this group shall be classified in Class 6.2 under UN Nos. 2814 or 2900, as appropriate.

NOTE: *Some licensed biological products may present a biohazard in certain parts of the world only. In that case competent authorities may require these biological products to comply with the requirements for infectious substances or may impose other restrictions.*

2.2.62.1.6 *Diagnostic specimens* are any human or animal material including, but not limited to, excreta, secreta, blood and its components, tissue and tissue fluids being transported for purposes of diagnosis or research, but excluding live infected animals.

For the purposes of ADR, diagnostic specimens are divided into the following groups:

(a) Those known or reasonably expected to contain pathogens in risk groups 2, 3 or 4 and those where a relatively low probability exists that pathogens of risk group 4 are present. Such substances shall be classified in Class 6.2 under UN Nos. 2814 or 2900, as appropriate. Specimens transported for the purposes of initial or confirmatory testing for the presence of pathogens fall within this group;

(b) Those where a relatively low probability exists that pathogens of risk groups 2 or 3 are present. Such substancs shall be classified in 6.2 under UN No. 2814 or 2900, as appropriate. Specimens transported for the purpose of initial diagnosis for other than the presence of pathogens or specimens transported for routine screening fall within this group;

(c) Those known not to contain pathogens. Such substances are not considered as substances of Class 6.2.

2.2.62.1.7 *Genetically modified micro-organisms and organisms* [1] are micro-organisms and organisms in which the genetic material has been deliberately altered by technical methods or by means that cannot occur naturally in nature.

For the purposes of ADR, genetically modified micro-organisms and organisms are divided into the following groups:

(a) Genetically modified micro-organisms which meet the definition of an infectious substance given in para 2.2.62.1.1 shall be classified in Class 6.2 and assigned to UN Nos. 2814 or 2900;

(b) Genetically modified organisms, which are known or suspected to be dangerous to humans, animals or the environment, shall be transported in accordance with conditions specified by the competent authority of the country of origin;

(c) Animals which contain or are contaminated with genetically modified micro-organisms and organisms that meet the definition of an infectious substance shall be transported in accordance with conditions specified by the competent authority of the country of origin;

(d) Except when authorized for unconditional use by the Governments of the countries of origin, transit and destination, genetically modified micro-organisms which do not meet the definition of infectious substances but which are capable of altering animals, plants or microbiological substances in a way not normally the result of natural reproduction shall be classified in Class 9 and assigned to UN No. 3245.

NOTE: *Genetically modified micro-organisms which are infectious within the meaning of this Class may not be assigned to UN No. 3291.*

2.2.62.1.8 Diagnostic specimens referred to in 2.2.62.1.6 (b) need not meet the requirements for infectious substances when the following conditions are met:

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[1] *See also Directive 90/219/EEC, Official Journal of the European Communities No. L 117 of 8 May 1990, page 1.*

(a) - The primary receptacle(s) do not contain more than 100 ml;

- The outer packaging does not contain more than 500 ml;

- The primary receptacle(s) are leakproof; and

- The packaging includes:

(i) an inner packaging comprising:

- watertight primary receptacle(s);
- a watertight secondary packaging;
- absorbent material in sufficient quantity to absorb the entire contents placed between the primary receptacle(s) and the secondary packaging; if several primary receptacles are placed in a single secondary packaging, they shall be individually wrapped so as to prevent contact between them;

(ii) an outer packaging of adequate strength for its capacity, mass and intended use, and with a minimum external dimensions of 100 mm;

(b) the packagings comply with standard EN 829:1996.

2.2.62.1.9 *Wastes* are wastes derived from the medical treatment of animals or humans or from bio-research where there is a relatively low probability that infectious substances are present. They shall be assigned to UN No. 3291. Wastes containing infectious substances which can be specified shall be assigned to UN Nos. 2814 or 2900 according to their degree of danger (see 2.2.62.1.3). Decontaminated wastes which previously contained infectious substances are considered non-dangerous unless the criteria of another class are met.

2.2.62.1.10 Clinical wastes assigned to UN No. 3291 are assigned to packing group II.

2.2.62.1.11 For the carriage of substances of this Class, the maintenance of a specified temperature may be necessary.

2.2.62.2 Substances not accepted for carriage

Live vertebrate or invertebrate animals shall not be used to carry an infectious agent unless the agent cannot be carried by any other means. Such animals shall be packed, marked, indicated, and carried in accordance with the relevant regulations governing the carriage of animals[2].

[2] *Such regulations are contained in, e.g. Directive 91/628/EEC (Official Journal of the European Communities No. L 340 of 11 December 1991, p. 17) and in the Recommendations of the Council of Europe (Ministerial Committee) on the carriage of certain animal species.*

2.2.62.3 List of collective entries

Effects on humans	**I1**	2814 INFECTIOUS SUBSTANCE, AFFECTING HUMANS
Effects on animals only	**I2**	2900 INFECTIOUS SUBSTANCE, AFFECTING ANIMALS only
Clinical waste	**I3**	3291 CLINICAL WASTE, UNSPECIFIED, N.O.S. ***NOTE**: (BIO) MEDICAL WASTE, N.O.S. or 3291 REGULATED MEDICAL WASTE, N.O.S. may be used as an alternative entry for 3291 CLINICAL WASTE, UNSPECIFIED, N.O.S. for carriage prior to or following maritime or air carriage.*

2.2.7 Class 7 Radioactive material

2.2.7.1 Definition of Class 7

2.2.7.1.1 *Radioactive material* means any material containing radionuclides where both the activity concentration and the total activity in the consignment exceed the values specified in 2.2.7.7.2.1-2.2.7.7.2.6.

2.2.7.1.2 The following radioactive materials are not included in Class 7 for the purposes of ADR:

(a) Radioactive material that is an integral part of the means of transport;
(b) Radioactive material moved within an establishment which is subject to appropriate safety regulations in force in the establishment and where the movement does not involve public roads or railways;
(c) Radioactive material implanted or incorporated into a person or live animal for diagnosis or treatment;
(d) Radioactive material in consumer products which have received regulatory approval, following their sale to the end user;
(e) Natural material and ores containing naturally occurring radionuclides which are not intended to be processed for use of these radionuclides provided the activity concentration of the material does not exceed 10 times the values specified in 2.2.7.7.2.

2.2.7.2 Definitions

A_1 and A_2
A_1 means the activity value of special form radioactive material which is listed in Table 2.2.7.7.2.1 or derived in 2.2.7.7.2 and is used to determine the activity limits for the requirements of ADR.

A_2 means the activity value of radioactive material, other than special form radioactive material, which is listed in Table 2.2.7.7.2.1 or derived in 2.2.7.7.2 and is used to determine the activity limits for the requirements of ADR.

Approval

Multilateral approval means approval by the relevant competent authority both of the country of origin of the design or shipment and of each country through or into which the consignment is to be transported.

Unilateral approval means an approval of a design which is required to be given by the competent authority of the country of origin of the design only. If the country of origin is not a party to ADR, the approval shall require validation by the competent authority of the first ADR country reached by the consignment (see 6.4.22.6).

Confinement system means the assembly of fissile material and packaging components specified by the designer and agreed to by the competent authority as intended to preserve criticality safety.

Consignment means any package or packages, or load of radioactive material, presented by a consignor for transport

Containment system means the assembly of components of the packaging specified by the designer as intended to retain the radioactive material during transport.

Contamination:

Contamination means the presence of a radioactive substance on a surface in quantities in excess of 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.

Non-fixed contamination means contamination that can be removed from a surface during routine conditions of transport.

Fixed contamination means contamination other than non-fixed contamination.

Container in the case of radioactive material transport means an article of transport equipment designed to facilitate the transport of goods, either packaged or unpackaged, by one or more modes of transport without intermediate reloading. It shall be of a permanent enclosed character, rigid and strong enough for repeated use, and shall be fitted with devices facilitating its handling, particularly in transfer between vehicles and from one mode of transport to another. A small container is that which has either any overall outer dimension less than 1.5 m, or an internal volume of not more than 3 m^3. Any other container is considered to be a large container.

Criticality safety index (CSI) assigned to a package, overpack or container containing fissile material means a number which is used to provide control over the accumulation of packages, overpacks or containers containing fissile material.

Design means the description of special form radioactive material, low dispersible radioactive material, package or packaging which enables such an item to be fully identified. The description may include specifications, engineering drawings, reports demonstrating compliance with regulatory requirements, and other relevant documentation.

Exclusive use means the sole use, by a single consignor, of a wagon/vehicle or of a large container, in respect of which all initial, intermediate and final loading and unloading is carried out in accordance with the directions of the consignor or consignee.

Fissile material means uranium-233, uranium-235, plutonium-239, plutonium-241, or any combination of these radionuclides. Excepted from this definition is:

(a) Natural uranium or depleted uranium which is unirradiated, and
(b) Natural uranium or depleted uranium which has been irradiated in thermal reactors only.

Low dispersible radioactive material means either a solid radioactive material or a solid radioactive material in a sealed capsule, that has limited dispersibility and is not in powder form.

***NOTE**: Low dispersible radioactive material may be transported by air in Type B(U) or B(M) packages in quantities as authorised for the package design as specified in the certificate of approval. This definition is included here since such packages carrying low dispersible radioactive material may also be carried by road.*

Low specific activity (LSA) material, see 2.2.7.3.

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

Maximum normal operating pressure means the maximum pressure above atmospheric pressure at mean sea-level that would develop in the containment system in a period of one year under the conditions of temperature and solar radiation corresponding to environmental conditions in the absence of venting, external cooling by an ancillary system, or operational controls during transport.

Package in the case of radioactive material means the packaging with its radioactive contents as presented for transport. The types of packages covered by ADR, which are subject to the activity limits and material restrictions of 2.2.7.7 and meet the corresponding requirements, are:

(a) Excepted package;
(b) Industrial package Type 1 (Type IP-1);
(c) Industrial package Type 2 (Type IP-2);
(d) Industrial package Type 3 (Type IP-3);
(e) Type A package;
(f) Type B(U) package;
(g) Type B(M) package;
(h) Type C package.

Packages containing fissile material or uranium hexafluoride are subject to additional requirements.

***NOTE**: For "packages" for other dangerous goods see definitions under 1.2.1.*

Packaging in the case of radioactive material means the assembly of components necessary to enclose the radioactive contents completely. It may, in particular, consist of one or more receptacles, absorbent materials, spacing structures, radiation shielding and service equipment for filling, emptying, venting and pressure relief; devices for cooling, absorbing mechanical shocks, handling and tie-down, thermal insulation; and service devices integral to the package. The packaging may be a box, drum or similar receptacle, or may also be a container, tank or intermediate bulk container.

***NOTE**: For "packagings" for other dangerous goods see definitions under 1.2.1*

Radiation level means the corresponding dose rate expressed in millisieverts per hour.

Radioactive contents mean the radioactive material together with any contaminated or activated solids, liquids, and gases within the packaging.

Shipment means the specific movement of a consignment from origin to destination.

Special form radioactive material, see 2.2.7.4.1.

Specific activity of a radionuclide means the activity per unit mass of that nuclide. The specific activity of a material shall mean the activity per unit mass or volume of the material in which the radionuclides are essentially uniformly distributed.

Surface contaminated object (SCO), see 2.2.7.5.

Transport index (TI) assigned to a package, overpack or container, or to unpackaged LSA-I or SCO-I, means a number which is used to provide control over radiation exposure.

Unirradiated thorium means thorium containing not more than 10^{-7} g of uranium-233 per gram of thorium-232.

Unirradiated uranium means uranium containing not more than 2×10^{3} Bq of plutonium per gram of uranium-235, not more than 9×10^{6} Bq of fission products per gram of uranium-235 and not more than 5×10^{-3} g of uranium-236 per gram of uranium-235.

Uranium - natural, depleted, enriched means the following:

Natural uranium means chemically separated uranium containing the naturally occurring distribution of uranium isotopes (approximately 99.28% uranium-238, and 0.72% uranium-235 by mass). *Depleted uranium* means uranium containing a lesser mass percentage of uranium-235 than in natural uranium. *Enriched uranium* means uranium containing a greater mass percentage of uranium-235 than 0.72%. In all cases, a very small mass percentage of uranium-234 is present.

2.2.7.3 Low specific activity (LSA) material, determination of groups

2.2.7.3.1 Radioactive material which by its nature has a limited specific activity, or radioactive material for which limits of estimated average specific activity apply, is termed low specific activity or LSA material. External shielding materials surrounding the LSA material shall not be considered in determining the estimated average specific activity.

2.2.7.3.2 LSA material shall be in one of three groups:

(a) LSA-I

(i) uranium and thorium ores and concentrates of such ores, and other ores containing naturally occurring radionuclides which are intended to be processed for the use of these radionuclides;

(ii) solid unirradiated natural uranium or depleted uranium or natural thorium or their solid or liquid compounds or mixtures;

(iii) radioactive material for which the A_2 value is unlimited, excluding fissile material in quantities not excepted under 6.4.11.2; or

(iv) other radioactive material in which the activity is distributed throughout and the estimated average specific activity does not exceed 30 times the values for activity concentration specified in 2.2.7.7.2.1-2.2.7.7.2.6, excluding fissile material in quantities not excepted under 6.4.11.2.

(b) LSA-II

(i) water with tritium concentration up to 0.8 TBq/L; or

(ii) other material in which the activity is distributed throughout 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.

(c) LSA-III - Solids (e.g. consolidated wastes, activated materials), excluding powders, in which:

(i) 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, ceramic, etc.);

(ii) the radioactive material is relatively insoluble, or it 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 seven days would not exceed 0.1 A_2; and

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

2.2.7.3.3 LSA-III material shall be a solid of such a nature that if the entire contents of a package were subjected to the test specified in 2.2.7.3.4 the activity in the water would not exceed 0.1 A_2.

2.2.7.3.4 LSA-III material shall be tested as follows:

A solid material sample representing the entire contents of the package shall be immersed for 7 days in water at ambient temperature. The volume of water to be used in the test shall be sufficient to ensure that at the end of the 7 day test period the free volume of the unabsorbed and unreacted water remaining shall be at least 10% of the volume of the solid test sample itself. The water shall have an initial pH of 6-8 and a maximum conductivity of 1 mS/m at 20°C. The total activity of the free volume of water shall be measured following the 7 day immersion of the test sample.

2.2.7.3.5 Demonstration of compliance with the performance standards in 2.2.7.3.4 shall be in accordance with 6.4.12.1 and 6.4.12.2.

2.2.7.4 Requirements for special form radioactive material

2.2.7.4.1 *Special form radioactive material* means either:

(a) An indispersible solid radioactive material; or
(b) A sealed capsule containing radioactive material that shall be so manufactured that it can be opened only by destroying the capsule.

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

2.2.7.4.2 Special form radioactive material shall be of such a nature or shall be so designed that if it is subjected to the tests specified in 2.2.7.4.4 to 2.2.7.4.8, it shall meet the following requirements:

(a) It would not break or shatter under the impact, percussion and bending tests 2.2.7.4.5(a)(b)(c), 2.2.7.4.6(a) as applicable;

(b) It would not melt or disperse in the applicable heat test 2.2.7.4.5(d) or 2.2.7.4.6(b) as applicable; and

(c) The activity in the water from the leaching tests specified in 2.2.7.4.7 and 2.2.7.4.8 would not exceed 2 kBq; or alternatively for sealed sources, the leakage rate for the volumetric leakage assessment test specified in ISO 9978:1992 "Radiation Protection - Sealed Radioactive Sources - Leakage Test Methods", would not exceed the applicable acceptance threshold acceptable to the competent authority.

2.2.7.4.3 Demonstration of compliance with the performance standards in 2.2.7.4.2 shall be in accordance with 6.4.12.1 and 6.4.12.2.

2.2.7.4.4 Specimens that comprise or simulate special form radioactive material shall be subjected to the impact test, the percussion test, the bending test, and the heat test specified in 2.2.7.4.5 or alternative tests as authorized in 2.2.7.4.6. A different specimen may be used for each of the tests. Following each test, a leaching assessment or volumetric leakage test shall be performed on the specimen by a method no less sensitive than the methods given in 2.2.7.4.7 for indispersible solid material or 2.2.7.4.8 for encapsulated material.

2.2.7.4.5 The relevant test methods are:

(a) Impact test: The specimen shall drop onto the target from a height of 9 m. The target shall be as defined in 6.4.14;

(b) Percussion test: The specimen shall be placed on a sheet of lead which is supported by a smooth solid surface and struck by the flat face of a mild steel bar so as to cause an impact equivalent to that resulting from a free drop of 1.4 kg through 1 m. The lower part of the bar shall be 25 mm in diameter with the edges rounded off to a radius of (3.0 ± 0.3) mm. The lead, of hardness number 3.5 to 4.5 on the Vickers scale and not more than 25 mm thick, shall cover an area greater than that covered by the specimen. A fresh surface of lead shall be used for each impact. The bar shall strike the specimen so as to cause maximum damage.

(c) Bending test: The test shall apply only to long, slender sources with both a minimum length of 10 cm and a length to minimum width ratio of not less than 10. The specimen shall be rigidly clamped in a horizontal position so that one half of its length protrudes from the face of the clamp. The orientation of the specimen shall be such that the specimen will suffer maximum damage when its free end is struck by the flat face of a steel bar. The bar shall strike the specimen so as to cause an impact equivalent to that resulting from a free vertical drop of 1.4 kg through 1 m. The lower part of the bar shall be 25 mm in diameter with the edges rounded off to a radius of (3.0 ± 0.3) mm.

(d) Heat test: The specimen shall be heated in air to a temperature of 800°C and held at that temperature for a period of 10 minutes and shall then be allowed to cool.

2.2.7.4.6 Specimens that comprise or simulate radioactive material enclosed in a sealed capsule may be excepted from:

(a) The tests prescribed in 2.2.7.4.5(a) and 2.2.7.4.5(b) provided the mass of the special form radioactive material is less than 200 g and they are alternatively subjected to the Class 4 impact test prescribed in ISO 2919:1980 "Sealed radioactive sources - Classification"; and

(b) The test prescribed in 2.2.7.4.5(d) provided they are alternatively subjected to the Class 6 temperature test specified in ISO 2919:1980 "Sealed radioactive sources - Classification".

2.2.7.4.7 For specimens which comprise or simulate indispersible solid material, a leaching assessment shall be performed as follows:

(a) The specimen shall be immersed for 7 days in water at ambient temperature. The volume of water to be used in the test shall be sufficient to ensure that at the end of the 7 day test period the free volume of the unabsorbed and unreacted water remaining shall be at least 10% of the volume of the solid test sample itself. The water shall have an initial pH of 6-8 and a maximum conductivity of 1 mS/m at 20°C;
(b) The water with specimen shall then be heated to a temperature of (50 ± 5)° C and maintained at this temperature for 4 hours;
(c) The activity of the water shall then be determined;
(d) The specimen shall then be kept for at least 7 days in still air at not less than 30°C and relative humidity not less than 90%;
(e) The specimen shall then be immersed in water of the same specification as in (a) above and the water with the specimen heated to (50 ± 5)° C and maintained at this temperature for 4 hours;
(f) The activity of the water shall then be determined.

2.2.7.4.8 For specimens which comprise or simulate radioactive material enclosed in a sealed capsule, either a leaching assessment or a volumetric leakage assessment shall be performed as follows:

(a) The leaching assessment shall consist of the following steps:

(i) the specimen shall be immersed in water at ambient temperature. The water shall have an initial pH of 6-8 with a maximum conductivity of 1 mS/m at 20°C;
(ii) the water and specimen shall be heated to a temperature of (50 ± 5)° C and maintained at this temperature for 4 hours;
(iii) the activity of the water shall then be determined;
(iv) the specimen shall then be kept for at least 7 days in still air at not less than 30°C and relative humidity of not less than 90%;
(v) the process in (i), (ii) and (iii) shall be repeated;

(b) The alternative volumetric leakage assessment shall comprise any of the tests prescribed in ISO 9978:1992 "Radiation Protection - Sealed radioactive sources - Leakage test methods", which are acceptable to the competent authority.

2.2.7.5 Surface contaminated object (SCO), determination of groups

Surface contaminated object (SCO) means a solid object which is not itself radioactive but which has radioactive material distributed on its surfaces. SCO is classified in one of two groups:

(a) SCO-I: A solid object on which:

(i) 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 4 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters, or 0.4 Bq/cm^2 for all other alpha emitters; and

(ii) 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 4×10^4 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters, or 4×10^3 Bq/cm^2 for all other alpha emitters; and

(iii) the non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 4×10^4 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters, or 4×10^3 Bq/cm^2 for all other alpha emitters;

(b) SCO-II: A solid object on which either the fixed or non-fixed contamination on the surface exceeds the applicable limits specified for SCO-I in (a) above and on which:

(i) 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 400 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters, or 40 Bq/cm^2 for all other alpha emitters; and

(ii) 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 8×10^5 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters, or 8×10^4 Bq/cm^2 for all other alpha emitters; and

(iii) the non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 8×10^5 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters, or 8×10^4 Bq/cm^2 for all other alpha emitters.

2.2.7.6 Determination of transport index (TI) and criticality safety index (CSI)

2.2.7.6.1 *Determination of transport index*

2.2.7.6.1.1 The transport index (TI) for a package, overpack or container, or for unpackaged LSA-I or SCO-I, shall be the number derived in accordance with the following procedure:

(a) Determine the maximum radiation level in units of millisieverts per hour (mSv/h) at a distance of 1 m from the external surfaces of the package, overpack, container, or unpackaged LSA-I and SCO-I. The value determined shall be multiplied by 100 and the resulting number is the transport index. For uranium and thorium ores and their concentrates, the maximum radiation level at any point 1 m from the external surface of the load may be taken as:
0.4 mSv/h for ores and physical concentrates of uranium and thorium;
0.3 mSv/h for chemical concentrates of thorium;
0.02 mSv/h for chemical concentrates of uranium, other than uranium hexafluoride;

(b) For tanks, containers and unpackaged LSA-I and SCO-I, the value determined in step (a) above shall be multiplied by the appropriate factor from Table 2.2.7.6.1.1;

(c) The value obtained in steps (a) and (b) above shall be rounded up to the first decimal place (e.g. 1.13 becomes 1.2), except that a value of 0.05 or less may be considered as zero.

Table 2.2.7.6.1.1

MULTIPLICATION FACTORS FOR LARGE DIMENSION LOADS

Size of load a/	Multiplication factor
size of load ≤ 1 m^2	1
1 m^2 < size of load ≤ 5 m^2	2
5 m^2 < size of load ≤ 20 m^2	3
20 m^2 < size of load	10

a/ Largest cross-sectional area of the load being measured.

2.2.7.6.1.2 The transport index for each overpack, container, vehicle shall be determined as either the sum of the TIs of all the packages contained, or by direct measurement of radiation level, except in the case of non-rigid overpacks for which the transport index shall be determined only as the sum of the TIs of all the packages.

2.2.7.6.2 ***Determination of criticality safety index (CSI)***

2.2.7.6.2.1 The criticality safety index (CSI) for packages containing fissile material shall be obtained by dividing the number 50 by the smaller of the two values of N derived in 6.4.11.11 and 6.4.11.12 (i.e. CSI = 50/N). The value of the criticality safety index may be zero, provided that an unlimited number of packages is subcritical (i.e. N is effectively equal to infinity in both cases).

2.2.7.6.2.2 The criticality safety index for each consignment shall be determined as the sum of the CSIs of all the packages contained in that consignment.

2.2.7.7 Activity limits and material restrictions

2.2.7.7.1 ***Contents limits for packages***

2.2.7.7.1.1 General

The quantity of radioactive material in a package shall not exceed the relevant limits for the package type as specified below.

2.2.7.7.1.2 Excepted packages

2.2.7.7.1.2.1 For radioactive material other than articles manufactured of natural uranium, depleted uranium or natural thorium, an excepted package shall not contain activities greater than the following:

(a) Where the radioactive material is enclosed in or is included as a component part of an instrument or other manufactured article, such as a clock or electronic apparatus, the limits specified in columns 2 and 3 of Table 2.2.7.7.1.2.1 for each individual item and each package, respectively; and

(b) Where the radioactive material is not so enclosed in or is not included as a component of an instrument or other manufactured article, the package limits specified in column 4 of Table 2.2.7.7.1.2.1.

Table 2.2.7.7.1.2.1

ACTIVITY LIMITS FOR EXCEPTED PACKAGES

Physical state of contents	**Instuments or article**		**Materials Package limits a/**
	Item limits a/	**Package limits a/**	
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	2×10^{-2} A_2	2×10^{-1} A_2	2×10^{-2} A_2
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/ For mixtures of radionuclides, see 2.2.7.7.2.4 to 2.2.7.7.2.6.

2.2.7.7.1.2.2 For articles manufactured of natural uranium, depleted uranium or natural thorium, an excepted package may contain any quantity of such material provided that the outer surface of the uranium or thorium is enclosed in an inactive sheath made of metal or some other substantial material.

2.2.7.7.1.3 Industrial packages

The radioactive contents in a single package of LSA material or in a single package of SCO shall be so restricted that the radiation level specified in 4.1.9.2.1 shall not be exceeded, and the activity in a single package shall also be so restricted that the activity limits for a vehicle specified in 7.5.11, CV33 (2) shall not be exceeded.

2.2.7.7.1.4 Type A packages

2.2.7.7.1.4.1 Type A packages shall not contain activities greater than the following:

(a) For special form radioactive material - A_1; or
(b) For all other radioactive material - A_2.

2.2.7.7.1.4.2 For mixtures of radionuclides whose identities and respective activities are known, the following condition shall apply to the radioactive contents of a Type A package:

$$\sum_i \frac{B(i)}{A_1(i)} + \sum_j \frac{C(j)}{A_2(j)} \leq 1$$

where

B(i) is the activity of radionuclide i as special form radioactive material and A_1(i) is the A_1 value for radionuclide i; and

C(j) is the activity of radionuclide j as other than special form radioactive material and A_2 (j) is the A_2 value for radionuclide j.

2.2.7.7.1.5 Type B(U) and Type B(M) packages

2.2.7.7.1.5.1 Type B(U) and Type B(M) packages shall not contain:

(a) Activities greater than those authorized for the package design;
(b) Radionuclides different from those authorized for the package design; or
(c) Contents in a form, or a physical or chemical state different from those authorized for the package design;

as specified in their certificates of approval.

2.2.7.7.1.6 Type C packages

***NOTE**: Type C packages may be transported by air carrying radioactive material in quantities exceeding either 3000A_1 or 100,000A_2 ,whichever is the lower for special form radioactive material, or 3000A_2. for all other radioactive material. Whilst Type C packages are not required for road transport of radioactive material in such quantities (Type B(U) or Type B(M) packages suffice), the following requirements are presented since such packages may also be carried by road.*

Type C packages shall not contain:

(a) Activities greater than those authorized for the package design;
(b) Radionuclides different from those authorized for the package design; or
(c) Contents in a form, or physical or chemical state different from those authorized for the package design;

as specified in their certificates of approval.

2.2.7.7.1.7 Packages containing fissile material

Packages containing fissile material shall not contain:

(a) A mass of fissile material different from that authorized for the package design;
(b) Any radionuclide or fissile material different from those authorized for the package design; or
(c) Contents in a form or physical or chemical state, or in a spatial arrangement, different from those authorized for the package design;

as specified in their certificates of approval where appropriate.

2.2.7.7.1.8 Packages containing uranium hexafluoride

The mass of uranium hexafluoride in a package shall not exceed a value that would lead to an ullage smaller than 5% at the maximum temperature of the package as specified for the plant systems where the package shall be used. The uranium hexafluoride shall be in solid form and the internal pressure of the package shall be below atmospheric pressure when presented for transport.

2.2.7.7.2 ***Activity levels***

2.2.7.7.2.1 The following basic values for individual radionuclides are given in Table 2.2.7.7.2.1:

(a) A_1 and A_2 in TBq;
(b) Activity concentration for exempt material in Bq/g; and
(c) Activity limits for exempt consignments in Bq.

Table 2.2.7.7.2.1

Radionuclide (atomic number)	A_1	A_2	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
Actinium (89)				
Ac-225 (a)	8×10^{-1}	6×10^{-3}	1×10^{1}	1×10^{4}
Ac-227 (a)	9×10^{-1}	9×10^{-5}	1×10^{-1}	1×10^{3}
Ac-228	6×10^{-1}	5×10^{-1}	1×10^{1}	1×10^{6}
Silver (47)				
Ag-105	2×10^{0}	2×10^{0}	1×10^{2}	1×10^{6}
Ag-108m (a)	7×10^{-1}	7×10^{-1}	1×10^{1} (b)	1×10^{6} (b)
Ag-110m (a)	4×10^{-1}	4×10^{-1}	1×10^{1}	1×10^{6}
Ag-111	2×10^{0}	6×10^{-1}	1×10^{3}	$1 \quad 10^{6}$
Aluminium (13)				
Al-26	1×10^{-1}	1×10^{-1}	1×10^{1}	1×10^{5}
Americium (95)				
Am-241	1×10^{1}	1×10^{-3}	1×10^{0}	1×10^{4}
Am-242m (a)	1×10^{1}	1×10^{-3}	1×10^{0} (b)	1×10^{4} (b)
Am-243 (a)	5×10^{0}	1×10^{-3}	1×10^{0} (b)	1×10^{3} (b)
Argon (18)				
Ar-37	4×10^{1}	4×10^{1}	1×10^{6}	1×10^{8}
Ar-39	2×10^{1}	4×10^{1}	1×10^{7}	1×10^{4}
Ar-41	3×10^{-1}	3×10^{-1}	1×10^{2}	1×10^{9}
Arsenic (33)				
As-72	3×10^{-1}	3×10^{-1}	1×10^{1}	1×10^{5}
As-73	4×10^{1}	4×10^{1}	1×10^{3}	1×10^{7}
As-74	1×10^{0}	9×10^{-1}	1×10^{1}	1×10^{6}
As-76	3×10^{-1}	3×10^{-1}	1×10^{2}	1×10^{5}
As-77	2×10^{1}	7×10^{-1}	1×10^{3}	1×10^{6}
Astatine (85)				
At-211 (a)	2×10^{1}	5×10^{-1}	1×10^{3}	1×10^{7}
Gold (79)				

Radionuclide (atomic number)	A_1	A_2	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
Au-193	7×10^{0}	2×10^{0}	1×10^{2}	1×10^{7}
Au-194	1×10^{0}	1×10^{0}	1×10^{1}	1×10^{6}
Au-195	1×10^{1}	6×10^{0}	1×10^{2}	1×10^{7}
Au-198	1×10^{0}	6×10^{-1}	1×10^{2}	1×10^{6}
Au-199	1×10^{1}	6×10^{-1}	1×10^{2}	1×10^{6}
Barium (56)				
Ba-131 (a)	2×10^{0}	2×10^{0}	1×10^{2}	1×10^{6}
Ba-133	3×10^{0}	3×10^{0}	1×10^{2}	1×10^{6}
Ba-133m	2×10^{1}	6×10^{-1}	1×10^{2}	1×10^{6}
Ba-140 (a)	5×10^{-1}	3×10^{-1}	1×10^{1} (b)	1×10^{5} (b)
Beryllium (4)				
Be-7	2×10^{1}	2×10^{1}	1×10^{3}	1×10^{7}
Be-10	4×10^{1}	6×10^{-1}	1×10^{4}	1×10^{6}
Bismuth (83)				
Bi-205	7×10^{-1}	7×10^{-1}	1×10^{1}	1×10^{6}
Bi-206	3×10^{-1}	3×10^{-1}	1×10^{1}	1×10^{5}
Bi-207	7×10^{-1}	7×10^{-1}	1×10^{1}	1×10^{6}
Bi-210	1×10^{0}	6×10^{-1}	1×10^{3}	1×10^{6}
Bi-210m (a)	6×10^{-1}	2×10^{-2}	1×10^{1}	1×10^{5}
Bi-212 (a)	7×10^{-1}	6×10^{-1}	1×10^{1} (b)	1×10^{5} (b)
Berkelium (97)				
Bk-247	8×10^{0}	8×10^{-4}	1×10^{0}	1×10^{4}
Bk-249 (a)	4×10^{1}	3×10^{-1}	1×10^{3}	1×10^{6}
Bromine (35)				
Br-76	4×10^{-1}	4×10^{-1}	1×10^{1}	1×10^{5}
Br-77	3×10^{0}	3×10^{0}	1×10^{2}	1×10^{6}
Br-82	4×10^{-1}	4×10^{-1}	1×10^{1}	1×10^{6}

Radionuclide (atomic number)	A_1	A_2	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
Carbon (6)				
C-11	1×10^{0}	6×10^{-1}	1×10^{1}	1×10^{6}
C-14	4×10^{1}	3×10^{0}	1×10^{4}	1×10^{7}
Calcium (20)				
Ca-41	Unlimited	Unlimited	1×10^{5}	1×10^{7}
Ca-45	4×10^{1}	1×10^{0}	1×10^{4}	1×10^{7}
Ca-47 (a)	3×10^{0}	3×10^{-1}	1×10^{1}	1×10^{6}
Cadmium (48)				
Cd-109	3×10^{1}	2×10^{0}	1×10^{4}	1×10^{6}
Cd-113m	4×10^{1}	5×10^{-1}	1×10^{3}	1×10^{6}
Cd-115 (a)	3×10^{0}	4×10^{-1}	1×10^{2}	1×10^{6}
Cd-115m	5×10^{-1}	5×10^{-1}	1×10^{3}	1×10^{6}
Cerium (58)				
Ce-139	7×10^{0}	2×10^{0}	1×10^{2}	1×10^{6}
Ce-141	2×10^{1}	6×10^{-1}	1×10^{2}	1×10^{7}
Ce-143	9×10^{-1}	6×10^{-1}	1×10^{2}	1×10^{6}
Ce-144 (a)	2×10^{-1}	2×10^{-1}	1×10^{2} (b)	1×10^{5} (b)
Californium (98)				
Cf-248	4×10^{1}	6×10^{-3}	1×10^{1}	1×10^{4}
Cf-249	3×10^{0}	8×10^{-4}	1×10^{0}	1×10^{3}
Cf-250	2×10^{1}	2×10^{-3}	1×10^{1}	1×10^{4}
Cf-251	7×10^{0}	7×10^{-4}	1×10^{0}	1×10^{3}
Cf-252	5×10^{-2}	3×10^{-3}	1×10^{1}	1×10^{4}
Cf-253 (a)	4×10^{1}	4×10^{-2}	1×10^{2}	1×10^{5}
Cf-254	1×10^{-3}	1×10^{-3}	1×10^{0}	1×10^{3}
Chlorine (17)				
Cl-36	1×10^{1}	6×10^{-1}	1×10^{4}	1×10^{6}
Cl-38	2×10^{-1}	2×10^{-1}	1×10^{1}	1×10^{5}

Radionuclide (atomic number)	A_1	A_2	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
Curium (96)				
Cm-240	4×10^{1}	2×10^{-2}	1×10^{2}	1×10^{5}
Cm-241	2×10^{0}	1×10^{0}	1×10^{2}	1×10^{6}
Cm-242	4×10^{1}	1×10^{-2}	1×10^{2}	1×10^{5}
Cm-243	9×10^{0}	1×10^{-3}	1×10^{0}	1×10^{4}
Cm-244	2×10^{1}	2×10^{-3}	1×10^{1}	1×10^{4}
Cm-245	9×10^{0}	9×10^{-4}	1×10^{0}	1×10^{3}
Cm-246	9×10^{0}	9×10^{-4}	1×10^{0}	1×10^{3}
Cm-247 (a)	3×10^{0}	1×10^{-3}	1×10^{0}	1×10^{4}
Cm-248	2×10^{-2}	3×10^{-4}	1×10^{0}	1×10^{3}
Cobalt (27)				
Co-55	5×10^{-1}	5×10^{-1}	1×10^{1}	1×10^{6}
Co-56	3×10^{-1}	3×10^{-1}	1×10^{1}	1×10^{5}
Co-57	1×10^{1}	1×10^{1}	1×10^{2}	1×10^{6}
Co-58	1×10^{0}	1×10^{0}	1×10^{1}	1×10^{6}
Co-58m	4×10^{1}	4×10^{1}	1×10^{4}	1×10^{7}
Co-60	4×10^{-1}	4×10^{-1}	1×10^{1}	1×10^{5}
Chromium (24)				
Cr-51	3×10^{1}	3×10^{1}	1×10^{3}	1×10^{7}
Caesium (55)				
Cs-129	4×10^{0}	4×10^{0}	1×10^{2}	1×10^{5}
Cs-131	3×10^{1}	3×10^{1}	1×10^{3}	1×10^{6}
Cs-132	1×10^{0}	1×10^{0}	1×10^{1}	1×10^{5}
Cs-134	7×10^{-1}	7×10^{-1}	1×10^{1}	1×10^{4}
Cs-134m	4×10^{1}	6×10^{-1}	1×10^{3}	1×10^{5}
Cs-135	4×10^{1}	1×10^{0}	1×10^{4}	1×10^{7}
Cs-136	5×10^{-1}	5×10^{-1}	1×10^{1}	1×10^{5}
Cs-137 (a)	2×10^{0}	6×10^{-1}	1×10^{1} (b)	1×10^{4} (b)

Radionuclide (atomic number)	A_1	A_2	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
Copper (29)				
Cu-64	6×10^{0}	1×10^{0}	1×10^{2}	1×10^{6}
Cu-67	1×10^{1}	7×10^{-1}	1×10^{2}	1×10^{6}
Dysprosium (66)				
Dy-159	2×10^{1}	2×10^{1}	1×10^{3}	1×10^{7}
Dy-165	9×10^{-1}	6×10^{-1}	1×10^{3}	1×10^{6}
Dy-166 (a)	9×10^{-1}	3×10^{-1}	1×10^{3}	1×10^{6}
Erbium (68)				
Er-169	4×10^{1}	1×10^{0}	1×10^{4}	1×10^{7}
Er-171	8×10^{-1}	5×10^{-1}	1×10^{2}	1×10^{6}
Europium (63)				
Eu-147	2×10^{0}	2×10^{0}	1×10^{2}	1×10^{6}
Eu-148	5×10^{-1}	5×10^{-1}	1×10^{1}	1×10^{6}
Eu-149	2×10^{1}	2×10^{1}	1×10^{2}	1×10^{7}
Eu-150(short lived)	2×10^{0}	7×10^{-1}	1×10^{3}	1×10^{6}
Eu-150(long lived)	7×10^{-1}	7×10^{-1}	1×10^{1}	1×10^{6}
Eu-152	1×10^{0}	1×10^{0}	1×10^{1}	1×10^{6}
Eu-152m	8×10^{-1}	8×10^{-1}	1×10^{2}	1×10^{6}
Eu-154	9×10^{-1}	6×10^{-1}	1×10^{1}	1×10^{6}
Eu-155	2×10^{1}	3×10^{0}	1×10^{2}	1×10^{7}
Eu-156	7×10^{-1}	7×10^{-1}	1×10^{1}	1×10^{6}
Fluorine (9)				
F-18	1×10^{0}	6×10^{-1}	1×10^{1}	1×10^{6}
Iron (26)				
Fe-52 (a)	3×10^{-1}	3×10^{-1}	1×10^{1}	1×10^{6}
Fe-55	4×10^{1}	4×10^{1}	1×10^{4}	1×10^{6}
Fe-59	9×10^{-1}	9×10^{-1}	1×10^{1}	1×10^{6}
Fe-60 (a)	4×10^{1}	2×10^{-1}	1×10^{2}	1×10^{5}

Radionuclide (atomic number)	A_1	A_2	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
Gallium (31)				
Ga-67	7×10^{0}	3×10^{0}	1×10^{2}	1×10^{6}
Ga-68	5×10^{-1}	5×10^{-1}	1×10^{1}	1×10^{5}
Ga-72	4×10^{-1}	4×10^{-1}	1×10^{1}	1×10^{5}
Gadolinium (64)				
Gd-146 (a)	5×10^{-1}	5×10^{-1}	1×10^{1}	1×10^{6}
Gd-148	2×10^{1}	2×10^{-3}	1×10^{1}	1×10^{4}
Gd-153	1×10^{1}	9×10^{0}	1×10^{2}	1×10^{7}
Gd-159	3×10^{0}	6×10^{-1}	1×10^{3}	1×10^{6}
Germanium (32)				
Ge-68 (a)	5×10^{-1}	5×10^{-1}	1×10^{1}	1×10^{5}
Ge-71	4×10^{1}	4×10^{1}	1×10^{4}	1×10^{8}
Ge-77	3×10^{-1}	3×10^{-1}	1×10^{1}	1×10^{5}
Hafnium (72)				
Hf-172 (a)	6×10^{-1}	6×10^{-1}	1×10^{1}	1×10^{6}
Hf-175	3×10^{0}	3×10^{0}	1×10^{2}	1×10^{6}
Hf-181	2×10^{0}	5×10^{-1}	1×10^{1}	1×10^{6}
Hf-182	Unlimited	Unlimited	1×10^{2}	1×10^{6}
Mercury (80)				
Hg-194 (a)	1×10^{0}	1×10^{0}	1×10^{1}	1×10^{6}
Hg-195m (a)	3×10^{0}	7×10^{-1}	1×10^{2}	1×10^{6}
Hg-197	2×10^{1}	1×10^{1}	1×10^{2}	1×10^{7}
Hg-197m	1×10^{1}	4×10^{-1}	1×10^{2}	1×10^{6}
Hg-203	5×10^{0}	1×10^{0}	1×10^{2}	1×10^{5}
Holmium (67)				
Ho-166	4×10^{-1}	4×10^{-1}	1×10^{3}	1×10^{5}
Ho-166m	6×10^{-1}	5×10^{-1}	1×10^{1}	1×10^{6}
Iodine (53)				
I-123	6×10^{0}	3×10^{0}	1×10^{2}	1×10^{7}

Radionuclide (atomic number)	A_1	A_2	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
I-124	1×10^{0}	1×10^{0}	1×10^{1}	1×10^{6}
I-125	2×10^{1}	3×10^{0}	1×10^{3}	1×10^{6}
I-126	2×10^{0}	1×10^{0}	1×10^{2}	1×10^{6}
I-129	Unlimited	Unlimited	1×10^{2}	1×10^{5}
I-131	3×10^{0}	7×10^{-1}	1×10^{2}	1×10^{6}
I-132	4×10^{-1}	4×10^{-1}	1×10^{1}	1×10^{5}
I-133	7×10^{-1}	6×10^{-1}	1×10^{1}	1×10^{6}
I-134	3×10^{-1}	3×10^{-1}	1×10^{1}	1×10^{5}
I-135 (a)	6×10^{-1}	6×10^{-1}	1×10^{1}	1×10^{6}
Indium (49)				
In-111	3×10^{0}	3×10^{0}	1×10^{2}	1×10^{6}
In-113m	4×10^{0}	2×10^{0}	1×10^{2}	1×10^{6}
In-114m (a)	1×10^{1}	5×10^{-1}	1×10^{2}	1×10^{6}
In-115m	7×10^{0}	1×10^{0}	1×10^{2}	1×10^{6}
Iridium (77)				
Ir-189 (a)	1×10^{1}	1×10^{1}	1×10^{2}	1×10^{7}
Ir-190	7×10^{-1}	7×10^{-1}	1×10^{1}	1×10^{6}
Ir-192	1×10^{0}(c)	6×10^{-1}	1×10^{1}	1×10^{4}
Ir-194	3×10^{-1}	3×10^{-1}	1×10^{2}	1×10^{5}
Potassium (19)				
K-40	9×10^{-1}	9×10^{-1}	1×10^{2}	1×10^{6}
K-42	2×10^{-1}	2×10^{-1}	1×10^{2}	1×10^{6}
K-43	7×10^{-1}	6×10^{-1}	1×10^{1}	1×10^{6}
Krypton (36)				
Kr-79	4×10^{0}	1×10^{0}	1×10^{3}	1×10^{5}
Kr-81	4×10^{1}	4×10^{1}	1×10^{4}	1×10^{7}
Kr-85	1×10^{1}	1×10^{1}	1×10^{5}	1×10^{4}
Kr-85m	8×10^{0}	3×10^{0}	1×10^{3}	1×10^{10}

Radionuclide (atomic number)	A_1	A_2	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
Kr-87	2×10^{-1}	2×10^{-1}	1×10^{2}	1×10^{9}
Lanthanum (57)				
La-137	3×10^{1}	6×10^{0}	1×10^{3}	1×10^{7}
La-140	4×10^{-1}	4×10^{-1}	1×10^{1}	1×10^{5}
Lutetium (71)				
Lu-172	6×10^{-1}	6×10^{-1}	1×10^{1}	1×10^{6}
Lu-173	8×10^{0}	8×10^{0}	1×10^{2}	1×10^{7}
Lu-174	9×10^{0}	9×10^{0}	1×10^{2}	1×10^{7}
Lu-174m	2×10^{1}	1×10^{1}	1×10^{2}	1×10^{7}
Lu-177	3×10^{1}	7×10^{-1}	1×10^{3}	1×10^{7}
Magnesium (12)				
Mg-28 (a)	3×10^{-1}	3×10^{-1}	1×10^{1}	1×10^{5}
Manganese (25)				
Mn-52	3×10^{-1}	3×10^{-1}	1×10^{1}	1×10^{5}
Mn-53	Unlimited	Unlimited	1×10^{4}	1×10^{9}
Mn-54	1×10^{0}	1×10^{0}	1×10^{1}	1×10^{6}
Mn-56	3×10^{-1}	3×10^{-1}	1×10^{1}	1×10^{5}
Molybdenum (42)				
Mo-93	4×10^{1}	2×10^{1}	1×10^{3}	1×10^{8}
Mo-99 (a)	1×10^{0}	6×10^{-1}	1×10^{2}	1×10^{6}
Nitrogen (7)				
N-13	9×10^{-1}	6×10^{-1}	1×10^{2}	1×10^{9}
Sodium (11)				
Na-22	5×10^{-1}	5×10^{-1}	1×10^{1}	1×10^{6}
Na-24	2×10^{-1}	2×10^{-1}	1×10^{1}	1×10^{5}
Niobium (41)				
Nb-93m	4×10^{1}	3×10^{1}	1×10^{4}	1×10^{7}
Nb-94	7×10^{-1}	7×10^{-1}	1×10^{1}	1×10^{6}
Nb-95	1×10^{0}	1×10^{0}	1×10^{1}	1×10^{6}

Radionuclide (atomic number)	A_1	A_2	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
Nb-97	9×10^{-1}	6×10^{-1}	1×10^{1}	1×10^{6}
Neodymium (60)				
Nd-147	6×10^{0}	6×10^{-1}	1×10^{2}	1×10^{6}
Nd-149	6×10^{-1}	5×10^{-1}	1×10^{2}	1×10^{6}
Nickel (28)				
Ni-59	Unlimited	Unlimited	1×10^{4}	1×10^{8}
Ni-63	4×10^{1}	3×10^{1}	1×10^{5}	1×10^{8}
Ni-65	4×10^{-1}	4×10^{-1}	1×10^{1}	1×10^{6}
Neptunium (93)				
Np-235	4×10^{1}	4×10^{1}	1×10^{3}	1×10^{7}
Np-236(short-lived)	2×10^{1}	2×10^{0}	1×10^{3}	1×10^{7}
Np-236(long-lived)	9×10^{0}	2×10^{-2}	1×10^{2}	1×10^{5}
Np-237	2×10^{1}	2×10^{-3}	1×10^{0} (b)	1×10^{3} (b)
Np-239	7×10^{0}	4×10^{-1}	1×10^{2}	1×10^{7}
Osmium (76)				
Os-185	1×10^{0}	1×10^{0}	1×10^{1}	1×10^{6}
Os-191	1×10^{1}	2×10^{0}	1×10^{2}	1×10^{7}
Os-191m	4×10^{1}	3×10^{1}	1×10^{3}	1×10^{7}
Os-193	2×10^{0}	6×10^{-1}	1×10^{2}	1×10^{6}
Os-194 (a)	3×10^{-1}	3×10^{-1}	1×10^{2}	1×10^{5}
Phosphorus (15)				
P-32	5×10^{-1}	5×10^{-1}	1×10^{3}	1×10^{5}
P-33	4×10^{1}	1×10^{0}	1×10^{5}	1×10^{8}
Protactinium (91)				
Pa-230 (a)	2×10^{0}	7×10^{-2}	1×10^{1}	1×10^{6}
Pa-231	4×10^{0}	4×10^{-4}	1×10^{0}	1×10^{3}
Pa-233	5×10^{0}	7×10^{-1}	1×10^{2}	1×10^{7}
Lead (82)				
Pb-201	1×10^{0}	1×10^{0}	1×10^{1}	1×10^{6}

Radionuclide (atomic number)	A_1	A_2	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
Pb-202	4×10^{1}	2×10^{1}	1×10^{3}	1×10^{6}
Pb-203	4×10^{0}	3×10^{0}	1×10^{2}	1×10^{6}
Pb-205	Unlimited	Unlimited	1×10^{4}	1×10^{7}
Pb-210 (a)	1×10^{0}	5×10^{-2}	1×10^{1} (b)	1×10^{4} (b)
Pb-212 (a)	7×10^{-1}	2×10^{-1}	1×10^{1} (b)	1×10^{5} (b)
Palladium (46)				
Pd-103 (a)	4×10^{1}	4×10^{1}	1×10^{3}	1×10^{8}
Pd-107	Unlimited	Unlimited	1×10^{5}	1×10^{8}
Pd-109	2×10^{0}	5×10^{-1}	1×10^{3}	1×10^{6}
Promethium (61)				
Pm-143	3×10^{0}	3×10^{0}	1×10^{2}	1×10^{6}
Pm-144	7×10^{-1}	7×10^{-1}	1×10^{1}	1×10^{6}
Pm-145	3×10^{1}	1×10^{1}	1×10^{3}	1×10^{7}
Pm-147	4×10^{1}	2×10^{0}	1×10^{4}	1×10^{7}
Pm-148m (a)	8×10^{-1}	7×10^{-1}	1×10^{1}	1×10^{6}
Pm-149	2×10^{0}	6×10^{-1}	1×10^{3}	1×10^{6}
Pm-151	2×10^{0}	6×10^{-1}	1×10^{2}	1×10^{6}
Polonium (84)				
Po-210	4×10^{1}	2×10^{-2}	1×10^{1}	1×10^{4}
Praseodymium (59)				
Pr-142	4×10^{-1}	4×10^{-1}	1×10^{2}	1×10^{5}
Pr-143	3×10^{0}	6×10^{-1}	1×10^{4}	1×10^{6}
Platinum (78)				
Pt-188 (a)	1×10^{0}	8×10^{-1}	1×10^{1}	1×10^{6}
Pt-191	4×10^{0}	3×10^{0}	1×10^{2}	1×10^{6}
Pt-193	4×10^{1}	4×10^{1}	1×10^{4}	1×10^{7}
Pt-193m	4×10^{1}	5×10^{-1}	1×10^{3}	1×10^{7}
Pt-195m	1×10^{1}	5×10^{-1}	1×10^{2}	1×10^{6}
Pt-197	2×10^{1}	6×10^{-1}	1×10^{3}	1×10^{6}

Radionuclide (atomic number)	A_1	A_2	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
Pt-197m	1×10^{1}	6×10^{-1}	1×10^{2}	1×10^{6}
Plutonium (94)				
Pu-236	3×10^{1}	3×10^{-3}	1×10^{1}	1×10^{4}
Pu-237	2×10^{1}	2×10^{1}	1×10^{3}	1×10^{7}
Pu-238	1×10^{1}	1×10^{-3}	1×10^{0}	1×10^{4}
Pu-239	1×10^{1}	1×10^{-3}	1×10^{0}	1×10^{4}
Pu-240	1×10^{1}	1×10^{-3}	1×10^{0}	1×10^{3}
Pu-241 (a)	4×10^{1}	6×10^{-2}	1×10^{2}	1×10^{5}
Pu-242	1×10^{1}	1×10^{-3}	1×10^{0}	1×10^{4}
Pu-244 (a)	4×10^{-1}	1×10^{-3}	1×10^{0}	1×10^{4}
Radium (88)				
Ra-223 (a)	4×10^{-1}	7×10^{-3}	1×10^{2} (b)	1×10^{5} (b)
Ra-224 (a)	4×10^{-1}	2×10^{-2}	1×10^{1} (b)	1×10^{5} (b)
Ra-225 (a)	2×10^{-1}	4×10^{-3}	1×10^{2}	1×10^{5}
Ra-226 (a)	2×10^{-1}	3×10^{-3}	1×10^{1} (b)	1×10^{4} (b)
Ra-228 (a)	6×10^{-1}	2×10^{-2}	1×10^{1} (b)	1×10^{5} (b)
Rubidium (37)				
Rb-81	2×10^{0}	8×10^{-1}	1×10^{1}	1×10^{6}
Rb-83 (a)	2×10^{0}	2×10^{0}	1×10^{2}	1×10^{6}
Rb-84	1×10^{0}	1×10^{0}	1×10^{1}	1×10^{6}
Rb-86	5×10^{-1}	5×10^{-1}	1×10^{2}	1×10^{5}
Rb-87	Unlimited	Unlimited	1×10^{4}	1×10^{7}
Rb(nat)	Unlimited	Unlimited	1×10^{4}	1×10^{7}
Rhenium (75)				
Re-184	1×10^{0}	1×10^{0}	1×10^{1}	1×10^{6}
Re-184m	3×10^{0}	1×10^{0}	1×10^{2}	1×10^{6}
Re-186	2×10^{0}	6×10^{-1}	1×10^{3}	1×10^{6}
Re-187	Unlimited	Unlimited	1×10^{6}	1×10^{9}
Re-188	4×10^{-1}	4×10^{-1}	1×10^{2}	1×10^{5}

Radionuclide (atomic number)	A_1	A_2	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
Re-189 (a)	3×10^{0}	6×10^{-1}	1×10^{2}	1×10^{6}
Re(nat)	Unlimited	Unlimited	1×10^{6}	1×10^{9}
Rhodium (45)				
Rh-99	2×10^{0}	2×10^{0}	1×10^{1}	1×10^{6}
Rh-101	4×10^{0}	3×10^{0}	1×10^{2}	1×10^{7}
Rh-102	5×10^{-1}	5×10^{-1}	1×10^{1}	1×10^{6}
Rh-102m	2×10^{0}	2×10^{0}	1×10^{2}	1×10^{6}
Rh-103m	4×10^{1}	4×10^{1}	1×10^{4}	1×10^{8}
Rh-105	1×10^{1}	8×10^{-1}	1×10^{2}	1×10^{7}
Radon (86)				
Rn-222 (a)	3×10^{-1}	4×10^{-3}	1×10^{1} (b)	1×10^{8} (b)
Ruthenium (44)				
Ru-97	5×10^{0}	5×10^{0}	1×10^{2}	1×10^{7}
Ru-103 (a)	2×10^{0}	2×10^{0}	1×10^{2}	1×10^{6}
Ru-105	1×10^{0}	6×10^{-1}	1×10^{1}	1×10^{6}
Ru-106 (a)	2×10^{-1}	2×10^{-1}	1×10^{2} (b)	1×10^{5} (b)
Sulphur (16)				
S-35	4×10^{1}	3×10^{0}	1×10^{5}	1×10^{8}
Antimony (51)				
Sb-122	4×10^{-1}	4×10^{-1}	1×10^{2}	1×10^{4}
Sb-124	6×10^{-1}	6×10^{-1}	1×10^{1}	1×10^{6}
Sb-125	2×10^{0}	1×10^{0}	1×10^{2}	1×10^{6}
Sb-126	4×10^{-1}	4×10^{-1}	1×10^{1}	1×10^{5}
Scandium (21)				
Sc-44	5×10^{-1}	5×10^{-1}	1×10^{1}	1×10^{5}
Sc-46	5×10^{-1}	5×10^{-1}	1×10^{1}	1×10^{6}
Sc-47	1×10^{1}	7×10^{-1}	1×10^{2}	1×10^{6}
Sc-48	3×10^{-1}	3×10^{-1}	1×10^{1}	1×10^{5}

Radionuclide (atomic number)	A_1	A_2	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
Selenium (34)				
Se-75	3×10^{0}	3×10^{0}	1×10^{2}	1×10^{6}
Se-79	4×10^{1}	2×10^{0}	1×10^{4}	1×10^{7}
Silicon (14)				
Si-31	6×10^{-1}	6×10^{-1}	1×10^{3}	1×10^{6}
Si-32	4×10^{1}	5×10^{-1}	1×10^{3}	1×10^{6}
Samarium (62)				
Sm-145	1×10^{1}	1×10^{1}	1×10^{2}	1×10^{7}
Sm-147	Unlimited	Unlimited	1×10^{1}	1×10^{4}
Sm-151	4×10^{1}	1×10^{1}	1×10^{4}	1×10^{8}
Sm-153	9×10^{0}	6×10^{-1}	1×10^{2}	1×10^{6}
Tin (50)				
Sn-113 (a)	4×10^{0}	2×10^{0}	1×10^{3}	1×10^{7}
Sn-117m	7×10^{0}	4×10^{-1}	1×10^{2}	1×10^{6}
Sn-119m	4×10^{1}	3×10^{1}	1×10^{3}	1×10^{7}
Sn-121m (a)	4×10^{1}	9×10^{-1}	1×10^{3}	1×10^{7}
Sn-123	8×10^{-1}	6×10^{-1}	1×10^{3}	1×10^{6}
Sn-125	4×10^{-1}	4×10^{-1}	1×10^{2}	1×10^{5}
Sn-126 (a)	6×10^{-1}	4×10^{-1}	1×10^{1}	1×10^{5}
Strontium (38)				
Sr-82 (a)	2×10^{-1}	2×10^{-1}	1×10^{1}	1×10^{5}
Sr-85	2×10^{0}	2×10^{0}	1×10^{2}	1×10^{6}
Sr-85m	5×10^{0}	5×10^{0}	1×10^{2}	1×10^{7}
Sr-87m	3×10^{0}	3×10^{0}	1×10^{2}	1×10^{6}
Sr-89	6×10^{-1}	6×10^{-1}	1×10^{3}	1×10^{6}
Sr-90 (a)	3×10^{-1}	3×10^{-1}	1×10^{2} (b)	1×10^{4} (b)
Sr-91 (a)	3×10^{-1}	3×10^{-1}	1×10^{1}	1×10^{5}
Sr-92 (a)	1×10^{0}	3×10^{-1}	1×10^{1}	1×10^{6}

Radionuclide (atomic number)	A_1	A_2	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
Tritium (1)				
T(H-3)	4×10^{1}	4×10^{1}	1×10^{6}	1×10^{9}
Tantalum (73)				
Ta-178(long-lived)	1×10^{0}	8×10^{-1}	1×10^{1}	1×10^{6}
Ta-179	3×10^{1}	3×10^{1}	1×10^{3}	1×10^{7}
Ta-182	9×10^{-1}	5×10^{-1}	1×10^{1}	1×10^{4}
Terbium (65)				
Tb-157	4×10^{1}	4×10^{1}	1×10^{4}	1×10^{7}
Tb-158	1×10^{0}	1×10^{0}	1×10^{1}	1×10^{6}
Tb-160	1×10^{0}	6×10^{-1}	1×10^{1}	1×10^{6}
Technetium (43)				
Tc-95m (a)	2×10^{0}	2×10^{0}	1×10^{1}	1×10^{6}
Tc-96	4×10^{-1}	4×10^{-1}	1×10^{1}	1×10^{6}
Tc-96m (a)	4×10^{-1}	4×10^{-1}	1×10^{3}	1×10^{7}
Tc-97	Unlimited	Unlimited	1×10^{3}	1×10^{8}
Tc-97m	4×10^{1}	1×10^{0}	1×10^{3}	1×10^{7}
Tc-98	8×10^{-1}	7×10^{-1}	1×10^{1}	1×10^{6}
Tc-99	4×10^{1}	9×10^{-1}	1×10^{4}	1×10^{7}
Tc-99m	1×10^{1}	4×10^{0}	1×10^{2}	1×10^{7}
Tellurium (52)				
Te-121	2×10^{0}	2×10^{0}	1×10^{1}	1×10^{6}
Te-121m	5×10^{0}	3×10^{0}	1×10^{2}	1×10^{5}
Te-123m	8×10^{0}	1×10^{0}	1×10^{2}	1×10^{7}
Te-125m	2×10^{1}	9×10^{-1}	1×10^{3}	1×10^{7}
Te-127	2×10^{1}	7×10^{-1}	1×10^{3}	1×10^{6}
Te-127m (a)	2×10^{1}	5×10^{-1}	1×10^{3}	1×10^{7}
Te-129	7×10^{-1}	6×10^{-1}	1×10^{2}	1×10^{6}
Te-129m (a)	8×10^{-1}	4×10^{-1}	1×10^{3}	1×10^{6}
Te-131m (a)	7×10^{-1}	5×10^{-1}	1×10^{1}	1×10^{6}

Radionuclide (atomic number)	A_1	A_2	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
Te-132 (a)	5×10^{-1}	4×10^{-1}	1×10^{2}	1×10^{7}
Thorium (90)				
Th-227	1×10^{1}	5×10^{-3}	1×10^{1}	1×10^{4}
Th-228 (a)	5×10^{-1}	1×10^{-3}	1×10^{0} (b)	1×10^{4} (b)
Th-229	5×10^{0}	5×10^{-4}	1×10^{0} (b)	1×10^{3} (b)
Th-230	1×10^{1}	1×10^{-3}	1×10^{0}	1×10^{4}
Th-231	4×10^{1}	2×10^{-2}	1×10^{3}	1×10^{7}
Th-232	Unlimited	Unlimited	1×10^{1}	1×10^{4}
Th-234 (a)	3×10^{-1}	3×10^{-1}	1×10^{3} (b)	1×10^{5} (b)
Th(nat)	Unlimited	Unlimited	1×10^{0} (b)	1×10^{3} (b)
Titanium (22)				
Ti-44 (a)	5×10^{-1}	4×10^{-1}	1×10^{1}	1×10^{5}
Thallium (81)				
Tl-200	9×10^{-1}	9×10^{-1}	1×10^{1}	1×10^{6}
Tl-201	1×10^{1}	4×10^{0}	1×10^{2}	1×10^{6}
Tl-202	2×10^{0}	2×10^{0}	1×10^{2}	1×10^{6}
Tl-204	1×10^{1}	7×10^{-1}	1×10^{4}	1×10^{4}
Thulium (69)				
Tm-167	7×10^{0}	8×10^{-1}	1×10^{2}	1×10^{6}
Tm-170	3×10^{0}	6×10^{-1}	1×10^{3}	1×10^{6}
Tm-171	4×10^{1}	4×10^{1}	1×10^{4}	1×10^{8}
Uranium (92)				
U-230 (fast lung absorption)(a)(d)	4×10^{1}	1×10^{-1}	1×10^{1} (b)	1×10^{5} (b)
U-230 (medium lung absorption)(a)(e)	4×10^{1}	4×10^{-3}	1×10^{1}	1×10^{4}
U-230 (slow lung absorption)(a)(f)	3×10^{1}	3×10^{-3}	1×10^{1}	1×10^{4}
U-232 (fast lung absorption)(d)	4×10^{1}	1×10^{-2}	1×10^{0} (b)	1×10^{3} (b)
U-232 (medium lung absorption)(e)	4×10^{1}	7×10^{-3}	1×10^{1}	1×10^{4}
U-232 (slow lung absorption)(f)	1×10^{1}	1×10^{-3}	1×10^{1}	1×10^{4}
U-233 (fast lung absorption)(d)	4×10^{1}	9×10^{-2}	1×10^{1}	1×10^{4}

Radionuclide (atomic number)	A_1	A_2	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
U-233 (medium lung absorption)(e)	4×10^{1}	2×10^{-2}	1×10^{2}	1×10^{5}
U-233 (slow lung absorption)(f)	4×10^{1}	6×10^{-3}	1×10^{1}	1×10^{5}
U-234 (fast lung absorption)(d)	4×10^{1}	9×10^{-2}	1×10^{1}	1×10^{4}
U-234 (medium lung absorption)(e)	4×10^{1}	2×10^{-2}	1×10^{2}	1×10^{5}
U-234 (slow lung absorption)(f)	4×10^{1}	6×10^{-3}	1×10^{1}	1×10^{5}
U-235 (all lung absorption types)(a),(d),(e),(f)	Unlimited	Unlimited	1×10^{1} (b)	1×10^{4} (b)
U-236 (fast lung absorption)(d)	Unlimited	Unlimited	1×10^{1}	1×10^{4}
U-236 (medium lung absorption)(e)	4×10^{1}	2×10^{-2}	1×10^{2}	1×10^{5}
U-236 (slow lung absorption)(f)	4×10^{1}	6×10^{-3}	1×10^{1}	1×10^{4}
U-238 (all lung absorption types)(d),(e),(f)	Unlimited	Unlimited	1×10^{1} (b)	1×10^{4} (b)
U (nat)	Unlimited	Unlimited	1×10^{0} (b)	1×10^{3} (b)
U (enriched to 20% or less)(g)	Unlimited	Unlimited	1×10^{0}	1×10^{3}
U (dep)	Unlimited	Unlimited	1×10^{0}	1×10^{3}
Vanadium (23)				
V-48	4×10^{-1}	4×10^{-1}	1×10^{1}	1×10^{5}
V-49	4×10^{1}	4×10^{1}	1×10^{4}	1×10^{7}
Tungsten (74)				
W-178 (a)	9×10^{0}	5×10^{0}	1×10^{1}	1×10^{6}
W-181	3×10^{1}	3×10^{1}	1×10^{3}	1×10^{7}
W-185	4×10^{1}	8×10^{-1}	1×10^{4}	1×10^{7}
W-187	2×10^{0}	6×10^{-1}	1×10^{2}	1×10^{6}
W-188 (a)	4×10^{-1}	3×10^{-1}	1×10^{2}	1×10^{5}
Xenon (54)				
Xe-122 (a)	4×10^{-1}	4×10^{-1}	1×10^{2}	1×10^{9}
Xe-123	2×10^{0}	7×10^{-1}	1×10^{2}	1×10^{9}
Xe-127	4×10^{0}	2×10^{0}	1×10^{3}	1×10^{5}
Xe-131m	4×10^{1}	4×10^{1}	1×10^{4}	1×10^{4}
Xe-133	2×10^{1}	1×10^{1}	1×10^{3}	1×10^{4}
Xe-135	3×10^{0}	2×10^{0}	1×10^{3}	1×10^{10}

Radionuclide (atomic number)	A_1	A_2	Activity concentration for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
Yttrium (39)				
Y-87 (a)	1×10^{0}	1×10^{0}	1×10^{1}	1×10^{6}
Y-88	4×10^{-1}	4×10^{-1}	1×10^{1}	1×10^{6}
Y-90	3×10^{-1}	3×10^{-1}	1×10^{3}	1×10^{5}
Y-91	6×10^{-1}	6×10^{-1}	1×10^{3}	1×10^{6}
Y-91m	2×10^{0}	2×10^{0}	1×10^{2}	1×10^{6}
Y-92	2×10^{-1}	2×10^{-1}	1×10^{2}	1×10^{5}
Y-93	3×10^{-1}	3×10^{-1}	1×10^{2}	1×10^{5}
Ytterbium (79)				
Yb-169	4×10^{0}	1×10^{0}	1×10^{2}	1×10^{7}
Yb-175	3×10^{1}	9×10^{-1}	1×10^{3}	1×10^{7}
Zinc (30)				
Zn-65	2×10^{0}	2×10^{0}	1×10^{1}	1×10^{6}
Zn-69	3×10^{0}	6×10^{-1}	1×10^{4}	1×10^{6}
Zn-69m (a)	3×10^{0}	6×10^{-1}	1×10^{2}	1×10^{6}
Zirconium (40)				
Zr-88	3×10^{0}	3×10^{0}	1×10^{2}	1×10^{6}
Zr-93	Unlimited	Unlimited	1×10^{3} (b)	1×10^{7} (b)
Zr-95 (a)	2×10^{0}	8×10^{-1}	1×10^{1}	1×10^{6}
Zr-97 (a)	4×10^{-1}	4×10^{-1}	1×10^{1} (b)	1×10^{5} (b)

(a) A_1 and/or A_2 values include contributions from daughter nuclides with half-lives less than 10 days.

(b) Parent nuclides and their progeny included in secular equilibrium are listed in the following:

Sr-90	Y-90
Zr-93	Nb-93m
Zr-97	Nb-97
Ru-106	Rh-106
Cs-137	Ba-137m
Ce-134	La-134
Ce-144	Pr-144
Ba-140	La-140
Bi-212	Tl-208 (0.36), Po-212 (0.64)
Pb-210	Bi-210, Po-210
Pb-212	Bi-212, Tl-208 (0.36), Po-212 (0.64)
Rn-220	Po-216
Rn-222	Po-218, Pb-214, Bi-214, Po-214
Ra-223	Rn-219, Po-215, Pb-211, Bi-211, Tl-207
Ra-224	Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
Ra-226	Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210
Ra-228	Ac-228
Th-226	Ra-222, Rn-218, Po-214
Th-228	Ra-224, Rn-220, Po-216, Pb212, Bi-212, Tl208 (0.36), Po-212 (0.64)
Th-229	Ra-225, Ac-225, Fr-221, At-217, Bi-213, Po-213, Pb-209
Th-nat	Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208(0.36), Po-212 (0.64)
Th-234	Pa-234m
U-230	Th-226, Ra-222, Rn-218, Po-214
U-232	Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
U-235	Th-231
U-238	Th-234, Pa-234m
U-nat	Th-234, Pa-234m, U-234, Th-230, Ra-226, Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210
U-240	Np-240m
Np-237	Pa-233
Am-242m	Am-242
Am-243	Np-239

(c) The quantity may be determined from a measurement of the rate of decay or a measurement of the radiation level at a prescribed distance from the source.

(d) These values apply only to compounds of uranium that take the chemical form of UF_6, UO_2F_2 and $UO_2(NO_3)_2$ in both normal and accident conditions of transport.

(e) These values apply only to compounds of uranium that take the chemical form of UO_3, UF_4, UCl_4 and hexavalent compounds in both normal and accident conditions of transport.

(f) These values apply to all compounds of uranium other than those specified in (d) and (e) above.

(g) These values apply to unirradiated uranium only.

2.2.7.7.2.2 For individual radionuclides which are not listed in Table 2.2.7.7.2.1 the determination of the basic radionuclide values referred to in 2.2.7.7.2.1 shall require competent authority approval or, for international transport, multilateral approval. Where the chemical form of each radionuclide is known, it is permissible to use the A_2 value related to its solubility class as recommended by the International Commission on Radiological Protection, if the chemical forms under both normal and accident conditions of transport are taken into consideration. Alternatively, the radionuclide values in Table 2.2.7.7.2.2 may be used without obtaining competent authority approval.

Table 2.2.7.7.2.2

BASIC RADIONUCLIDE VALUES FOR UNKNOWN RADIONUCLIDES OR MIXTURES

Radioactive contents	**A_1**	**A_2**	Activity concentration for exempt material	Activity limits for exempt consignments
	TBq	TBq	Bq/g	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}
No relevant data are available	0.001	9×10^{-5}	1×10^{-1}	1×10^{3}

2.2.7.7.2.3 In the calculations of A_1 and A_2 for a radionuclide not in Table 2.2.7.7.2.1, a single radioactive 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 days or longer than that of the parent nuclide, shall be considered as a single radionuclide; and the activity to be taken into account and the A_1 or A_2 value to be applied shall be those corresponding to the parent nuclide of that chain. In the case of radioactive decay chains in which any daughter nuclide has a half-life either longer than 10 days or greater than that of the parent nuclide, the parent and such daughter nuclides shall be considered as mixtures of different nuclides.

2.2.7.7.2.4 For mixtures of radionuclides, the determination of the basic radionuclide values referred to in 2.2.7.7.2.1 may be determined as follows:

$$X_m = \frac{1}{\sum_i \frac{f_i}{X_i}}$$

where,

f(i) is the fraction of activity or activity concentration of radionuclide i in the mixture;

X(i) is the appropriate value of A_1 or A_2, or the activity concentration for exempt material or the activity limit for an exempt consignment as appropriate for the radionuclide i; and

X_m is the derived value of A_1 or A_2, or the activity concentration for exempt material or the activity limit for an exempt consignment in the case of a mixture.

2.2.7.7.2.5 When the identity of each radionuclide is known but the individual activities of some of the radionuclides are not known, the radionuclides may be grouped and the lowest radionuclide value, as appropriate, for the radionuclides in each group may be used in applying the formulas in 2.2.7.7.2.4 and 2.2.7.7.1.4.2. Groups may be based on the total alpha activity and the total beta/gamma activity when these are known, using the lowest radionuclide values for the alpha emitters or beta/gamma emitters, respectively.

2.2.7.7.2.6 For individual radionuclides or for mixtures of radionuclides for which relevant data are not available, the values shown in Table 2.2.7.7.2.2 shall be used.

2.2.7.8 Limits on transport index (TI), criticality safety index (CSI), radiation levels for packages and overpacks

2.2.7.8.1 Except for consignments under exclusive use, the transport index of any package or overpack shall not exceed 10, nor shall the criticality safety index of any package or overpack exceed 50.

2.2.7.8.2 Except for packages or overpacks transported under exclusive use by road under the conditions specified in 7.5.11, CV33 (3.5) (a), the maximum radiation level at any point on any external surface of a package or overpack shall not exceed 2 mSv/h.

2.2.7.8.3 The maximum radiation level at any point on any external surface of a package under exclusive use shall not exceed 10 mSv/h.

2.2.7.8.4 Packages and overpacks shall be assigned to either category I-WHITE, II-YELLOW or III-YELLOW in accordance with the conditions specified in Table 2.2.7.8.4 and with the following requirements:

(a) For a package or overpack, both the transport index and the surface radiation level conditions shall be taken into account in determining which is the appropriate category. Where the transport index satisfies the condition for one category but the surface radiation level satisfies the condition for a different category, the package or overpack shall be assigned to the higher category. For this purpose, category I-WHITE shall be regarded as the lowest category;

(b) The transport index shall be determined following the procedures specified in 2.2.7.6.1.1 and 2.2.7.6.1.2;

(c) If the surface radiation level is greater than 2 mSv/h, the package or overpack shall be transported under exclusive use and under the provisions of 7.5.11, CV33 (3.5) (a);

(d) A package transported under a special arrangement shall be assigned to category III-YELLOW;

(e) An overpack which contains packages transported under special arrangement shall be assigned to category III-YELLOW.

Table 2.2.7.8.4

CATEGORIES OF PACKAGES AND OVERPACKS

Conditions		
Transport index	**Maximum radiation level at any point on external surface**	**Category**
0 a/	Not more than 0.005 mSv/h	I-WHITE
More than 0 but not more than 1 a/	More than 0.005 mSv/h but not more than 0.5 mSv/h	II-YELLOW
More than 1 but not more than 10	More than 0.5 mSv/h but not more than 2 mSv/h	III-YELLOW
More than 10	More than 2 mSv/h but not more than 10 mSv/h	III-YELLOW b/

a/ If the measured TI is not greater than 0.05, the value quoted may be zero in accordance with 2.2.7.6.1.1(c).

b/ Shall also be transported under exclusive use.

2.2.7.9 Requirements and controls for transport of excepted packages

2.2.7.9.1 Excepted packages which may contain radioactive material in limited quantities, instruments, manufactured articles as specified in 2.2.7.7.1.2 and empty packagings as specified in 2.2.7.9.6 may be transported under the following conditions:

(a) The applicable requirements specified in 2.2.7.9.2, 3.3.1 (special provisions 172 or 290), 4.1.9.1.2, 5.2.1.2, 5.2.1.7.1, 5.2.1.7.2, 5.2.1.7.3, 5.4.1.2.5.1 (a), 7.5.11 CV33 (5.2) and, as applicable 2.2.7.9.3- 2.2.7.9.6;

(b) The requirements for excepted packages specified in 6.4.4;

(c) If the excepted package contains fissile material, one of the fissile exceptions provided by 6.4.11.2 shall apply and the requirement of 6.4.7.2 shall be met.

2.2.7.9.2 The radiation level at any point on the external surface of an excepted package shall not exceed 5 µSv/h.

2.2.7.9.3 Radioactive material which is enclosed in or is included as a component part of an instrument or other manufactured article, with activity not exceeding the item and package limits specified in columns 2 and 3 respectively of Table 2.2.7.7.1.2.1, may be transported in an excepted package provided that:

(a) The radiation level at 10 cm from any point on the external surface of any unpackaged instrument or article is not greater than 0.1 mSv/h; and

(b) Each instrument or article (except radioluminescent time-pieces or devices) bears the marking "RADIOACTIVE"; and

(c) The active material is completely enclosed by non-active components (a device performing the sole function of containing radioactive material shall not be considered to be an instrument or manufactured article).

2.2.7.9.4 Radioactive material in forms other than as specified in 2.2.7.9.3, with an activity not exceeding the limit specified in column 4 of Table 2.2.7.7.1.2.1, may be transported in an excepted package provided that:

(a) The package retains its radioactive contents under routine conditions of transport; and

(b) The package bears the marking "RADIOACTIVE" on an internal surface in such a manner that a warning of the presence of radioactive material is visible on opening the package.

2.2.7.9.5 A manufactured article in which the sole radioactive material is unirradiated natural uranium, unirradiated depleted uranium or unirradiated natural thorium may be transported as an excepted package provided that the outer surface of the uranium or thorium is enclosed in an inactive sheath made of metal or some other substantial material.

2.2.7.9.6 An empty packaging which had previously contained radioactive material may be transported as an excepted package provided that:

(a) It is in a well maintained condition and securely closed;

(b) The outer surface of any uranium or thorium in its structure is covered with an inactive sheath made of metal or some other substantial material;

(c) The level of internal non-fixed contamination does not exceed one hundred times the levels specified in 4.1.9.1.2; and

(d) Any labels which may have been displayed on it in conformity with 5.2.2.1.11.1 are no longer visible.

2.2.7.9.7 The following provisions do not apply to excepted packages and the controls for transport of excepted packages:

2.2.7.4.1, 2.2.7.4.2, 4.1.9.1.3, 4.1.9.1.4, 5.1.3.2, 5.1.5.1.1, 5.1.5.1.2, 5.2.2.1.11.1, 5.4.1.2.5.1 except for (a), 5.4.1.2.5.2, 5.4.1.3, 6.4.6.1, 7.5.11 CV 33 except for para. (5.2).

2.2.7.10 Reserved

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, and may also cause other hazards. 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-C10 Corrosive substances without subsidiary risk
  - 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
    - C1 Liquid
    - C2 Solid
- C11 Articles
- CF Corrosive substances. flammable
  - CF1 Liquid
  - CF2 Solid
- CS Corrosive substances, liable to spontaneous combustion
  - 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
	CT1 Liquid CT2 Solid
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 transport, 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[3] and reactivity with water (including the formation of dangerous decomposition products).

2.2.8.1.5 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.
Substances 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 Guideline 404 [4] .

(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

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[3] *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.*

[4] *OECD guidelines for Testing of Chemicals, No. 404 " Acute Dermal Irritation/Corrosion" (1992).*

- are judged not to cause full thickness destruction of intact skin tissue, but which exhibit a corrosion rate on steel or aluminium surfaces exceeding 6.25 mm a year at a test temperature of 55 °C. For the purposes of testing steel, type P235 [ISO 9328(II):1991] or a similar type, and for testing aluminium, non-clad types 7075-T6 or AZ5GU-T6 shall be used. An acceptable test is prescribed in ASTM G31-72 (Reapproved 1990).

2.2.8.1.6 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 (see also 2.1.3).

2.2.8.1.7 On the basis of the criteria set out in paragraph 2.2.8.1.5, 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.

2.2.8.1.8 Substances, solutions and mixtures, which

- do not meet the criteria of Directives 67/548/EEC [5] or 88/379/EEC [6] 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 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.

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[5] *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).*

[6] *Council Directive 88/379/EEC on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous preparations (Official Journal of the European Communities No. L.187 of 16.07.1988, page 14).*

2.2.8.2.2 The following substances shall not be accepted for carriage:

- UN No. 1798 NITROHYDROCHLORIC ACID;
- chemically unstable mixture of spent sulphuric acid;
- chemically unstable mixtures of nitrating acid or mixtures of residual 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

Acid	inorganic	liquid	C1	2693	BISULPHITES, AQUEOUS SOLUTION, N.O.S.
				2837	BISULPHATES, AQUEOUS SOLUTION
				3264	CORROSIVE LIQUID, ACIDIC, INORGANIC, N.O.S.
		solid	C2	1740	HYDROGENDIFLUORIDES, N.O.S.
				3260	CORROSIVE SOLID, ACIDIC, INORGANIC, N.O.S.
	organic	liquid	C3	2584	ALKYLSULPHONIC ACIDS, LIQUID or 2584ARYLSULPHONIC ACIDS, LIQUID with more than 5% free sulphuric acid
				2586	ALKYLSULPHONIC ACIDS, LIQUID or 2586 ARYLSULPHONIC ACIDS, LIQUID with not more than 5% free sulphuric acid
				2987	CHLOROSILANES, CORROSIVE, N.O.S.
				3145	ALKYLPHENOLS, LIQUID, N.O.S. (including C2-C12 homologues)
				3265	CORROSIVE LIQUID, ACIDIC, ORGANIC, N.O.S
		solid	C4	2430	ALKYLPHENOLS, SOLID, N.O.S. (including C2-C12 homologues)
				2583	ALKYLSULPHONIC ACIDS, SOLID or 2583 ARYLSULPHONIC ACIDS, SOLID with more than 5% free sulphuric acid
				2585	ALKYLSULPHONIC ACIDS, SOLID or 2585 ARYLSULPHONIC 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.
	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.
Other corrosive substances		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 PAINT RELATED MATERIAL (including paint thinning or reducing compound)
				1760	CORROSIVE LIQUID, N.O.S.
		solid[1]	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

(cont'd on next page)

[1] *Mixtures of solids which are not subject to the provisions of ADR, and corrosive liquids, may be carried 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 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)

Flammable [1, 2, 3] **CF**		**CF1**	2986 CHLOROSILANES, CORROSIVE, FLAMMABLE, N.O.S. 2734 AMINES, LIQUID, CORROSIVE, FLAMMABLE, N.O.S. or 2734 POLYAMINES, LIQUID, CORROSIVE, FLAMMABLE, N.O.S. 2920 CORROSIVE LIQUID, FLAMMABLE, N.O.S.
		CF2	2921 CORROSIVE SOLID, FLAMMABLE, N.O.S.
Self-heating CS	**liquid**	**CS1**	3301 CORROSIVE LIQUID, SELF-HEATING, N.O.S.
	solid	**CS2**	3095 CORROSIVE SOLID, SELF-HEATING, N.O.S.
Water-reactive CW	**liquid** [3]	**CW1**	3094 CORROSIVE LIQUID, WATER-REACTIVE, N.O.S.
	solid	**CW2**	3096 CORROSIVE SOLID, WATER-REACTIVE, N.O.S.
Oxidizing CO	**liquid**	**CO1**	3093 CORROSIVE LIQUID, OXIDIZING, N.O.S.
	solid	**CO2**	3084 CORROSIVE SOLID, OXIDIZING, N.O.S.
Toxic [5] **CT**	**liquid** [4]	**CT1**	2922 CORROSIVE LIQUID, TOXIC, N.O.S.
	solid [6]	**CT2**	2923 CORROSIVE SOLID, TOXIC, N.O.S.
Flammable, liquid, toxic [5]		**CFT**	(no collective entry available, classification according to table of precedence of hazard in 2.1.3.9)
Oxidizing, toxic [6]		**COT**	(no collective entry available, classification according to table of precedence of hazard in 2.1.3.9)

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[1] *Flammable corrosive liquids having a flash-point below 23 °C, other than UN Nos. 2734 and 2920, are substances of Class 3.*

[2] *Flammable, slightly corrosive liquids having a flash-point between 23°C and 61°C, are substances of Class 3.*

[3] *Chlorosilanes which, in contact with water or moist air, emit flammable gases, are substances of Class 4.3.*

[4] *Chloroformates having predominantly toxic properties are substances of Class 6.1.*

[5] *Corrosive substances which are highly toxic by inhalation, as defined in 2.2.61.1.4 are substances of Class 6.1.*

[6] *UN No. 2505 AMMONIUM FLUORIDE, UN No. 1812 POTASSIUM FLUORIDE, UN No. 1690 SODIUM FLUORIDE, UN No. 2674 SODIUM FLUOROSILICATE and UN No. 2856 FLUOROSILICATES, N.O.S. 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 micro-organisms 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 and polyhalogenated 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 Lithium cells and batteries may be assigned to Class 9 if they meet the requirements of special provision 230 of Chapter 3.3. They are not subject to the provisions of ADR if they meet the requirements of special provision 188 of Chapter 3.3. They shall be classified in accordance with the procedures of section 38.3 of the Manual of Tests and Criteria.

Life-saving appliances

2.2.9.1.8 Life-saving appliances include life-saving appliances and motor vehicle components which meet the definitions of special provisions 170, 171 or 235 of Chapter 3.3.

Environmentally hazardous substances

2.2.9.1.9 Environmentally hazardous substances include liquid or solid substances pollutant to the aquatic environment and solutions and mixtures of such substances (such as preparations and wastes), which cannot be classified in the other classes or under any other entry of Class 9 listed in table A of Chapter 3.2. It also includes genetically modified micro-organisms and organisms.

Pollutants to the aquatic environment

2.2.9.1.10 Assignment of a substance to the entries UN No. 3082 ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S and UN No. 3077 ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. as pollutant to the aquatic environment shall be as indicated in 2.3.5. Substances already classified as environmentally hazardous with UN Nos. 3077 and 3082 are listed in 2.2.9.4.

Genetically modified micro-organisms or organisms

2.2.9.1.11 Genetically modified micro-organisms are micro-organisms in which the genetic material has been deliberately altered by technical means or by such means that cannot occur naturally.Genetically modified micro-organisms within the meaning of Class 9 are those which are not dangerous for humans and animals, but which could alter animals, plants, microbiological substances and ecosystems in such a way as cannot occur naturally.

NOTE 1: *Genetically modified micro-organisms which are infectious are substances of Class 6.2, UN Nos. 2814 and 2900.*

NOTE 2: *Genetically modified micro-organisms which have received a consent for deliberate release into the environment*[2] *are not subject to the provisions for this Class.*

NOTE 3: *Live vertebrate or invertebrate animals shall not be used to carry genetically modified micro-organisms classified in Class 9 unless the substance can be carried no other way.*

2.2.9.1.12 Genetically modified organisms, which are known or suspected to be dangerous to the environment shall be carried in accordance with conditions specified by the competent authority of the country of origin.

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 compound having a flash-point below 61 °C
Low hazard dithionite
Highly volatile liquid
Substance emitting noxious fumes
Substances containing allergens
Chemical kits and first aid kits

NOTE: *UN No. 1845 carbon dioxide, solid (dry ice), UN No. 2071 ammonium nitrate fertilizers, UN No. 2216 fish meal (fish scrap), stabilized, UN No. 2807 magnetized material, UN No. 3166 engines, internal combustion, including when fitted in machinery or vehicles, UN No. 3171 battery-powered vehicle or 3171 battery-powered equipment (wet battery), UN No. 3334 aviation regulated liquid, n.o.s. and UN No. 3335 aviation regulated solid, n.o.s., listed in the UN Model Regulations, are not subject to the provisions of ADR.*

Assignment of the packing groups

2.2.9.1.15 The substances and articles of Class 9 listed as such in table A of Chapter 3.2 shall be 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] *See in particular Part C of Directive 90/220/EEC (Official Journal of the European Communities, No. L 117, of 8 May 1990, pp. 18-20), which sets out the authorization procedures for the European Community.*

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, 287 and/or 636 of Chapter 3.3.

- Uncleaned empty containment vessels for apparatus such as transformers, condensers containing substances assigned to UN Nos. 2315, 3151 or 3152.

2.2.9.3 List of collective entries

Substances which, on inhalation as fine dust, may endanger health		**M1**	2212 BLUE ASBESTOES (crocidolite) or 2212 BLUE ASBESTOES (amosite, nysorite) 2590 WHITE ASBESTOS (chrysotile, actinolite, anthophyllite, tremolite)
Substances and apparatus which, n the event of fire, may form dioxins		**M2**	2315 POLYCHLORINATED BIPHENYLS 3151 POLYHALOGENATED BIPHENYLS, LIQUID or 3151 POLYHALOGENATED TERPHENYLS, LIQUID 3152 POLYHALOGENATED BIPHENYLS, SOLID or 3152 POLYHALOGENATED TERPHENYLS, SOLID
Substances evolving flammable vapour		**M3**	2211 POLYMERIC BEADS, EXPANDABLE, evolving flammable vapour 3314 PLASTICS MOULDING COMPOUND in dough, sheet or extruded rope form evolving flammable vapour
Lithium batteries		**M4**	3090 LITHIUM BATTERIES 3091 LITHIUM BATTERIES CONTAINED IN EQUIPMENT or 3091 LITHIUM BATTERIES PACKED WITH EQUIPMENT
Live-saving appliances		**M5**	2990 LIFE-SAVING APPLIANCES, SELF-INFLATING 3072 LIFE-SAVING APPLIANCES NOT SELF-INFLATING containing dangerous goods as equipment 3268 AIR BAG INFLATORS or 3268 AIR BAG MODULES or 3268 SEAT-BELT PRETENSIONERS
Environmentally hazardous substances	**liquid**	**M6**	3082 ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S.
	solid	**M7**	3077 ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S.
	genetically modified organisms	**M8**	3245 GENETICALLY MODIFIED MICRO-ORGANISMS
Elevated temperature subs tances	**liquid**	**M9**	3257 ELEVATED TEMPERATURE LIQUID, N.O.S., at or above 100 °C and below i flash-point (including molten metal, molten palt, etc.)
	solid	**M10**	3258 ELEVATED TEMPERATURE SOLID, N.O.S., at or above 240 °C
Other substances or articles covered by Class 9		**M11**	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.

2.2.9.4 Substances already classified as environmentally hazardous which do not belong to any other class nor to Class 9 entries other than the entries UN Nos. 3077 or 3082

UN No. 3082 ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S. pollutant to the aquatic environment, liquid

alcohol C_6-C_{17} (secondary) poly (3-6) ethoxylate
alcohol C_{12}-C_{15} poly (1-3) ethoxylate
alcohol C_{13}-C_{15} poly (1-6) ethoxylate
alpha-cypermethrin
butyl benzyl phthalate
chlorinated paraffins (C_{10}-C_{13})
1-chlorooctane
cresyl diphenyl phosphate
cyfluthrin
decyl acrylate
di-n-butyl phthalate
1,6-dichlorohexane
diisopropylbenzenes
isodecyl acrylate
isodecyl diphenyl phosphate
isoctyl nitrate
malathion
resmethrin
triaryl phosphates
tricresyl phosphates
triethylbenzene
trixylenyl phosphate

UN No. 3077 ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. pollutant to the aquatic environment, solid

chlorohexidine
chlorinated paraffins (C_{10}-C_{13})
p-dichlorobenzene
diphenyl
diphenyl ether
fenbutadin oxide
mercurous chloride (calomel)
tributyltin phosphate
zinc bromide

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 2 220 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

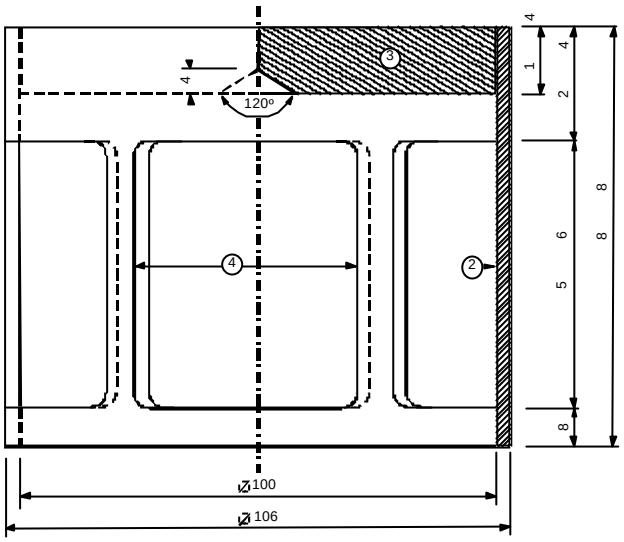


Fig.1: Bell-form charge, mass 2220 g., capable of being suspended from a bronze piston

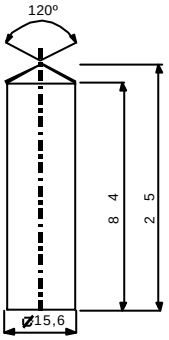


Fig.2: Cylindrical bronze piston, dimensions in mm.

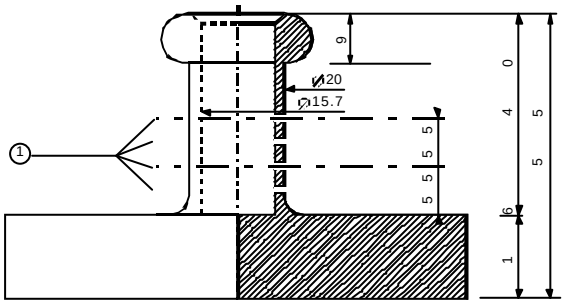
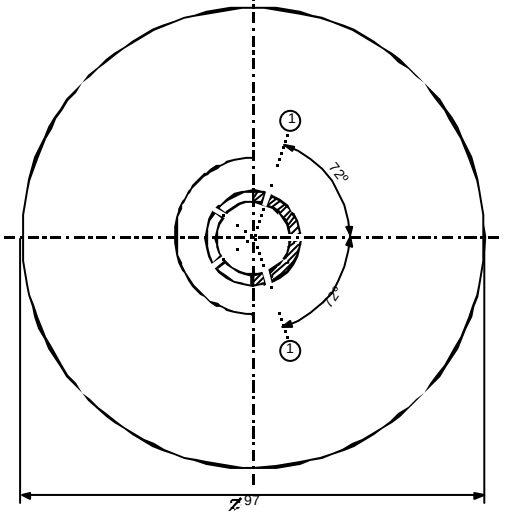


Fig.3: Hollow bronze cylinder, closed at one end; Plan and cut dimensions in mm.



(1) 4 series of 5 holes at 0.5 Ø
(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 sub-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 0.05g 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 Test for determining flash-point

2.3.3.1.1 The flash-point shall be determined by means of one of the following types of apparatus:

(a) Abel
(b) Abel-Pensky
(c) Tag
(d) Pensky-Martens
(e) Apparatus in accordance with ISO 3679: 1983 or ISO 3680: 1983.

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) German Standard DIN 53213: 1978, Part 1

2.3.3.1.3 The test procedure shall be either according to an equilibrium method or according to a non-equilibrium method.

2.3.3.1.4 For the procedure according to an equilibrium method, see:

(a) International Standard ISO 1516: 1981;
(b) International Standard ISO 3680: 1983;
(c) International Standard ISO 1523: 1983;
(d) International Standard ISO 3679: 1983

2.3.3.1.5 The procedure according to a non-equilibrium method shall be:

(a) for the Abel apparatus, see:

(i) British Standard BS 2000 Part 170: 1995;
(ii) French Standard NF MO7-011: 1988;
(iii) French Standard NF T66-009: 1969

(b) for the Abel-Pensky apparatus, see:

(i) German Standard DIN 51755, Part 1: 1974 (for temperatures from 5 °C to 65 °C);

(ii) German Standard DIN 51755, Part 2: 1978 (for temperatures below 5 °C);

(iii) French Standard NF MO7-036: 1984

(c) for the Tag apparatus, see American Standard ASTM D 56: 1993

(d) for the Pensky-Martens apparatus, see:

(i) International Standard ISO 2719: 1988;

(ii) European Standard EN 22719 in each of its national versions (e.g. BS 2000, part 404/EN 22719): 1994;

(iii) American Standard ASTM D 93: 1994;

(iv) Institute of Petroleum Standard IP 34: 1988

2.3.3.1.6 The test methods listed in 2.3.3.1.4 and 2.3.3.1.5 shall only be used for flash-point ranges which are specified in the individual methods. The possibility of chemical reactions between the substance and the sample holder shall be considered when selecting the method 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.

2.3.3.1.7 When the flash-point, determined by a non-equilibrium method in accordance with 2.3.3.1.3 is found to be 23 ± 2 °C or 61 ± 2 °C, it shall be confirmed for each temperature range by an equilibrium method in accordance with 2.3.3.1.2

2.3.3.1.8 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 61 °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 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 cm^3 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 cm^3 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 cm^3 of thiosulphate solution required, the percentage of peroxide (calculated as H_2O_2) 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 Standard 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.

2.3.4.3 ***Evaluation of test results***

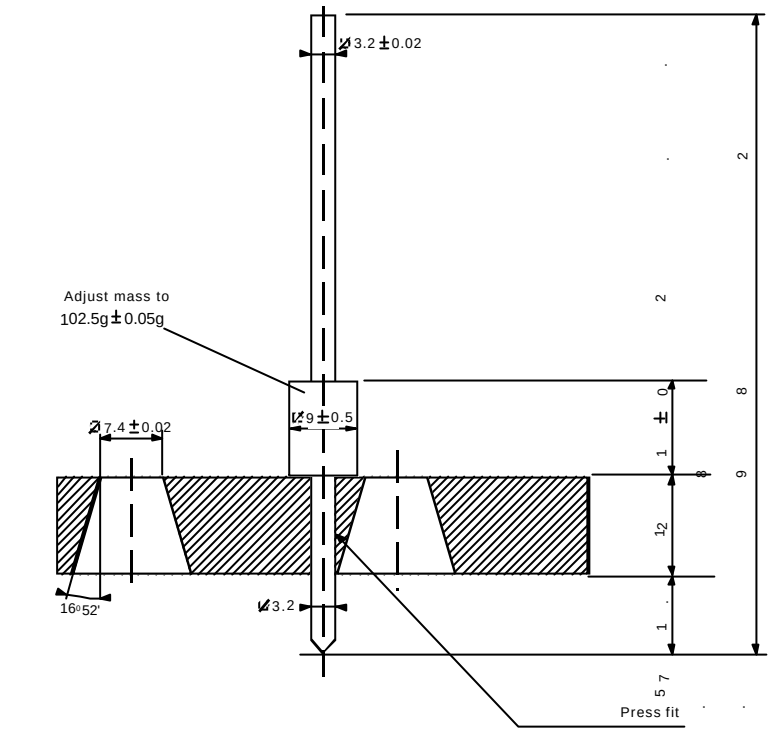
A substance is pasty if, after the centre S has been brought into contact with the surface of the sample, the penetration indicated by the dial gauge:

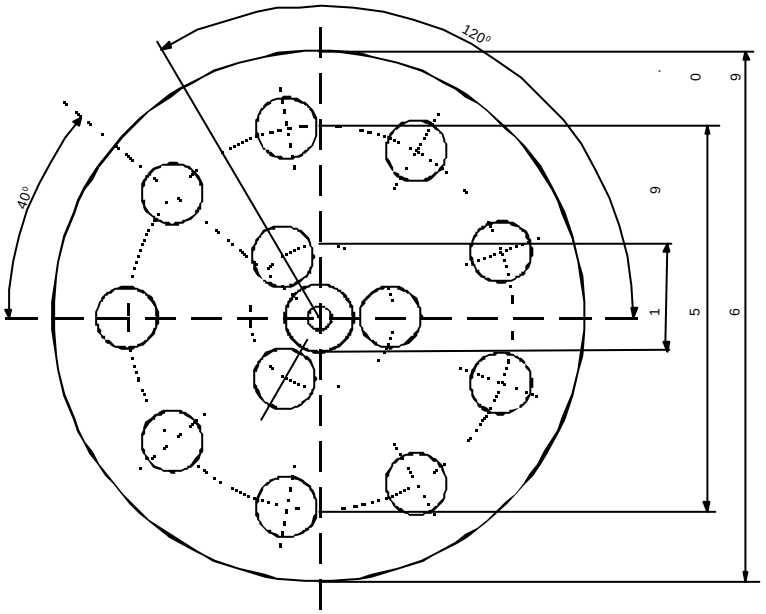
(a) after a loading time of 5 s ± 0.1 s, is less than 15.0 mm ± 0.3 mm; or

(b) after a loading time of 5 s ± 0.1 s, is greater than 15.0 mm ± 0.3 mm, but the additional penetration after another 55 s ± 0.5 s is less than 5.0 mm ± 0.5 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 2.3.4.2.*

Figure 1 - Penetrometer





Tolerances not specified are ± 0.1 mm.

2.3.5 Test for determining the ecotoxicity, persistence and bioaccumulation of substances in the aquatic environment for assignment to Class 9

NOTE: *The test methods used shall be those adopted by the Organization for Economic Cooperation and Development (OECD) and the European Commission (EC). If other methods are used, they shall be internationally recognized, be equivalent to the OECD/EC tests and be referenced in test reports.*

2.3.5.1 Acute toxicity for fish

The object is to determine the concentration which causes 50% mortality in the test species; this is the (LC_{50}) value, namely, the concentration of the substance in water which will cause the death of 50% of a test group of fish during a continuous period of testing of at least 96 hours. Appropriate types of fish include: striped brill (Brachydanio rerio), fathead minnow (Pimephales promelas) and rainbow trout (Oncorhynchus mykiss).

The fish are exposed to the test substance added to the water in varying concentrations (+1control). Observations are recorded at least every 24 hours. At the end of the 96-hour activity and, if possible, at each observation, the concentration causing the death of 50% of the fish is calculated. The no observed effect concentration (NOEC) at 96 hours is also determined.

2.3.5.2 Acute toxicity for daphnia

The object is to determine the effective concentration of the substance in water which renders 50% of the daphnia unable to swim (EC_{50}). The appropriate test organisms are daphnia magna and daphnia pulex. The daphnia are exposed for 48 hours to the test substance added to the water in varying concentrations. The no observed effect concentration (NOEC) at 48 hours is also determined.

2.3.5.3 Algal growth inhibition

The object is to determine the effect of a chemical on the growth of algae under standard conditions. The change in biomass and the rate of growth with algae under the same conditions, but without the presence of the test chemical, are compared over 72 hours. The results are expressed as the effective concentration which reduces the rate of algal growth by 50%, IC_{50r}, and also the formation of the biomass, IC_{50b}.

2.3.5.4 Tests for ready biodegradability

The object is to determine the degree of biodegradation under standard aerobic conditions. The test substance is added in low concentrations to a nutrient solution containing aerobic bacteria. The progress of degradation is followed for 28 days by determining the parameter specified in the test method used. Several equivalent test methods are available. The parameters include reduction of dissolved organic carbon (DOC), carbon dioxide (CO_2) generation of oxygen (O_2) depletion.

A substance is considered to be readily biodegradable if within not more than 28 days the following criteria are satisfied - within 10 days from when degradation first reaches 10%:

Reduction of DOC:	70%
Generation of CO_2:	60% of theoretical CO_2 production
Depletion of O_2:	60% of theoretical O_2 requirement.

The test may be continued beyond 28 days if the above criteria are not satisfied, but the result will represent the inherent biodegradability of the test substance. For assignment purposes, the "ready" result is normally required.
Where only COD and BOD5 data are available, a substance is considered to be readily biodegradable if:

$$\frac{BOD5}{COD} \geq 0.5$$

BOD (Biochemical Oxygen Demand) is defined as the mass of dissolved oxygen required by a specific volume of solution of the substance for the process of biochemical oxidation under prescribed conditions. The result is expressed as grams of BOD per gram of test substance. The normal test period is five days (BOD5) using a national standard test procedure.

COD (Chemical Oxygen Demand) is a measure of the oxidizability of a substance, expressed as the equivalent amount in oxygen of an oxidizing reagent consumed by the substance under fixed laboratory conditions. The results are expressed in grams of COD per gram of substance. A national standard procedure may be used.

2.3.5.5 Tests for bioaccumulation potential

2.3.5.5.1 The object is to determine the potential for bioaccumulation either by the ratio at equilibrium of the concentration (c) of a substance in a solvent to that in water or by the bioconcentration factor (BCF).

2.3.5.5.2 The ratio at equilibrium of the concentration (c) of a substance in a solvent to that in water is normally expressed as a log10. The solvent and water shall have negligible miscibility and the substance shall not ionize in water. The solvent normally used is n-octanol.

In the case of n-octanol and water, the result is:

$$\log P_{ow} = \log_{10} [c_o/c_w]$$

where P_{ow} is the partition coefficient obtained by dividing the concentration of the substance in n-octanol (c_o) by the concentration of the substance in water (C_w). If log P_{ow} 3.0 then the substance has a potential to bioaccumulate.

2.2.5.5.3 The bioconcentration factor (BCF) is defined as the ratio of the concentration of the test substance in the test fish (c_f) to the concentration in the test water (c_w) at steady state:

$$BCF = (c_f) / (c_w).$$

The principle of the test involves exposing fish to a solution or dispersion at known concentrations of the test substance in water. Continuous flow, static or semi-static procedures may be used according to the test procedure selected, based on the properties of the test substances. Fish are exposed to the test substances over a given period of time, followed by a period of no further exposure. During the second period, measurements are made of the rate of increase in the water of the test substance (i.e. the rate of excretion or depuration).
(Full details of the various test procedures and the calculation method for the BCF are given in the OECD Guidelines for Testing of Chemicals, methods 305A to 305E, 12 May 1981).
2.2.5.5.4 A substance may have a log P_{ow} greater than 3 and a BCF less than 100 which would indicate little or no potential to bioaccumulate. In cases of doubt, the BCF value takes precedence over log P_{ow}, as indicated in the following flow chart of the Procedure.

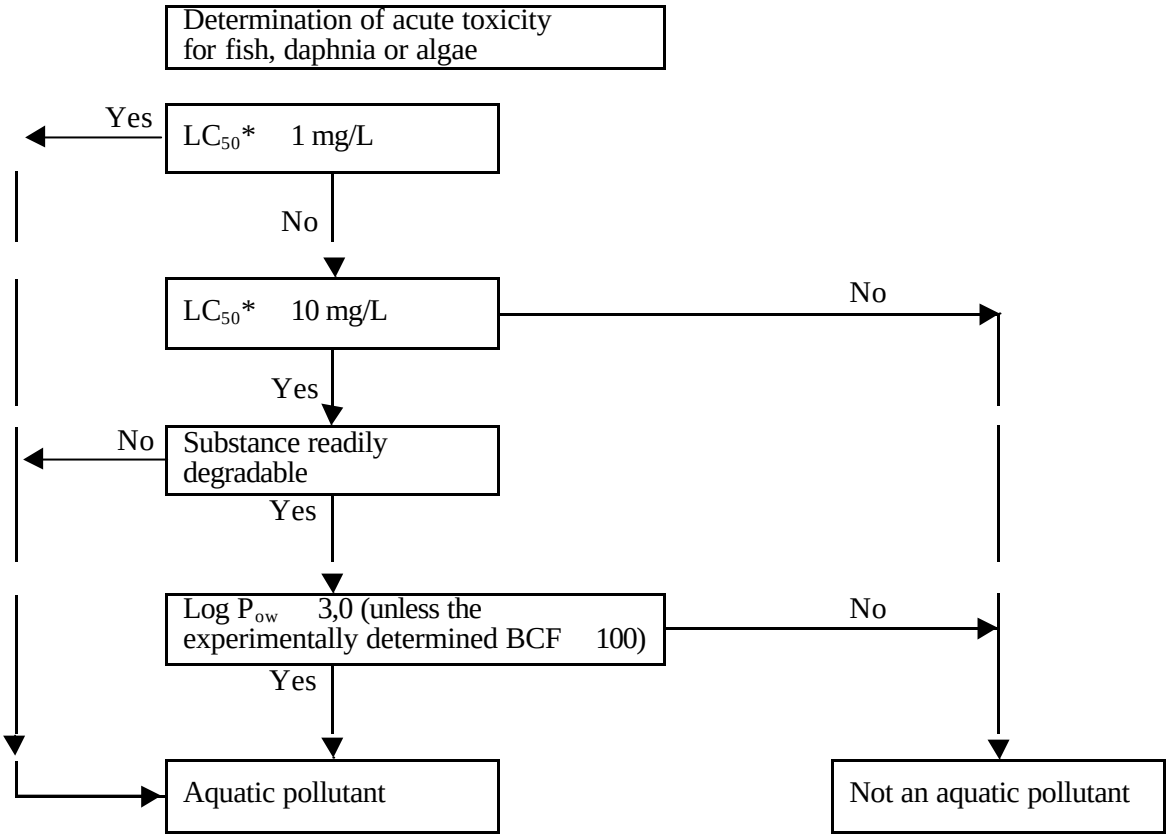
2.3.5.6 Criteria

A substance may be regarded as a pollutant to the aquatic environment if it satisfies one of the following criteria:

The lowest of the values of the 96-hour LC_{50} for fish, the 48-hour EC_{50} for daphnia or the 72-hour IC_{50} for algae

- is less than or equal to 1 mg/L;
- is greater than 1 mg/L but less than or equal to 10 mg/L, and the substance is not biodegradable;
- is greater than 1 mg/L but less than or equal to 10 mg/L, and the log P_{ow} is greater than or equal to 3.0 (unless the experimentally determined BCF is less than or equal to 100).

2.3.5.7 Procedure to be followed



* Lowest value of 96-hour LC_{50}, 48-hour EC_{50} or 72-hour IC_{50} as appropriate.

BCF = bioconcentration factor

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