ECONOMIC COMMISSION FOR EUROPE

Inland Transport Committee

Restructured

ADR

applicable as from 1 July 2001

European Agreement

Concerning the International Carriage
of Dangerous Goods by Road

Volume II

UNITED NATIONS

TABLE OF CONTENTS

VOLUME II

Table of contents (cont'd)

Table of contents (cont'd)

Table of contents (cont'd)

ANNEX A

GENERAL PROVISIONS AND PROVISIONS CONCERNING DANGEROUS SUBSTANCES AND ARTICLES

(cont'd)

PART 3

Dangerous goods list, special provisions and exemptions related to dangerous goods packed in limited quantities

(cont'd)

CHAPTER 3.3

SPECIAL PROVISIONS APPLICABLE TO CERTAIN ARTICLES OR SUBSTANCES

3.3.1 When Column (6) of Table A of Chapter 3.2 indicates that a special provision is relevant to a substance or article, the meaning and requirements of that special provision are as set forth below.

15 For small quantities of not more than 500 g per package, this substance, with not less than 10% water, by mass, may also be classified in Class 4.1, subject to packing instruction P406 of 4.1.4.1.

16 Samples of new or existing explosive substances or articles may be carried as directed by the competent authorities (see 2.2.1.1.3) for purposes including: testing, classification, research and development, quality control, or as a commercial sample. Explosive samples which are not wetted or desensitized shall be limited to 10 kg in small packages as specified by the competent authorities. Explosive samples which are wetted or desensitized shall be limited to 25 kg.

18 For quantities of not more than 11.5 kg per package, this substance, with not less than 10% water, by mass, may also be classified in Class 4.1, subject to packing instruction P406 of 4.1.4.1.

23 Even though this substance has a flammability hazard, it only exhibits such hazard under extreme fire conditions in confined areas.

32 This substance is not subject to the requirements of ADR when in any other form.

36 This substance is to be classified under UN No. 1373 if it contains more than 5% animal or vegetable oil.

37 This substance is not subject to the requirements of ADR when coated.

38 This substance is not subject to the requirements of ADR when it contains not more than 0.1% calcium carbide.

39 This substance is not subject to the requirements of ADR when it contains less than 30% or not less than 90% silicon.

43 When offered for carriage as pesticides, these substances shall be carried under the relevant pesticide entry and in accordance with the relevant pesticide provisions (see 2.2.61.1.10 to 2.2.61.1.11.2).

45 Antimony sulphides and oxides which contain not more than 0.5% of arsenic calculated on the total mass are not subject to the requirements of ADR.

47 Ferricyanides and ferrocyanides are not subject to the requirements of ADR.

48 The carriage of this substance, when it contains more than 20% hydrocyanic acid, is prohibited.

59 These substances are not subject to the requirements of ADR when they contain not more than 50% magnesium.

60 If the concentration is more than 72%, the carriage of this substance is prohibited.

61 The technical name which shall supplement the proper shipping name shall be the ISO common name (see also ISO 1750:1981 "*Pesticides and other agrochemicals - common names*", as amended), other name listed in the WHO "*Recommended Classification of Pesticides by Hazard and Guidelines to Classification*" or the name of the active substance (see also 3.1.2.6.1.1).

62 This substance is not subject to the requirements of ADR when it contains not more than 4% sodium hydroxide.

65 Hydrogen peroxide aqueous solutions with less than 8% hydrogen peroxide are not subject to the requirements of ADR.

103 The carriage of ammonium nitrites and mixtures of an inorganic nitrite with an ammonium salt is prohibited.

105 Nitrocellulose meeting the descriptions of UN No. 2556 or UN No. 2557 may be classified in Class 4.1.

107 The consignment is not subject to the requirements of ADR if the consignor declares that it has no self-heating properties.

113 The carriage of chemically unstable mixtures is prohibited.

119 Refrigerating machines include machines or other appliances which have been designed for the specific purpose of keeping food or other items at a low temperature in an internal compartment, and air conditioning units. Refrigerating machines are not subject to the requirements of ADR if containing less than 12 kg of gas in Class 2, group A or O according to 2.2.2.1.3, or if containing less than 12 *l* ammonia solution (UN No. 2672).

122 The subsidiary risks, control and emergency temperatures if any, and the UN number (generic entry) for each of the currently assigned organic peroxide formulations are given in 2.2.52.4.

127 Other inert material or inert material mixture may be used, provided this inert material has identical phlegmatizing properties.

131 The phlegmatized substance shall be significantly less sensitive than dry PETN.

135 The dihydrated sodium salt of dichloroisocyanuric acid is not subject to the requirements of ADR.

138 p-Bromobenzyl cyanide is not subject to the requirements of ADR.

141 Products which have undergone sufficient heat treatment so that they present no hazard during carriage are not subject to the requirements of ADR.

142 Solvent extracted soya bean meal containing not more than 1.5% oil and 11% moisture, which is substantially free of flammable solvent, is not subject to the requirements of ADR.

144 An aqueous solution containing not more than 24% alcohol by volume is not subject to the requirements of ADR.

145 Alcoholic beverages of packing group III, when carried in receptacles of 250 litres or less, are not subject to the requirements of ADR.

152 The classification of this substance will vary with particle size and packaging, but borderlines have not been experimentally determined. Appropriate classifications shall be made in accordance with 2.2.1.

153 This entry applies only if it is demonstrated, on the basis of tests, that the substances when in contact with water are not combustible nor show a tendency to auto-ignition and that the mixture of gases evolved is not flammable.

162 Mixtures with a flash-point of not more than 61 °C shall bear a label conforming to model No. 3.

163 A substance mentioned by name in Table A of Chapter 3.2 shall not be carried under this entry. Substances carried under this entry may contain 20% or less nitrocellulose provided the nitrocellulose contains not more than 12.6% nitrogen (by dry mass).

168 Asbestos which is immersed or fixed in a natural or artificial binder (such as cement, plastics, asphalt, resins or mineral ore) in such a way that no escape of hazardous quantities of respirable asbestos fibres can occur during carriage is not subject to the requirements of ADR. Manufactured articles containing asbestos and not meeting this provision are nevertheless not subject to the requirements of ADR when packed so that no escape of hazardous quantities of respirable asbestos fibres can occur during carriage.

169 Phthalic anhydride in the solid state and tetrahydrophthalic anhydrides, with not more than 0.05% maleic anhydride, are not subject to the requirements of ADR. Phthalic anhydride molten at a temperature above its flash-point, with not more than 0.05% maleic anhydride, shall be classified under UN No. 3256.

172 For radioactive material with a subsidiary risk :

(a) The packages shall be labelled with a label corresponding to each subsidiary risk exhibited by the material; corresponding placards shall be affixed to vehicles or containers in accordance with the relevant provisions of 5.3.1;

(b) The radioactive material shall be allocated to packing groups I, II or III, as and if appropriate, by application of the grouping criteria provided in Part 2 corresponding to the nature of the predominant subsidiary risk.

The description required in 5.4.1.2.5.1 (e) shall include a description of these subsidiary risks (e.g. "Subsidiary risk: 3, 6.1"), the name of the constituents which most predominantly contribute to this (these) subsidiary risk(s), and where applicable, the packing group.

177 Barium sulphate is not subject to the requirements of ADR.

178 This designation shall be used only when no other appropriate designation exists in Table A of Chapter 3.2, and only with the approval of the competent authority of the country of origin (see 2.2.1.1.3).

181 Packages containing this type of substance shall bear a label conforming to model No. 1 unless the competent authority of the country of origin has permitted this label to be dispensed with for the specific packaging employed because test data have proved that the substance in this packaging does not exhibit explosive behaviour (see 5.2.2.1.9).

182 The group of alkali metals includes lithium, sodium, potassium, rubidium and caesium.

183 The group of alkaline earth metals includes magnesium, calcium, strontium and barium.

186 In determining the ammonium nitrate content, all nitrate ions for which a molecular equivalent of ammonium ions is present in the mixture shall be calculated as ammonium nitrate.

188 Lithium cells and batteries offered for carriage are not subject to the requirements of ADR if they meet the following provisions:

(a) For a lithium metal or lithium alloy cell with a liquid cathode, the lithium content is not more than 0.5 g, for a lithium metal or lithium alloy cell with a solid cathode, the lithium content is not more than 1 g, and for a lithium-ion cell, the equivalent lithium content is not more than 1.5 g;

(b) For a lithium metal or lithium alloy battery with liquid cathodes, the aggregate lithium content is not more than 1 g, for a lithium metal or lithium alloy battery with solid cathodes, the aggregate lithium content is not more than 2 g, and for a lithium-ion battery, the aggregate equivalent lithium content is not more than 8 g;

(c) Each cell or battery containing a liquid cathode is hermetically sealed;

(d) Cells are separated so as to prevent short circuits;

(e) Batteries are separated so as to prevent short circuits and are packed in strong packagings, except when installed in electronic devices; and

(f) If, when fully charged, the aggregate lithium content of the anodes in a liquid cathode battery is more than 0.5 g, or of the aggregate lithium content of the anodes in a solid cathode battery is more than 1 g, it does not contain a liquid or gas which is considered dangerous unless the liquid or gas, if free, would be completely absorbed or neutralized by other materials in the battery.

Lithium cells and lithium batteries are also not subject to the requirements of ADR if they meet the following provisions:

(g) The lithium content of the anode of each cell, when fully charged, is not more than 5 g;

(h) The aggregate lithium content of the anodes of each battery, when fully charged, is not more than 25 g;

(i) Each cell or battery is of the type proved to be non-dangerous by testing in accordance with tests in the *Manual of Tests and Criteria*, Part III, sub-section 38.3; such testing shall be carried out on each type prior to the initial carriage of that type; and

(j) Cells and batteries are designed or packed in such a way as to prevent short circuits under conditions normally encountered during carriage.

As used above and elsewhere in ADR, "lithium content" means the mass of lithium in the anode of a lithium metal or lithium alloy cell, except in the case of a lithium-ion

cell the "equivalent lithium content" in grams is calculated to be 0.3 times the rated capacity in ampere-hours.

190 Aerosol dispensers shall be provided with protection against inadvertent discharge. Aerosols with a capacity not exceeding 50 ml containing only non-toxic constituents are not subject to the requirements of ADR.

191 Receptacles, small, with a capacity not exceeding 50 ml, containing only non-toxic constituents are not subject to the requirements of ADR.

194 The control and emergency temperatures, if any, and the UN number (generic entry) for each of the currently assigned self-reactive substances are given in 2.2.41.4.

196 This formulation shall fulfil the criteria given in paragraph 20.4.2 (g) of Part II of the *Manual of Tests and Criteria*, except that a diluent of type A is not required for desensitization. Formulations not meeting these criteria shall be carried under the provisions of Class 5.2, (see 2.2.52.4).

198 Nitrocellulose solutions containing not more than 20% nitrocellulose may be carried as paint or printing ink, as applicable (see UN Nos. 1210, 1263 and 3066).

199 Lead compounds which, when mixed in a ratio of 1:1000 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 considered insoluble. See ISO 3711:1990 *"Lead chromate pigments and lead chromate - molybdate pigments - Specifications and methods of test"*.

203 This entry shall not be used for polychlorinated biphenyls, UN No. 2315.

204 Articles containing smoke-producing substance(s) corrosive according to the criteria for Class 8 shall be labelled with a label conforming to model No. 8.

205 This entry shall not be used for UN No. 3155 PENTACHLOROPHENOL.

207 Polymeric beads and moulding compounds may be made from polystyrene, poly(methyl methacrylate) or other polymeric material.

208 The commercial grade of calcium nitrate fertilizer, when consisting mainly of a double salt (calcium nitrate and ammonium nitrate) containing not more than 10% ammonium nitrate and at least 12% water of crystallization, is not subject to the requirements of ADR.

210 Toxins from plant, animal or bacterial sources which contain infectious substances, or toxins that are contained in infectious substances, shall be classified in Class 6.2.

215 This entry only applies to the technically pure substance or to formulations derived from it having an SADT higher than 75 °C and therefore does not apply to formulations which are self-reactive substances (for self-reactive substances, see 2.2.41.4).

216 Mixtures of solids which are not subject to the requirements of ADR and flammable liquids may be carried under this entry without first applying the classification criteria of Class 4.1, provided there is no free liquid visible at the time the substance is loaded or at the time the packaging, vehicle or container is closed.

217 Mixtures of solids which are not subject to the requirements of ADR and toxic liquids may be carried under this entry 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, vehicle or container is closed. This entry shall not be used for solids containing a packing group I liquid.

218 Mixtures of solids which are not subject to the requirements of ADR and corrosive liquids may be carried under this entry without first applying the classification criteria of Class 8, provided there is no free liquid visible at the time the substance is loaded or at the time the packaging, vehicle or container is closed.

219 Genetically modified micro-organisms which are infectious shall be carried as UN Nos. 2814 or 2900.

220 Only the technical name of the flammable liquid component of this solution or mixture shall be shown in parentheses immediately following the proper shipping name.

221 Substances included under this entry shall not be of packing group I.

222 Where the term "water-reactive" is used to describe a substance in ADR, it means a substance which in contact with water emits flammable gas.

224 Unless it can be demonstrated by testing that the sensitivity of the substance in its frozen state is no greater than in its liquid state, the substance shall remain liquid during normal transport conditions. It shall not freeze at temperatures above -15 °C.

225 Fire extinguishers under this entry may include installed actuating cartridges (cartridges, power device of classification code 1.4C or 1.4S), without changing the classification of Class 2, group A or O according to 2.2.2.1.3 provided the total quantity of deflagrating (propellant) explosives does not exceed 3.2 g per extinguishing unit.

226 Formulations of this substance containing not less than 30% non-volatile, non-flammable phlegmatizer are not subject to the requirements of ADR.

227 This substance may be carried under provisions other than those of Class 1 only if it is so packed that the percentage of water will not fall below that stated at any time during carriage. When phlegmatized with water and inorganic inert material the content of urea nitrate may not exceed 75% by mass and the mixture shall not be capable of being detonated by the Series 1, type (a), test in the *Manual of Tests and Criteria*, Part 1.

228 Mixtures not meeting the criteria for flammable gases (see 2.2.2.1.5) shall be carried under UN No. 3163.

230 This entry applies to cells and batteries containing lithium in any form, including lithium polymer and lithium ion cells and batteries.

Lithium cells and batteries may be carried under this entry if they meet the following provisions:

(a) Each cell or battery type has been determined to meet the criteria for assignment to Class 9 on the basis of tests carried out in accordance with the *Manual of Tests and Criteria*, Part III, sub-section 38.3;

(b) Each cell and battery incorporates a safety venting device or is designed to preclude a violent rupture under normal conditions of carriage;

(c) Each cell and battery is equipped with an effective means of preventing external short circuits;

(d) Each battery containing cells or series of cells connected in parallel is equipped with effective means as necessary to prevent dangerous reverse current flow (e.g. diodes, fuses, etc.).

235 This entry applies to articles which may be classified in Class 1 in accordance with 2.2.1.1 which are used as life-saving vehicle air bags or seat-belts, when carried as component parts and when these articles as presented for carriage have been tested in accordance with Test series 6 (c) of Section 16 of Part I of the *Manual of Tests and Criteria*, with no explosion of the device, no fragmentation of device casings, and no projection hazard or thermal effect which would significantly hinder fire-fighting or other emergency response efforts in the immediate vicinity. If the air bag inflator unit satisfactorily passes the series 6(c) test, it is not necessary to repeat the test on the air bag module itself.

236 Polyester resin kits consist of two components: a base material (Class 3, packing group II or III) and an activator (organic peroxide). The organic peroxide shall be type D, E or F, not requiring temperature control. Packing group shall be II or III, according to the criteria for Class 3, applied to the base material. The quantity limit referred to in Column (7) of Table A of Chapter 3.2 applies to the base material.

237 The membrane filters, including paper separators, coating or backing materials, etc., that are present in carriage, shall not be liable to propagate a detonation as tested by one of the tests described in the *Manual of Tests and Criteria*, Part I, Test series 1 (a).

In addition the competent authority may determine, on the basis of the results of suitable burning rate tests taking account of the standard tests in the *Manual of Tests and Criteria*, Part III, sub-section 33.2.1, that nitrocellulose membrane filters in the form in which they are to be carried are not subject to the requirements applicable to flammable solids in Class 4.1.

238 (a) Batteries can be considered as non-spillable provided that they are capable of withstanding the vibration and pressure differential tests given below, without leakage of battery fluid.

Vibration test: The battery is rigidly clamped to the platform of a vibration machine and a simple harmonic motion having an amplitude of 0.8 mm (1.6 mm maximum total excursion) is applied. The frequency is varied at the rate of 1 Hz/min between the limits of 10 Hz and 55 Hz. The entire range of frequencies and return is traversed in 95 ± 5 minutes for each mounting position (direction of vibration) of the battery. The battery is tested in three mutually perpendicular positions (to include testing with fill openings and vents, if any, in an inverted position) for equal time periods.

Pressure differential test: Following the vibration test, the battery is stored for six hours at 24 °C ± 4 °C while subjected to a pressure differential of at least 88 kPa. The battery is tested in three mutually perpendicular positions (to include testing with fill openings and vents, if any, in an inverted position) for at least six hours in each position.

(b) Non-spillable batteries are not subject to the requirements of ADR if, at a temperature of 55 °C, the electrolyte will not flow from a ruptured or cracked case and there is no free liquid to flow and if, as packaged for carriage, the terminals are protected from short circuit.

239 Batteries or cells shall not contain dangerous substances other than sodium, sulphur and/or polysulphides. Batteries or cells shall not be offered for carriage at a temperature such that liquid elemental sodium is present in the battery or cell unless approved and under the conditions established by the competent authority of the country of origin. If the country of origin is not a Contracting Party to ADR, the approval and conditions of carriage shall be recognized by the competent authority of the first country Contracting Party to ADR reached by the consignment.

Cells shall consist of hermetically sealed metal casings which fully enclose the dangerous substances and which are so constructed and closed as to prevent the release of the dangerous substances under normal conditions of carriage.

Batteries shall consist of cells secured within and fully enclosed by a metal casing so constructed and closed as to prevent the release of the dangerous substances under normal conditions of carriage.

241 The formulation shall be prepared so that it remains homogeneous and does not separate during carriage. Formulations with low nitrocellulose contents and not showing dangerous properties when tested for their liability to detonate, deflagrate or explode when heated under defined confinement by tests of Test series 1 (a), 2 (b) and 2 (c) respectively in the *Manual of Tests and Criteria*, Part I and not being a flammable solid when tested in accordance with test No. 1 in the *Manual of Tests and Criteria*, Part III, sub-section 33.2.1.4 (chips, if necessary, crushed and sieved to a particle size of less than 1.25 mm) are not subject to the requirements of ADR.

244 This entry includes e.g. aluminium dross, aluminium skimmings, spent cathodes, spent potliner, and aluminium salt slags.

247 Alcoholic beverages containing more than 24% alcohol but not more than 70% by volume, when carried as part of the manufacturing process, may be carried in wooden casks with a capacity of not more than 500 litres deviating from the requirements of Chapter 6.1, on the following conditions:

(a) The casks shall be checked and tightened before filling;

(b) Sufficient ullage (not less than 3%) shall be left to allow for the expansion of the liquid;

(c) The casks shall be carried with the bungholes pointing upwards;
(d) The casks shall be carried in containers meeting the requirements of the CSC. Each cask shall be secured in custom-made cradles and be wedged by appropriate means to prevent it from being displaced in any way during carriage.

249 Ferrocerium, stabilized against corrosion, with a minimum iron content of 10% is not subject to the requirements of ADR.

250 This entry may only be used for samples of chemicals taken for analysis in connection with the implementation of the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction. The carriage of substances under this entry shall be in accordance with the chain of

custody and security procedures specified by the Organisation for the Prohibition of Chemical Weapons.

The chemical sample may only be carried providing prior approval has been granted by the competent authority or the Director General of the Organisation for the Prohibition of Chemical Weapons and providing the sample complies with the following provisions:

(a) It shall be packed according to packing instruction 623 in the ICAO Technical Instructions (see S-3-8 of the Supplement); and

(b) During carriage, a copy of the document of approval for transport, showing the quantity limitations and the packing provisions shall be attached to the transport document.

251 The entry CHEMICAL KIT or FIRST AID KIT is intended to apply to boxes, cases etc. containing small quantities of various dangerous goods which are used for medical, analytical or testing purposes. Such kits may not contain dangerous goods for which the code "LQ0" has been indicated in Column (7) of Table A of Chapter 3.2.

Components shall not react dangerously (see "dangerous reaction" in 1.2.1). The total quantity of dangerous goods in any one kit shall not exceed either 1 *l* or 1 kg. The packing group assigned to the kit as a whole shall be the most stringent packing group assigned to any individual substance in the kit.

Kits which are carried on board vehicles for first-aid or operating purposes are not subject to the requirements of ADR.

252 Provided the ammonium nitrate remains in solution under all conditions of carriage, aqueous solutions of ammonium nitrate, with not more than 0.2% combustible material, in a concentration not exceeding 80%, are not subject to the requirements of ADR.

266 This substance, when containing less alcohol, water or phlegmatizer than specified, shall not be carried unless specifically authorized by the competent authority (see 2.2.1.1).

267 Any explosives, blasting, type C containing chlorates shall be segregated from explosives containing ammonium nitrate or other ammonium salts.

268 The word "AGENT" may be used instead of "EXPLOSIVE" when approved by the competent authority (see 2.2.1.1).

270 Aqueous solutions of Class 5.1 inorganic solid nitrate substances are considered as not meeting the criteria of Class 5.1 if the concentration of the substances in solution at the minimum temperature encountered during carriage is not greater than 80% of the saturation limit.

271 Lactose or glucose or similar materials, may be used as a phlegmatizer provided that the substance contains not less than 90%, by mass, of phlegmatizer. The competent authority may authorize these mixtures to be classified in Class 4.1 on the basis of a test Series 6(c) of Section 16 of Part I of the *Manual of Tests and Criteria* on at least three packages as prepared for carriage. Mixtures containing at least 98%, by mass, of phlegmatizer are not subject to the requirements of ADR. Packages containing mixtures with not less than 90%, by mass, of phlegmatizer need not bear a label conforming to model No. 6.1.

272 This substance shall not be carried under the provisions of Class 4.1 unless specifically authorized by the competent authority (see UN No. 0143).

273 Maneb and maneb preparations stabilized against self-heating need not be classified in Class 4.2 when it can be demonstrated by testing that a cubic volume of 1 m^3 of substance does not self-ignite and that the temperature at the centre of the sample does not exceed 200 °C, when the sample is maintained at a temperature of not less than 75 °C ± 2 °C for a period of 24 hours.

274 The provisions of 3.1.2.6.1 apply.

278 These substances shall not be classified and carried unless authorized by the competent authority on the basis of results from Series 2 tests and a Series 6(c) test of Part I of the *Manual of Tests and Criteria* on packages as prepared for carriage (see 2.2.1.1). The competent authority shall assign the packing group on the basis of 2.2.3 criteria and the package type used for the Series 6(c) test.

279 The substance is assigned to this classification or packing group based on human experience rather than the strict application of classification criteria set out in ADR.

280 This entry applies to articles which are used as life saving vehicle air bag inflators or air bag modules or seat-belt pretensioners, containing a gas or a mixture of compressed gases classified under Class 2, group A or O according to 2.2.2.1.3, and with or without small quantities of pyrotechnic material. For units with pyrotechnic material, initiated explosive effects shall be contained within the pressure vessel such that the unit may be excluded from Class 1 in accordance with the NOTE under 2.2.1.1.1 (b), in conjunction with 16.6.1.4.7 (a)(ii) of the *Manual of Tests and Criteria*, Part I. In addition, units shall be designed or packaged for carriage so that when engulfed in a fire there will be no fragmentation of the pressure vessel or projection hazard. This shall be determined by analysis.

282 Suspensions with a flash-point of not more than 61 °C, shall bear a label conforming to model No. 3.

283 Articles, containing gas, intended to function as shock absorbers, including impact energy-absorbing devices, or pneumatic springs are not subject to the requirements of ADR provided:

(a) Each article has a gas space capacity not exceeding 1.6 litres and a charge pressure not exceeding 280 bar where the product of the capacity (litres) and charge pressure (bars) does not exceed 80 (i.e. 0.5 litres gas space and 160 bar charge pressure, 1 litre gas space and 80 bar charge pressure, 1.6 litres gas space and 50 bar charge pressure, 0.28 litres gas space and 280 bar charge pressure);

(b) Each article has a minimum burst pressure of 4 times the charge pressure at 20 °C for products not exceeding 0.5 litres gas space capacity and 5 times charge pressure for products greater than 0.5 litres gas space capacity;

(c) Each article is manufactured from material which will not fragment upon rupture;

(d) Each article is manufactured in accordance with a quality assurance standard acceptable to the competent authority; and

(e) The design type has been subjected to a fire test demonstrating that the article relieves its pressure by means of a fire degradable seal or other pressure relief

device, such that the article will not fragment and that the article does not rocket.

See also 1.1.3.2 (d) for equipment used for the operation of the vehicle.

284 An oxygen generator, chemical, containing oxidizing substances shall meet the following conditions:

(a) The generator when containing an explosive actuating device shall only be carried under this entry when excluded from Class 1 in accordance with the NOTE under paragraph 2.2.1.1.1 (b);

(b) The generator, without its packaging, shall be capable of withstanding a 1.8 m drop test onto a rigid, non-resilient, flat and horizontal surface, in the position most likely to cause damage, without loss of its contents and without actuation;

(c) When a generator is equipped with an actuating device, it shall have at least two positive means of preventing unintentional actuation.

286 Nitrocellulose membrane filters covered by this entry, each with a mass not exceeding 0.5 g, are not subject to the requirements of ADR when contained individually in an article or a sealed packet.

287 New, uncycled and uncharged lithium ion cells and batteries are not subject to the requirements of ADR:

(a) if the electrolyte does not meet the definition of any class in ADR; or

(b) if the electrolyte meets the definition of a class in ADR, it will not flow from a ruptured or cracked case and there is no free liquid to flow.

288 These substances shall not be classified and carried unless authorized by the competent authority on the basis of results from Series 2 tests and a Series 6(c) test of Part I of the *Manual of tests and Criteria* on packages as prepared for carriage (see 2.2.1.1).

289 Air bags or seat-belts installed in vehicles or in completed vehicle components such as steering columns, door panels, seats, etc. are not subject to the requirements of ADR.

290 When this material meets the definitions and criteria of other classes as defined in Part 2, it shall be classified in accordance with the predominant subsidiary risk. Such material shall be declared under the proper shipping name and UN number appropriate for the material in that predominant Class, with the addition of the name applicable to this material according to Column (2) of Table A of Chapter 3.2, and shall be carried in accordance with the provisions applicable to that UN number. In addition, all other requirements specified in 2.2.7.9.1 shall apply, except 5.2.1.7.2 and 5.4.1.2.5.1 (a).

291 Flammable liquefied gases shall be contained within refrigerating machine components. These components shall be designed and tested to at least three times the working pressure of the machinery. The refrigerating machines shall be designed and constructed to contain the liquefied gas and preclude the risk of bursting or cracking of the pressure retaining components during normal conditions of carriage. Refrigerating machines are not subject to the requirements of ADR if containing less than 12 kg of gas.

292 Only mixtures with not more than 23.5% oxygen may be carried under this entry. A label conforming to model No. 5.1 is not required for any concentrations within this limit.

293 The following definitions apply to matches:

(a) Fusee matches are matches the heads of which are prepared with a friction-sensitive igniter composition and a pyrotechnic composition which burns with little or no flame, but with intense heat;

(b) Safety matches are matches which are combined with or attached to the box, book or card that can be ignited by friction only on a prepared surface;

(c) Strike anywhere matches are matches that can be ignited by friction on a solid surface;

(d) Wax Vesta matches are matches that can be ignited by friction either on a prepared surface or on a solid surface.

295 Batteries need not be individually marked and labelled if the pallet bears the appropriate mark and label.

296 These articles may contain:

(a) Class 2 compressed gases group A or O, according to 2.2.2.1.3;

(b) Signal devices (Class 1) which may include smoke and illumination signal flares;

(c) Electric storage batteries;

(d) First aid kits;

(e) Strike anywhere matches.

297-499 *(Reserved)*

500 UN No. 3064 nitroglycerin, solution in alcohol with more than 1% but not more than 5% nitroglycerin, packed in accordance with packing instruction P300 of 4.1.4.1, is a substance of Class 3.

501 For naphthalene, molten, see UN No. 2304.

502 UN No. 2006 plastics, nitrocellulose-based, self-heating, n.o.s., and 2002 celluloid scrap are substances of Class 4.2.

503 For phosphorus, white or yellow, molten, see UN No. 2447.

504 UN No. 1847 potassium sulphide, hydrated with not less than 30% water of crystallization, UN No. 1849 sodium sulphide, hydrated with not less than 30% water of crystallization and UN No. 2949 sodium hydrosulphide with not less than 25% water of crystallization are substances of Class 8.

505 UN No. 2004 magnesium diamide is a substance of Class 4.2.

506 Alkaline earth metals and alkaline earth metal alloys in pyrophoric form are substances of Class 4.2.

UN No. 1869 magnesium or magnesium alloys containing more than 50% magnesium as pellets, turnings or ribbons, are substances of Class 4.1.

507 UN No. 3048 aluminium phosphide pesticides, with additives inhibiting the emission of toxic flammable gases are substances of Class 6.1.

508 UN No. 1871 titanium hydride and UN No. 1437 zirconium hydride are substances of Class 4.1. UN No. 2870 aluminium borohydride is a substance of Class 4.2.

509 UN No. 1908 chlorite solution is a substance of Class 8.

510 UN No. 1755 chromic acid solution is a substance of Class 8.

511 UN No. 1625 mercuric nitrate, UN No. 1627 mercurous nitrate and UN No. 2727 thallium nitrate are substances of Class 6.1. Thorium nitrate, solid, uranyl nitrate hexahydrate solution and uranyl nitrate, solid are substances of Class 7.

512 UN No. 1730 antimony pentachloride, liquid, UN No. 1731 antimony pentachloride solution, UN No. 1732 antimony pentafluoride and UN No. 1733 antimony trichloride are substances of Class 8.

513 UN No. 1571 barium azide, wetted, is a substance of Class 4.1. UN No. 1445 barium chlorate, UN No. 1446 barium nitrate, UN No. 1447 barium perchlorate, UN No. 1448 barium permanganate and UN No. 1449 barium peroxide are substances of Class 5.1.

514 UN No. 2464 beryllium nitrate is a substance of Class 5.1.

515 UN No. 1581 chloropicrin and methyl bromide mixture and UN No. 1582 chloropicrin and methyl chloride mixture are substances of Class 2.

516 UN No. 1912 methyl chloride and methylene chloride mixture is a substance of Class 2.

517 UN No. 1690 sodium fluoride, UN No. 1812 potassium fluoride, UN No. 2505 ammonium fluoride, UN No. 2674 sodium fluorosilicate and UN No. 2856 fluorosilicates, n.o.s. are substances of Class 6.1.

518 UN No. 1463 chromium trioxide, anhydrous (chromic acid, solid) is a substance of Class 5.1.

519 UN No. 1048 hydrogen bromide, anhydrous, is a substance of Class 2.

520 UN No. 1050 hydrogen chloride, anhydrous, is a substance of Class 2.

521 Solid chlorites and hypochlorites are substances of Class 5.1.

522 UN No. 1873 perchloric acid aqueous solution with more than 50% but not more than 72% pure acid, by mass are substances of Class 5.1. Perchloric acid solutions containing more than 72% pure acid, by mass, or mixtures of perchloric acid with any liquid other than water, are not to be accepted for carriage.

523 UN No. 1382 anhydrous potassium sulphide and UN No. 1385 anhydrous sodium sulphide and their hydrates with less than 30% water of crystallization, and

UN No. 2318 sodium hydrosulphide with less than 25% water of crystallization are substances of Class 4.2.

524 UN No. 2858 finished zirconium products of a thickness of 18 µm or more are substances of Class 4.1.

525 Solutions of inorganic cyanides with a total cyanide ion content of more than 30% shall be classified in packing group I, solutions with a total cyanide ion content of more than 3% and not more than 30% in packing group II and solutions with a cyanide ion content of more than 0.3% and not more than 3% in packing group III.

526 UN No. 2000 celluloid is assigned to Class 4.1.

527 Organometallic compounds and their solutions, not spontaneously flammable, but which, in contact with water, emit flammable gases, are substances of Class 4.3, UN No. 3207. Flammable solutions containing organometallic compounds which are not spontaneously flammable and which, in contact with water, do not emit flammable gases, are substances of Class 3.

528 UN No. 1353 fibres or fabrics impregnated with weakly nitrated cellulose, non-self heating are articles of Class 4.1.

529 UN No. 0135 mercury fulminate, wetted with not less than 20% water, or mixture of alcohol and water, by mass, is a substance of Class 1. Mercurous chloride (calomel) is a substance of Class 9 (UN No. 3077).

530 UN No. 3293 hydrazine, aqueous solution with not more than 37% hydrazine, by mass, is a substance of Class 6.1.

531 Mixtures having a flash-point below 23 °C and containing more than 55% nitrocellulose, whatever its nitrogen content or containing not more than 55% nitrocellulose with a nitrogen content above 12.6% (by dry mass), are substances of Class 1 (see UN Nos. 0340 or 0342) or of Class 4.1.

532 UN No. 2672 ammonia solution containing not less than 10% but not more than 35% ammonia is a substance of Class 8.

533 UN No. 1198 formaldehyde solutions, flammable are substances of Class 3. Formaldehyde solutions, non-flammable, with less than 25% formaldehyde are not subject to the requirements of ADR.

534 While in some climatic conditions, petrol (gasoline) may have a vapour pressure at 50 °C of more than 110 kPa (1.10 bar) but not more than 150 kPa (1.50 bar) it is to continue to be considered as a substance having a vapour pressure at 50 °C of not more than 110 kPa (1.10 bar).

535 UN No. 1469 lead nitrate and UN No. 1470 lead perchlorate are substances of Class 5.1.

536 For naphthalene, solid, see UN No. 1334.

537 UN No. 2869 titanium trichloride mixture, not pyrophoric, is a substance of Class 8.

538 For sulphur (in the solid state), see UN No. 1350.

539 Solutions of isocyanates having a flash-point of not less than 23 °C are substances of Class 6.1.

540 UN No. 1326 hafnium powder, wetted, UN No. 1352 titanium powder, wetted or UN No. 1358 zirconium powder, wetted, with not less than 25% water, are substances of Class 4.1.

541 Nitrocellulose mixtures with a water content, alcohol content or plasticizer content lower than the stated limits are substances of Class 1.

542 Talc containing tremolite and/or actinolite is covered by this entry.

543 UN No. 1005 ammonia, anhydrous, UN No. 3318 ammonia solution with more than 50% ammonia and UN No. 2073 ammonia solution, with more than 35% but not more than 50% ammonia, are substances of Class 2. Ammonia solutions with not more than 10% ammonia are not subject to the requirements of ADR.

544 UN No. 1032 dimethylamine, anhydrous, UN No. 1036 ethylamine, UN No. 1061 methylamine, anhydrous and UN No. 1083 trimethylamine, anhydrous, are substances of Class 2.

545 UN No. 0401 dipicryl sulphide, wetted with less than 10% water by mass is a substance of Class 1.

546 UN No. 2009 zirconium, dry, finished sheets, strip or coiled wire, in thicknesses of less than 18 µm, is a substance of Class 4.2. Zirconium, dry, finished sheets, strip or coiled wire, in thicknesses of 254 µm or more, is not subject to the requirements of ADR.

547 UN No. 2210 maneb or UN No. 2210 maneb preparations in self-heating form are substances of Class 4.2.

548 Chlorosilanes which, in contact with water, emit flammable gases, are substances of Class 4.3.

549 Chlorosilanes having a flash-point of less than 23 °C and which, in contact with water, do not emit flammable gases are substances of Class 3. Chlorosilanes having a flash-point equal to or greater than 23 °C and which, in contact with water, do not emit flammable gases are substances of Class 8.

550 UN No. 1333 cerium in slabs, rods or ingots is a substance of Class 4.1.

551 Solutions of these isocyanates having a flash-point below 23 °C are substances of Class 3.

552 Metals and metal alloys in powdered or other flammable form, liable to spontaneous combustion, are substances of Class 4.2. Metals and metal alloys in powdered or other flammable form which, in contact with water, emit flammable gases are substances of Class 4.3.

553 This mixture of hydrogen peroxide and peroxyacetic acid shall, in laboratory testing (see *Manual of Tests and Criteria*, Part II, section 20), neither detonate in the cavitated state nor deflagrate at all and shall show no effect when heated under confinement nor any explosive power. The formulation shall be thermally stable (self-accelerating decomposition temperature 60 °C or higher for a 50 kg package), and a liquid compatible with peroxyacetic acid shall be used for desensitization. Formulations not

meeting these criteria are to be regarded as substances of Class 5.2 (see *Manual of Tests and Criteria*, Part II, paragraph 20.4.3(g)).

554 Metal hydrides which, in contact with water, emit flammable gases are substances of Class 4.3. UN No. 2870 aluminium borohydride or UN No. 2870 aluminium borohydride in devices is a substance of Class 4.2.

555 Dust and powder of metals in non-spontaneously combustible form, non-toxic which nevertheless, in contact with water, emit flammable gases, are substances of Class 4.3.

556 Organometallic compounds and their solutions which ignite spontaneously are substances of Class 4.2. Flammable solutions with organometallic compounds in concentrations which, in contact with water, neither emit flammable gases in dangerous quantities nor ignite spontaneously are substances of Class 3.

557 Dust and powder of metals in pyrophoric form are substances of Class 4.2.

558 Metals and metal alloys in pyrophoric form are substances of Class 4.2. Metals and metal alloys which, in contact with water, do not emit flammable gases and are not pyrophoric or self-heating, but which are easily ignited, are substances of Class 4.1.

559 Mixtures of a hypochlorite with an ammonium salt are not to be accepted for carriage. UN No. 1791 hypochlorite solution is a substance of Class 8.

560 UN No. 3257 elevated temperature liquid, n.o.s., at or above 100 °C and, for a substance with a flash-point, below its flash-point (including molten metals and molten salts) is a substance of Class 9.

561 Chloroformates having predominantly corrosive properties are substances of Class 8.

562 Spontaneously combustible organometallic compounds are substances of Class 4.2. Water-reactive organometallic compounds, flammable, are substances of Class 4.3.

563 UN No. 1905 selenic acid is a substance of Class 8.

564 UN No. 2443 vanadium oxytrichloride, UN No. 2444 vanadium tetrachloride and UN No. 2475 vanadium trichloride are substances of Class 8.

565 Unspecified wastes resulting from medical/veterinary treatment of humans/animals or from biological research, and which are unlikely to contain substances of Class 6.2 shall be assigned to this entry. Decontaminated clinical wastes or wastes resulting from biological research which previously contained infectious substances are not subject to the requirements of Class 6.2.

566 UN No. 2030 hydrazine hydrate and UN No. 2030 hydrazine aqueous solution, with more than 37% and not more than 64% hydrazine, by mass, are substances of Class 8.

567 Mixtures containing more than 21% oxygen by volume shall be classified as oxidizing.

568 Barium azide with a water content lower than the stated limit is a substance of Class 1, UN No. 0224.

569-579 *(Reserved)*

580 Tank-vehicles, specialized vehicles and specially equipped vehicles for carriage in bulk shall bear on both sides and at the rear the mark referred to in 5.3.3.

Tank-containers, portable tanks, special containers and specially equipped containers for carriage in bulk shall bear this mark on both sides and at each end.

581 This entry covers mixtures of methylacetylene and propadiene with hydrocarbons, which as

Mixture P1, contain not more than 63% methylacetylene and propadiene by volume and not more than 24% propane and propylene by volume, the percentage of C_4-saturated hydrocarbons being not less than 14% by volume; and as

Mixture P2, contain not more than 48% methylacetylene and propadiene by volume and not more than 50% propane and propylene by volume, the percentage of C_4-saturated hydrocarbons being not less than 5% by volume,

as well as mixtures of propadiene with 1 to 4% methylacetylene.

When relevant, in order to meet the requirements for the transport document (5.4.1.1), the term "Mixture P1" or "Mixture P2" may be used as technical name.

582 This entry covers, inter alia , mixtures of gases indicated by the letter R ..., which as

Mixture F1, have a vapour pressure at 70° C not exceeding 1.3 MPa (13 bar) and a density at 50 °C not lower than that of dichlorofluoromethane (1.30 kg/l);

Mixture F2, have a vapour pressure at 70 °C not exceeding 1.9 MPa (19 bar) and a density at 50 °C not lower than that of dichloridifluoromethane (1.21 kg/l);

Mixture F3, have a vapour pressure at 70 °C not exceeding 3 MPa (30 bar) and a density at 50 °C not lower than that of chlorodifluoromethane (1.09 kg/l).

NOTE: *Trichlorofluoromethane (refrigerant gas R 11), 1,1,2-trichloro-1,2,2-trifluoroethane (refrigerant gas R 113), 1,1,1-trichloro-2,2,2-trifluoroethane (refrigerant gas R 113a), 1-chloro-1,2,2-trifluoroethane (refrigerant gas R 133) and 1-chloro-1,1,2-trifluoroethane (refrigerant gas R 133 b) are not substances of Class 2. They may, however, enter into the composition of mixtures F 1 to F 3.*

When relevant, in order to meet the requirements for the transport document (5.4.1.1), the term "Mixture F1", "Mixture F2" or "Mixture F3" may be used as technical name.

583 This entry covers, inter alia , mixtures which as

Mixture A, have a vapour pressure at 70 °C not exceeding 1.1 MPa (11 bar) and a density at 50 °C not lower than 0.525 kg/l;

Mixture A01, have a vapour pressure at 70 °C not exceeding 1.6 MPa (16 bar) and a relative density at 50 °C not lower than 0.516 kg/l;

Mixture A02, have a vapour pressure at 70 °C not exceeding 1.6 MPa (16 bar) and a relative density at 50 °C not lower than 0.505 kg/l;

Mixture A0, have a vapour pressure at 70 °C not exceeding 1.6 MPa (16 bar) and a density at 50 °C not lower than 0.495 kg/l;

Mixture A1, have a vapour pressure at 70 °C not exceeding 2.1 MPa (21 bar) and a density at 50 °C not lower than 0.485 kg/l;

Mixture B1, have a vapour pressure at 70 °C not exceeding 2.6 MPa (26 bar) and a relative density at 50 °C not lower than 0.474 kg/l;

Mixture B2, have a vapour pressure at 70 °C not exceeding 2.6 MPa (26 bar) and a relative density at 50 °C not lower than 0.463 kg/l;

Mixture B, have a vapour pressure at 70 °C not exceeding 2.6 MPa (26 bar) and a density at 50 °C not lower than 0.450 kg/l;

Mixture C, have a vapour pressure at 70 °C not exceeding 3.1 MPa (31 bar) and a relative density at 50 °C not lower than 0.440 kg/l;

When relevant, in order to meet the requirements for the transport document (5.4.1.1), the following terms may be used as technical name:

- "Mixture A" or "Butane";
- "Mixture A01" or "Butane";
- "Mixture A02" or "Butane";
- "Mixture A0" or "Butane";
- "Mixture A1";
- "Mixture B1";
- "Mixture B2";
- "Mixture B";
- "Mixture C" or "Propane".

For carriage in tanks, the trade names "butane" or "propane" may be used only as a complement.

584 This gas is not subject to the requirements of ADR when:

- it is in the gaseous state;
- it contains not more than 0.5% air;
- it is contained in metal capsules (sodors, sparklets) free from defects which may impair their strength;
- the leakproofness of the closure of the capsule is ensured;
- a capsule contains not more than 25 g of this gas;
- a capsule contains not more than 0.75 g of this gas per cm^3 of capacity.

585 Cinnabar is not subject to the requirements of ADR.

586 Hafnium, titanium and zirconium powders shall contain a visible excess of water. Hafnium, titanium and zirconium powders, wetted, mechanically produced, of a particle size of 53 µm and over, or chemically produced, of a particle size of 840 µm and over, are not subject to the requirements of ADR.

587 Barium stearate and barium titanate are not subject to the requirements of ADR.

588 Solid hydrated forms of aluminium bromide and aluminium chloride are not subject to the requirements of ADR.

589 Calcium hypochlorite mixtures, dry, containing not more than 10% available chlorine are not subject to the requirements of ADR.

590 Ferric chloride hexahydrate is not subject to the requirements of ADR.

591 Lead sulphate with not more than 3% free acid is not subject to the requirements of ADR.

592 Uncleaned empty packagings (including empty IBCs and large packagings), empty tank-vehicles, empty demountable tanks, empty portable tanks, empty tank-containers and empty small containers which have contained this substance are not subject to the requirements of ADR.

593 This gas, intended for the cooling of e.g. medical or biological specimens, if contained in double wall receptacles which comply with the provisions of packing instruction P203 (11) of 4.1.4.1 is not subject to the requirements of ADR.

594 The following articles, manufactured and filled according to the regulations of the manufacturing State and packaged in strong outer packagings, are not subject to the requirements of ADR:

- UN No. 1044 fire extinguishers provided with protection against inadvertent discharge;

- UN No. 3164 articles, pressurized pneumatic or hydraulic, designed to withstand stresses greater than the internal gas pressure by virtue of transmission of force, intrinsic strength or construction.

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

596 Cadmium pigments, such as cadmium sulphides, cadmium sulphoselenides and cadmium salts of higher fatty acids (e.g. cadmium stearate), are not subject to the requirements of ADR.

597 Acetic acid solutions with not more than 10% pure acid by mass, are not subject to the requirements of ADR.

598 The following are not subject to the requirements of ADR:

(a) New storage batteries when:

- they are secured in such a way that they cannot slip, fall or be damaged;

- they are provided with carrying devices, unless they are suitably stacked, e.g. on pallets;

- there are no dangerous traces of alkalis or acids on the outside;

- they are protected against short circuits.

(b) Used storage batteries when:

- their cases are undamaged;
- they are secured in such a way that they cannot leak, slip, fall or be damaged, e.g. by stacking on pallets;
- there are no dangerous traces of alkalis or acids on the outside of the articles;
- they are protected against short circuits.

"Used storage batteries" means storage batteries carried for recycling at the end of their normal service life.

599 Manufactured articles or instruments containing not more than 1 kg of mercury are not subject to the requirements of ADR.

600 Vanadium pentoxide, fused and solidified, is not subject to the requirements of ADR.

601 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 are not subject to the requirements of ADR.

602 Phosphorus sulphides which are not free from yellow and white phosphorus are not to be accepted for carriage.

603 Anhydrous hydrogen cyanide not meeting the description for UN No. 1051 or UN No. 1614 is not to be accepted for carriage. Hydrogen cyanide (hydrocyanic acid) containing less than 3% water is stable, if the pH-value is 2.5 ± 0.5 and the liquid is clear and colourless.

604 Ammonium bromate and its aqueous solutions and mixtures of a bromate with an ammonium salt are not to be accepted for carriage.

605 Ammonium chlorate and its aqueous solutions and mixtures of a chlorate with an ammonium salt are not to be accepted for carriage.

606 Ammonium chlorite and its aqueous solutions and mixtures of a chlorite with an ammonium salt are not to be accepted for carriage.

607 Mixtures of potassium nitrate and sodium nitrite with an ammonium salt are not to be accepted for carriage.

608 Ammonium permanganate and its aqueous solutions and mixtures of a permanganate with an ammonium salt are not to be accepted for carriage.

609 Tetranitromethane not free from combustible impurities is not to be accepted for carriage.

610 The carriage of this substance, when it contains more than 45% hydrogen cyanide is prohibited.

611 Ammonium nitrate containing more than 0.2% combustible substances (including any organic substance calculated as carbon) is not to be accepted for carriage unless it is a constituent of a substance or article of Class 1.

612 *(Reserved)*

613 Chloric acid solution containing more than 10% chloric acid and mixtures of chloric acid with any liquid other than water is not to be accepted for carriage.

614 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in concentrations considered highly toxic according to the criteria in 2.2.61.1 is not to be accepted for carriage.

615 *(Reserved)*

616 Substances containing more than 40% liquid nitric esters shall satisfy the exudation test specified in 2.3.1.

617 In addition to the type of explosive, the commercial name of the particular explosive shall be marked on the package and shall be specified in the transport document.

618 In receptacles containing 1,2-butadiene, the oxygen concentration in the gaseous phase shall not exceed 50 ml/m^3.

619-622 *(Reserved)*

623 UN No. 1829 sulphur trioxide shall be inhibited. Sulphur trioxide, 99.95% pure or above, may be carried without inhibitor in tanks provided that its temperature is maintained at or above 32.5 °C. For the carriage of this substance without inhibitor in tanks at a minimum temperature of 32.5 °C, the specification "**Transport under minimum temperature of the product of 32.5 °C**" shall appear in the transport document.

624 Fertilizers having an ammonium nitrate content or a content in combustible substances exceeding the values shown are not to be accepted for carriage except under the conditions applicable to Class 1.

Fertilizers having an ammonium nitrate content below the limit values indicated are not subject to the requirements of ADR.

Ammonium nitrate fertilizers, uniform non-segregating mixtures of nitrogen/phosphate or nitrogen/potash types or complete fertilizers of nitrogen/phosphate/potash type whose molecular excess of nitrate ions over ammonium ions (calculated as potassium nitrate) is less than 10% are not subject to the requirements of ADR provided that:

(a) their ammonium nitrate content is not more than 70% and their total content of combustible material is not more than 0.4%, or

(b) their ammonium nitrate content is not more than 45% irrespective of their content of combustible material.

625 Packages containing these articles shall be clearly marked as follows:
"**UN 1950 AEROSOLS**"

626-627 *(Reserved)*

628 Uniform non-segregating mixtures of ammonium nitrate with added matter which is inorganic and chemically inert towards ammonium nitrate, with not less than 90% ammonium nitrate and not more than 0.2% combustible material (including organic

material calculated as carbon), or with more than 70% but less than 90% ammonium nitrate and not more than 0.4% total combustible material.

629 Uniform non-segregating mixtures of ammonium nitrate with calcium carbonate and/or dolomite, with more than 80% but less than 90% ammonium nitrate and not more than 0.4% total combustible material.

630 Uniform non-segregating mixtures of ammonium nitrate and ammonium sulphate, with more than 45% but not more than 70% ammonium nitrate and not more than 0.4% total combustible material.

631 Uniform non-segregating mixtures of nitrogen/phosphate or nitrogen/potash types or complete fertilizers of nitrogen/phosphate/potash type, with more than 70% but less than 90% ammonium nitrate and not more than 0.4% total combustible material.

632 Considered to be spontaneously flammable (pyrophoric).

633 Packages and small containers containing this substance shall bear the following marking: "**Keep away from any source of ignition**". This marking shall be in an official language of the forwarding country, and also, if that language is not English, French or German, in English, French or German, unless any agreements concluded between the countries concerned in the transport operation provide otherwise.

634 Packages containing substances carried in refrigerated liquid nitrogen shall, in addition, bear a label conforming to model No. 2.2.

635 Packages containing these articles need not bear a label conforming to model No. 9 unless the article is fully enclosed by packaging, crates or other means that prevent the ready identification of the article.

636 (a) With the approval of the competent authority of the country of origin, the quantity of lithium or lithium alloy in each cell may be raised to 60 g and a package may contain up to 2500 g of lithium or lithium alloy; the competent authority shall determine the conditions of carriage as well as the type and duration of the test. If the country of origin is not a Contracting Party to ADR, the approval shall be recognized by the competent authority of the first country Contracting Party to ADR reached by the consignment. In such a case, a copy of the approval with the conditions of carriage shall be attached to the transport document. This approval shall be drawn up in an official language of the forwarding country and also, if that language is not English, French or German, in English, French or German, unless any agreements concluded between the countries concerned in the transport operation provide otherwise.

(b) Cells contained in equipment shall not be capable of being discharged during carriage to the extent that the open circuit voltage falls below 2 volts or two thirds of the voltage of the undischarged cell, whichever is the lower.

(c) Packages containing used cells or batteries in unmarked packagings shall bear the inscription: "**Used lithium cells**".

(d) Articles which do not meet the requirements of this special provision and/or special provisions 188, 230, 287 as appropriate are not to be accepted for carriage.

637 Genetically modified micro-organisms 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. Genetically modified micro-organisms which have received a consent for deliberate release into the environment [1] are not subject to the requirements of Class 9. Live vertebrate or invertebrate animals shall not be used to carry these substances classified under this UN number unless the substance can be carried in no other way. For the carriage of easily perishable substances under this UN number appropriate information shall be given, e.g.: "**Cool at +2 °/+4 °C**" or "**Carry in frozen state**" or "**Do not freeze**".

638 Substances related to self-reactive substances (see 2.2.41.1.19).

639 See 2.2.2.3, classification code 2F, UN No. 1965, Note 2.

640 The physical and technical characteristics mentioned in Column (2) of Table A of Chapter 3.2, which were intended to establish different conditions of carriage for the same packing group, shall also be mentioned additionally in the transport document.

641 Sulphur is not subject to the requirements of ADR when it has been formed to specific shape (e.g. pellets, granules, pastilles or flakes).

642 Except as authorized under 1.1.4.2, this entry of the UN Model Regulations shall not be used for the carriage of fertilizer ammoniating solutions with free ammonia.

643 Stone or aggregate asphalt mixture is not subject to the requirements for Class 9.

644 This substance is admitted for carriage provided that:

- The pH is between 5 and 7 measured in an aqueous solution of 10% of the substance carried;

- The solution does not contain more than 0.2% combustible material or chlorine compounds in quantities such that the chlorine level exceeds 0.02%.

[1] *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.*

CHAPTER 3.4

EXEMPTIONS RELATED TO DANGEROUS GOODS PACKED IN LIMITED QUANTITIES

3.4.1 Packagings used in accordance with 3.4.3 to 3.4.6 below, need only to conform to the general provisions of 4.1.1.1, 4.1.1.2 and 4.1.1.4 to 4.1.1.8.

3.4.2 When the code "LQ0" is shown in Column (7) of Table A in Chapter 3.2 for a given substance or article, that substance or article is not exempted from any of the applicable provisions of Annexes A and B when it is packed in limited quantities, unless otherwise specified in these Annexes.

3.4.3 Unless otherwise provided in this Chapter, when one of the codes "LQ1" or "LQ2" is shown in Column (7) of Table A in Chapter 3.2 for a given substance or article, the provisions of other Chapters of ADR do not apply to the carriage of that substance or article, provided:

(a) The provisions of 3.4.5 (a) to (c) are observed; with respect to these provisions, articles are considered to be inner packagings;

(b) Inner packagings meet the conditions of 6.2.1.2 when "LQ1" is shown, and the conditions of 6.2.1.2, 6.2.4.1 and 6.2.4.2 when "LQ2" is shown.

3.4.4 Unless otherwise provided in this Chapter, when one of the codes "LQ3", "LQ20", "LQ21" or "LQ29" is shown in Column (7) of Table A in Chapter 3.2 for a given substance, the provisions of other Chapters of ADR do not apply to the carriage of that substance, provided:

(a) The substance is carried in combination packagings, the following outer packagings being allowed:

- steel or aluminium drums with removable head;
- steel or aluminium jerricans with removable head;
- plywood or fibre drums;
- plastics drums or jerricans with removable head;
- boxes of natural wood, plywood, reconstituted wood, fibreboard, plastics, steel or aluminium;

(b) The maximum quantity per inner packaging and per package, prescribed for the relevant code in the second and third column of the table in 3.4.6, are not exceeded;

(c) Each package is clearly and durably marked with :

(i) the UN number of the goods contained therein, as given in Column (1) of Table A in Chapter 3.2, preceded by the letters "UN";

(ii) in the case of different goods with different UN numbers within a single package:

- the UN numbers of the goods contained therein, preceded by the letters "UN", or

- the letters "LQ" [1].

These markings shall be displayed within a diamond-shaped area surrounded by a line that measures at least 100 mm x 100 mm. If the size of the package so requires, the dimensions may be reduced, provided the markings remain clearly visible.

3.4.5 Unless otherwise provided in this Chapter, when one of the codes "LQ4" to "LQ19" and "LQ22" to "LQ28" is shown in Column (7) of Table A in Chapter 3.2 for a given substance, the provisions of other Chapters of ADR do not apply to the carriage of that substance, provided:

(a) The substance is carried:

- in combination packagings, corresponding to the prescriptions of 3.4.4 (a), or

- in metal or plastics inner packagings which are not liable to break or be easily punctured, placed in shrink-wrapped or stretch-wrapped trays;

(b) The maximum quantity per inner packaging and per package, prescribed for the relevant code in the table in 3.4.6 (in the second and third column in the case of combination packagings, and in the fourth and fifth column in the case of shrink-wrapped or stretch-wrapped trays), are not exceeded;

(c) Each package is clearly and durably marked as indicated in 3.4.4 (c).

[1] *The letters "LQ" are an abbreviation of the English words "Limited Quantities".*

3.4.6 Table

Code	Combination packagings		Inner packagings placed in shrink-wrapped or stretch-wrapped trays	
	Inner packaging Maximum contents	**Package Maximum gross mass (kg) / contents (*l*)**	**Inner packaging Maximum contents**	**Package Maximum gross mass (kg) / contents (*l*)**
LQ0	No exemption under the conditions of 3.4.2.			
LQ1	120 ml	30 kg	120 ml	20 kg
LQ2	1 *l*	30 kg	1 *l*	20 kg
LQ3 [a]	500 ml	1 *l*	Not allowed	Not allowed
LQ4	3 *l*	12 *l*	1 *l*	12 *l* and 20 kg
LQ5	5 *l*	-	1 *l*	20 kg
LQ6 [a]	5 *l*	20 *l*	1 *l*	20 *l* and 20 kg
LQ7 [a]	5 *l*	45 *l*	5 *l*	20 kg
LQ8	3 kg	12 kg	500 g	12 kg
LQ9	6 kg	24 kg	3 kg	20 kg
LQ10	500 ml	30 kg	500 ml	20 kg
LQ11 [b]	500 g	30 kg	500 g	20 kg
LQ12	1 kg	30 kg	1 kg	20 kg
LQ13	1 *l*	30 kg	1 *l*	20 kg
LQ14 [b]	25 ml	30 kg	25 ml	20 kg
LQ15 [b]	100 g	30 kg	100 g	20 kg
LQ16 [b]	125 ml	30 kg	125 ml	20 kg
LQ17	500 ml	2 *l*	100 ml	2 *l*
LQ18	1 kg	4 kg	500 g	4 kg
LQ19	3 *l*	12 *l*	1 *l*	12 *l* and 20 kg
LQ20	100 ml	400 ml	Not allowed	Not allowed
LQ21	500 g	2 kg	Not allowed	Not allowed
LQ22	1 *l*	4 *l*	500 ml	4 *l* and 20 kg
LQ23	3 kg	12 kg	1 kg	12 kg
LQ24	6 kg	24 kg	2 kg	20 kg
LQ25	1 kg	4 kg	1 kg	20 kg
LQ26	500 ml	2 *l*	500 ml	2 *l*
LQ27	6 kg	24 kg	6 kg	20 kg
LQ28	3 *l*	12 *l*	3 *l*	12 *l* and 20 kg
LQ29	500 ml (per apparatus) if packed in leakproof packagings and conforming to 3.4.4 (c) only	2 *l* if packed in leakproof packagings and conforming to 3.4.4 (c) only	Not allowed	Not allowed

[a] *In the case of homogenous mixtures of Class 3 containing water, the quantities specified relate only to the substance of Class 3 contained in those mixtures.*

[b] *For Class 5.2 these quantities of substances may be packed together with other articles or substances, provided they will not interact dangerously in the event of leakage.*

PART 4

Packing and tank provisions

CHAPTER 4.1

USE OF PACKAGINGS, INCLUDING INTERMEDIATE BULK CONTAINERS (IBCs) AND LARGE PACKAGINGS

Introductory notes

NOTE 1: Packing groups

Dangerous substances of all classes other than those of Classes 1, 2, 5.2, 6.2 and 7 and the self-reactive substances of Class 4.1 have for packing purposes been assigned to three packing groups in accordance with the degree of danger they present, i.e.:

Packing group I:	*Substances presenting high danger;*
Packing group II:	*Substances presenting medium danger ; and*
Packing group III:	*Substances presenting low danger.*

The packing group to which a substance is assigned is indicated in Table A of Chapter 3.2.

NOTE 2: Explosives, self-reactive substances and organic peroxides

Unless specific provision to the contrary is made in ADR, the packagings, including IBCs and large packagings, used for goods of Class 1, self-reactive substances of Class 4.1 and organic peroxides of Class 5.2 shall comply with the requirements for the medium danger group (packing group II).

4.1.1 General provisions for the packing of dangerous goods, other than goods of Classes 2, 6.2 or 7, in packagings, including IBCs and large packagings

NOTE*: Some of these general provisions may apply to the packing of goods of Class 2, 6.2 and 7. Refer to sections 4.1.6 (Class 2), 4.1.8 (Class 6.2), 4.1.9 (Class 7) and to the applicable packing instruction in Section 4.1.4.*

4.1.1.1 Dangerous goods shall be packed in good quality packagings, including IBCs and large packagings, which shall be strong enough to withstand the shocks and loadings normally encountered during carriage, including trans-shipment between transport units and/or warehouses as well as any removal from a pallet or overpack for subsequent manual or mechanical handling. Packagings, including IBCs and large packagings, shall be constructed and closed so as to prevent any loss of contents when prepared for transport which might be caused under normal conditions of transport, by vibration, or by changes in temperature, humidity or pressure (resulting from altitude, for example). No dangerous residue shall adhere to the outside of packagings, IBCs and large packagings during carriage. These provisions apply, as appropriate, to new, reused, reconditioned or remanufactured packagings and to new and reused IBCs and large packagings.

4.1.1.2 Parts of packagings, including IBCs and large packagings, which are in direct contact with dangerous goods:

(a) shall not be affected or significantly weakened by those dangerous goods; and

(b) shall not cause a dangerous effect e.g. catalysing a reaction or reacting with the dangerous goods.

Where necessary, they shall be provided with a suitable inner coating or treatment.

4.1.1.3 Unless provided elsewhere in ADR, each packaging, including IBCs and large packagings, except inner packagings, shall conform to a design type successfully tested in accordance with the requirements of 6.1.5, 6.5.4 or 6.6.5, respectively. The packagings for which the test is not required are mentioned under 6.1.1.3.

4.1.1.4 When filling packagings, including IBCs and large packagings, with liquids, sufficient ullage (outage) shall be left to ensure that neither leakage nor permanent distortion of the packaging occurs as a result of an expansion of the liquid caused by temperatures likely to occur during transport. Unless specific requirements are prescribed, liquids shall not completely fill a packaging at a temperature of 55 °C. However, sufficient ullage shall be left in an IBC to ensure that at the mean bulk temperature of 50 °C it is not filled to more than 98% of its water capacity. For a filling temperature of 15 °C, the maximum degree of filling shall be determined as follows, unless otherwise provided, either:

(a)

Boiling point (initial boiling point) of the substance in °C	<60	>60 <100	>100 <200	>200 <300	>300
Degree of filling as a percentage of the capacity of the packaging	90	92	94	96	98

or

(b) degree of filling $= \frac{98}{1 + \alpha\,(50 - t_F)}$ % of the capacity of the packaging.

In this formula a represents the mean coefficient of cubic expansion of the liquid substance between 15 °C and 50 °C; that is to say, for a maximum rise in temperature of 35 °C,

α is calculated according to the formula: $\alpha = \frac{d_{15} - d_{50}}{35 \times d_{50}}$

d_{15} and d_{50} being the relative densities [1] of the liquid at 15 °C and 50 °C and t_F the mean temperature of the liquid at the time of filling.

4.1.1.4.1 For air transport, packagings intended to contain liquids shall also be capable of withstanding a pressure differential without leakage as specified in the international regulations for air transport.

4.1.1.5 Inner packagings shall be packed in an outer packaging in such a way that, under normal conditions of carriage, they cannot break, be punctured or leak their contents into the outer packaging. Inner packagings that are liable to break or be punctured easily, such as those made of glass, porcelain or stoneware or of certain plastics materials, etc., shall be secured in outer packagings with suitable cushioning material. Any leakage of the contents shall not substantially impair the protective properties of the cushioning material or of the outer packaging.

4.1.1.6 Dangerous goods shall not be packed together in the same outer packaging or in large packagings, with dangerous or other goods if they react dangerously with each other and cause:

(a) combustion or evolution of considerable heat;

[1] *Relative density (d) is considered to be synonymous with specific gravity (SG) and will be used throughout this Chapter.*

(b) evolution of flammable, asphyxiant, oxidizing or toxic gases;

(c) the formation of corrosive substances; or

(d) the formation of unstable substances.

NOTE: *For mixed packing special provisions, see 4.1.10.*

4.1.1.7 The closures of packagings containing wetted or diluted substances shall be such that the percentage of liquid (water, solvent or phlegmatizer) does not fall below the prescribed limits during transport.

4.1.1.7.1 Where two or more closure systems are fitted in series on an IBC, that nearest to the substance being carried shall be closed first.

4.1.1.8 Liquids may only be filled into inner packagings which have an appropriate resistance to internal pressure that may be developed under normal conditions of carriage. Where pressure may develop in a package by the emission of gas from the contents (as a result of temperature increase or other cause), the packaging may be fitted with a vent, provided that the gas emitted will not cause danger on account of its toxicity, its flammability, the quantity released, etc. A venting device shall be fitted if dangerous overpressure may develop due to normal decomposition of substances. The vent shall be so designed that, when the packaging is in the attitude in which it is intended to be carried, leakages of liquid and the penetration of foreign matter are prevented under normal conditions of carriage.

4.1.1.9 New, remanufactured or reused packagings, including IBCs and large packagings, or reconditioned packagings and repaired IBCs shall be capable of passing the tests prescribed in 6.1.5, 6.5.4 or 6.6.5, respectively. Before being filled and handed over for carriage, every packaging, including IBCs and large packagings, shall be inspected to ensure that it is free from corrosion, contamination or other damage and every IBC shall be inspected with regard to the proper functioning of any service equipment. Any packaging which shows signs of reduced strength as compared with the approved design type shall no longer be used or shall be so reconditioned, that it is able to withstand the design type tests. Any IBC which shows signs of reduced strength as compared with the tested design type shall no longer be used or shall be so repaired that it is able to withstand the design type tests.

4.1.1.10 Liquids shall be filled only into packagings, including IBCs, which have an appropriate resistance to the internal pressure that may develop under normal conditions of carriage. Packagings and IBCs marked with the hydraulic test pressure prescribed in 6.1.3.1 (d) and 6.5.2.2.1, respectively shall be filled only with a liquid having a vapour pressure:

(a) such that the total gauge pressure in the packaging or IBC (i.e. the vapour pressure of the filling substance plus the partial pressure of air or other inert gases, less 100 kPa) at 55 °C, determined on the basis of a maximum degree of filling in accordance with 4.1.1.4 and a filling temperature of 15 °C, will not exceed two-thirds of the marked test pressure; or

(b) at 50 °C less than four-sevenths of the sum of the marked test pressure plus 100 kPa; or

(c) at 55 °C less than two-thirds of the sum of the marked test pressure plus 100 kPa.

Metal IBCs intended for the carriage of liquids shall not be used to carry liquids having a vapour pressure of more than 110kPa (1.1 bar) at 50 °C or 130kPa (1.3 bar) at 55 °C.

EXAMPLES OF REQUIRED MARKED TEST PRESSURES FOR PACKAGINGS,

INCLUDING IBCs, CALCULATED AS IN 4.1.1.10 (c)

UN No	Name	Class	Packing group	V_{p55} (kPa)	$V_{p55} \times 1.5$ (kPa)	$(V_{p55} \times 1.5)$ minus 100 (kPa)	Required minimum test pressure gauge under 6.1.5.5.4.(c) (kPa)	Minimum test pressure (gauge) to be marked on the packaging (kPa)
2056	Tetrahydrofuran	3	II	70	105	5	100	100
2247	n-Decane	3	III	1.4	2.1	-97.9	100	100
1593	Dichloromethane	6.1	III	164	246	146	146	150
1155	Diethyl ether	3	I	199	299	199	199	250

NOTE 1*: For pure liquids the vapour pressure at 55 °C (V_{p55}) can often be obtained from scientific tables.*

NOTE 2: *The table refers to the use of 4.1.1.10 (c) only, which means that the marked test pressure shall exceed 1.5 times the vapour pressure at 55 °C less 100 kPa. When, for example, the test pressure for n-decane is determined according to 6.1.5.5.4 (a), the minimum marked test pressure may be lower.*

NOTE 3*: For diethyl ether the required minimum test pressure under 6.1.5.5.5 is 250 kPa.*

4.1.1.11 Empty packagings, including IBCs and large packagings, that have contained a dangerous substance are subject to the same requirements as those for a filled packaging, unless adequate measures have been taken to nullify any hazard.

4.1.1.l2 Every packagings, including IBCs, intended to contain liquids shall successfully undergo a suitable leakproofness test, and be capable of meeting the appropriate test level indicated in 6.1.5.4.3 or 6.5.4.7 for the various types of IBCs:

(a) before it is first used for carriage;

(b) after remanufacturing or reconditioning of any packaging, before it is re-used for carriage;

(c) after the repair of any IBC, before it is re-used for carriage.

For this test the packaging, or IBC, need not have its closures fitted. The inner receptacle of a composite packaging or IBC may be tested without the outer packaging, provided the test results are not affected. This test is not required for:

- inner packagings of combination packagings or large packagings;

- inner receptacles of composite packagings (glass, porcelain or stoneware) marked with the symbol "RID/ADR" in accordance with 6.1.3.1 (a) (ii);

- light gauge metal packagings marked with the symbol "RID/ADR" in accordance with 6.1.3.1 (a) (ii).

4.1.1.13 Packagings, including IBCs, used for solids which may become liquid at temperatures likely to be encountered during carriage shall also be capable of containing the substance in the liquid state.

4.1.1.14 Packagings, including IBCs, used for powdery or granular substances shall be sift-proof or shall be provided with a liner.

4.1.1.15 For plastics drums and jerricans, rigid plastics IBCs and composite IBCs with plastics inner receptacles, unless otherwise approved by the competent authority, the period of use permitted for the carriage of dangerous substances shall be five years from the date of manufacture of the receptacles, except where a shorter period of use is prescribed because of the nature of the substance to be carried.

4.1.1.16 Packagings marked in accordance with 6.1.3 but which were approved in a State which is not a Contracting Party to ADR may nevertheless be used for carriage under ADR.

4.1.1.17 ***Use of salvage packagings***

4.1.1.17.1 Damaged, defective or leaking packages, or dangerous goods that have spilled or leaked may be carried in salvage packagings mentioned in 6.1.5.1.11. This does not prevent the use of bigger size packagings of appropriate type and performance level under the conditions of 4.1.1.17.2.

4.1.1.17.2 Appropriate measures shall be taken to prevent excessive movement of the damaged or leaking packages within a salvage packaging. When the salvage packaging contains liquids, sufficient inert absorbent material shall be added to eliminate the presence of free liquid.

4.1.2 Additional general provisions for the use of IBCs

4.1.2.1 When IBCs are used for the carriage of liquids with a flash-point of 61 °C (closed cup) or lower, or of powders liable to dust explosion, measures shall be taken to prevent a dangerous electrostatic discharge.

4.1.2.2 The periodic testing and inspection requirements for IBCs are provided in Chapter 6.5. An IBC shall not be filled and offered for carriage after the date of expiry of the last periodic test required by 6.5.4.14.3, or the date of expiry of the last periodic inspection required by 6.5.1.6.4. However, an IBC filled prior to the date of expiry of the last periodic test or inspection may be carried for a period not to exceed three months beyond the date of expiry of the last periodic test or inspection. In addition, an IBC may be carried after the date of expiry of the last periodic test or inspection:

(a) after emptying but before cleaning, for purposes of performing the required test or inspection prior to refilling; and

(b) unless otherwise approved by the competent authority, for a period not to exceed six months beyond the date of expiry of the last periodic test or inspection in order to allow the return of dangerous goods or residues for proper disposal or recycling.

Note*: For the particulars in the transport document, see 5.4.1.1.11.*

4.1.2.3 IBCs of type 31HZ2 shall be filled to at least 80% of the volume of the outer casing and always be carried in closed vehicles or containers.

4.1.3 General provisions concerning packing instructions

4.1.3.1 Packing instructions applicable to dangerous goods of Classes 1 to 9 are specified in Section 4.1.4. They are subdivided in three sub-sections depending on the type of packagings to which they apply:

Sub-section 4.1.4.1 for packagings other than IBCs and large packagings; these packing instructions are designated by an alphanumeric code starting with the letter "P" or "R" for packagings specific to RID and ADR;

Sub-section 4.1.4.2 for IBCs; these are designated by an alphanumeric code starting with the letters "IBCs";

Sub-section 4.1.4.3 for large packagings; these are designated by an alphanumeric code starting with the letters "LP".

Generally, packing instructions specify that the general provisions of 4.1.1, 4.1.2 or 4.1.3, as appropriate, are applicable. They may also require compliance with the special provisions of Sections 4.1.5, 4.1.6, 4.1.7, 4.1.8 or 4.1.9 when appropriate. Special packing provisions may also be specified in the packing instruction for individual substances or articles. They are also designated by an alphanumeric code comprising the letters:

"PP" for packagings other than IBCs and large packagings, or "RR" for special provisions specific to RID and ADR;

"B" for IBCs;

"L" for large packagings.

Unless otherwise specified, each packaging shall conform to the applicable requirements of Part 6. Generally packing instructions do not provide guidance on compatibility and the user shall not select a packaging without checking that the substance is compatible with the packaging material selected (e.g. glass receptacles are unsuitable for most fluorides). Where glass receptacles are permitted in the packing instructions porcelain, earthenware and stoneware packagings are also allowed.

4.1.3.2 Column (8) of Table A of Chapter 3.2 shows for each article or substance the packing instruction(s) that shall be used. Columns (9a) and (9b) indicate the special packing provisions and the mixed packing provisions (see 4.1.10) applicable to specific substances or articles.

4.1.3.3 Each packing instruction shows, where applicable, the acceptable single and combination packagings. For combination packagings, the acceptable outer packagings, inner packagings and when applicable the maximum quantity permitted in each inner or outer packaging, are shown. Maximum net mass and maximum capacity are as defined in 1.2.1.

4.1.3.4 The following packagings shall not be used when the substances being carried are liable to become liquid during carriage:

Packagings

Drums:	1D and 1G
Boxes:	4A, 4B, 4C1, 4C2, 4D, 4F, 4G, 4H1 and 4H2
Bags:	5L1, 5L2, 5L3, 5H1, 5H2, 5H3, 5H4, 5M1 and 5M2
Composite packagings:	6HC, 6HD2, 6HG1, 6HG2, 6HD1, 6PC, 6PD1, 6PD2, 6PG1, 6PG2 and 6PH1

IBCs

For substances of packing group I: All types of IBC
For substances of packing groups II and III:

Wooden:	11C, 11D and 11F
Fibreboard:	11G
Flexible:	13H1, 13H2, 13H3, 13H4, 13H5, 13L1, 13L2, 13L3, 13L4, 13M1 and 13M2
Composite:	11HZ2, 21HZ2 and 31HZ2

For the purposes of this paragraph, substances and mixtures of substances having a melting point equal to or less than 45 °C shall be treated as solids liable to become liquid during transport.

4.1.3.5 Where the packing instructions in this Chapter authorize the use of a particular type of outer packaging in a combination packaging (e.g. 4G), packagings bearing the same packaging identification code followed by the letters "V", "U" or "W" marked in accordance with the requirements of Part 6 (e.g. 4GV, 4GU or 4GW) may also be used under the same conditions and limitations applicable to the use of that type of outer packaging according to the relevant packing instructions. For example, a combination packaging marked with the packaging code "4GV" may be used whenever a combination packaging marked "4G" is authorized, provided the requirements in the relevant packing instruction regarding types of inner packagings and quantity limitations are respected.

4.1.3.6 Gas cylinders and gas receptacles approved by the competent authority are authorized for the transport of any liquid or solid substance assigned to packing instruction P001 or P002 unless otherwise indicated in the packing instruction or by a special provision in Column (9a) of Table A of Chapter 3.2. The capacity of gas cylinders shall not exceed 450 litres. The capacity for gas receptacles shall not exceed 1000 litres.

4.1.3.7 Packagings or IBCs not specifically authorized in the applicable packing instruction shall not be used for the carriage of a substance or article unless specifically allowed under a temporary derogation agreed between Contracting Parties in accordance with 1.5.1.

4.1.4 List of packing instructions

***NOTE**: Although the following packing instructions use the same numbering system as used in the IMDG Code and the UN Model Regulations, readers should be aware that some of the details may be different in the case of ADR.*

4.1.4.1 ***Packing instructions concerning the use of packagings (except IBCs and large packagings)***

P001	**PACKING INSTRUCTION (LIQUIDS)**			**P001**
The following packagings are authorized provided the general provisions of **4.1.1** and **4.1.3** are met:				
Combination packagings:		**Maximum capacity/Net mass (see 4.1.3.3.)**		
Inner packagings	**Outer packagings**	**Packing group I**	**Packing group II**	**Packing group III**
Glass 10 *l* Plastics 30 *l* Metal 40 *l*	**Drums**			
	steel (1A2)	250 kg	400 kg	400 kg
	aluminium (1B2)	250 kg	400 kg	400 kg
	metal other than steel or aluminium (1N2)	250 kg	400 kg	400 kg
	plastics (1H2)	250 kg	400 kg	400 kg
	plywood (1D)	150 kg	400 kg	400 kg
	fibre (1G)	75 kg	400 kg	400 kg
	Boxes			
	steel (4A)	250 kg	400 kg	400 kg
	aluminium (4B)	250 kg	400 kg	400 kg
	natural wood (4C1, 4C2)	150 kg	400 kg	400 kg
	plywood (4D)	150 kg	400 kg	400 kg
	reconstituted wood (4F)	75 kg	400 kg	400 kg
	fibreboard (4G)	75 kg	400 kg	400 kg
	expanded plastics (4H1)	60 kg	60 kg	60 kg
	solid plastics (4H2)	150 kg	400 kg	400 kg
	Jerricans			
	steel (3A2)	120 kg	120 kg	120 kg
	aluminium (3B2)	120 kg	120 kg	120 kg
	plastics (3H2)	120 kg	120 kg	120 kg
Single packagings:				
Drums				
steel, non-removable head (1A1)		250 *l*	450 *l*	450 *l*
steel, removable head (1A2)		250 *l* [a]	450 *l*	450 *l*
aluminium, non-removable head (1B1)		250 *l*	450 *l*	450 *l*
aluminium, removable head (1B2)		250 *l* [a]	450 *l*	450 *l*
metal other than steel or aluminium, non-removable head (1N1)		250 *l*	450 *l*	450 *l*
metal other than steel or aluminium, removable head (1N2)		250 *l* [a]	450 *l*	450 *l*
plastics, non-removable head (1H1)		250 *l*	450 *l*	450 *l*
plastics, removable head (1H2)		250 *l* [a]	450 *l*	450 *l*
Jerricans				
steel, non-removable head (3A1)		60 *l*	60 *l*	60 *l*
steel, removable head (3A2)		60 *l* [a]	60 *l*	60 *l*
aluminium, non-removable head (3B1)		60 *l*	60 *l*	60 *l*
aluminium, removable head (3B2)		60 *l* [a]	60 *l*	60 *l*
plastics, non-removable head (3H1)		60 *l*	60 *l*	60 *l*
plastics, removable head (3H2)		60 *l* [a]	60 *l*	60 *l*

[a] *Only substances with a viscosity of more than 2 680 mm^2/s are authorized.*

P001 PACKING INSTRUCTION (LIQUIDS) (cont'd) P001			
Single packagings (cont'd)	**Maximum capacity/Net mass (see 4.1.3.3.)**		
Composite packagings	**Packing group I**	**Packing group II**	**Packing group III**
plastics receptacle with outer steel or aluminium drum (6HA1, 6HB1)	250 *l*	250 *l*	250 *l*
plastics receptacle with outer fibre, plastics or plywood drum (6HG1, 6HH1, 6HD1)	120 *l*	250 *l*	250 *l*
plastics receptacle with outer steel or aluminium crate or box or plastics receptacle with outer wooden, plywood, fibreboard or solid plastics box (6HA2, 6HB2, 6HC, 6HD2, 6HG2 or 6HH2)	60 *l*	60 *l*	60 *l*
glass receptacle with outer steel, aluminium, fibreboard, plywood, solid plastics or expanded plastics drum (6PA1, 6PB1, 6PG1, 6PD1, 6PH1 or 6PH2) or with outer steel or aluminium crate or box or with outer wooden or fibreboard box or with outer wickerwork hamper (6PA2, 6PB2, 6PC, 6PG2 or 6PD2)	60 *l*	60 *l*	60 *l*

Additional requirement:
For substances of Class 3, packing group III, which give off small quantities of carbon dioxide or nitrogen, the packagings shall be vented.

Special packing provisions:

PP1 For UN Nos. 1133, 1210, 1263 and 1866, substances of packing groups II and III may be carried in quantities of 5 litres or less per packaging in metal or plastics packagings which are not required to meet the performance tests of Chapter 6.1, provided that such packagings are carried:

(a) in palletized loads, a pallet box or unit load device, e.g. individual packagings placed or stacked and secured by strapping, shrink or stretch-wrapping or other suitable means to a pallet; or

(b) as inner packagings of combination packagings with a maximum net mass of 40 kg.

PP2 For UN Nos. 3065 and 1170, wooden barrels (2C1 and 2C2) may be used.

PP4 For UN No. 1774, packagings shall meet the packing group II performance level.

PP5 For UN No. 1204, packagings shall be so constructed that explosion is not possible by reason of increased internal pressure. Gas cylinders and gas receptacles shall not be used for these substances.

PP6 For UN Nos. 1851 and 3248, the maximum net quantity per package shall be 5 *l*.

PP10 For UN No. 1791, packing group II, the packaging shall be vented.

PP31 For UN No. 1131, packagings shall be hermetically sealed.

PP33 For UN No. 1308, packing groups I and II, only combination packagings with a maximum gross mass of 75 kg allowed.

Special packing provisions specific to RID and ADR

RR1 For UN No. 1790 with not more than 85% hydrofluoric acid and UN No. 2031 containing more than 55% pure acid, the permissible period of use for plastics drums and jerricans used as single packagings shall be two years from the date of manufacture.

RR2 For UN No. 1261, removable head packagings are not permitted.

P002	PACKING INSTRUCTION (SOLIDS)	P002

The following packagings are authorized provided the general provisions of **4.1.1** and **4.1.3** are met:

Combination packagings:		**Maximum net mass (see 4.1.3.3)**		
Inner packagings	**Outer packagings**	**Packing group I**	**Packing group II**	**Packing group III**
	Drums			
Glass 10 kg	steel (1A2)	400 kg	400 kg	400 kg
Plastics [a] 50 kg	aluminium (1B2)	400 kg	400 kg	400 kg
Metal 50 kg	metal, other than steel	400 kg	400 kg	400 kg
Paper [a, b, c] 50 kg	or aluminium (1N2)			
Fibre [a, b, c] 50 kg	plastics (1H2)	400 kg	400 kg	400 kg
	plywood (1D)	400 kg	400 kg	400 kg
[a] *These inner packagings shall be sift-proof.*	fibre (1G)	400 kg	400 kg	400 kg
	Boxes			
	steel (4A)	400 kg	400 kg	400 kg
[b] *These inner packagings shall not be used when the substances being carried may become liquid during carriage (see 4.1.3.4).*	aluminium (4B)	400 kg	400 kg	400 kg
	natural wood (4C1)	250 kg	400 kg	400 kg
	natural wood with sift proof walls (4C2)	250 kg	400 kg	400 kg
	plywood (4D)	250 kg	400 kg	400 kg
	reconstituted wood (4F)	125 kg	400 kg	400 kg
	fibreboard (4G)	125 kg	400 kg	400 kg
	expanded plastics (4H1)	60 kg	60 kg	60 kg
	solid plastics (4H2)	250 kg	400 kg	400 kg
[c] *These inner packagings shall not be used for substances of packing group I.*	**Jerricans**			
	steel (3A2)	120 kg	120 kg	120 kg
	aluminium (3B2)	120 kg	120 kg	120 kg
	plastics (3H2)	120 kg	120 kg	120 kg
Single packagings:				
Drums				
steel (1A1 or 1A2 [d])		400 kg	400 kg	400 kg
aluminium (1B1 or 1B2 [d])		400 kg	400 kg	400 kg
metal, other than steel or aluminium (1N1 or 1N2 [d])		400 kg	400 kg	400 kg
plastics (1H1 or 1H2 [d])		400 kg	400 kg	400 kg
fibre (1G) [e]		400 kg	400 kg	400 kg
plywood (1D) [e]		400 kg	400 kg	400 kg
Jerricans				
steel (3A1 or 3A2 [d])		120 kg	120 kg	120 kg
aluminium (3B1 or 3B2 [d])		120 kg	120 kg	120 kg
plastics (3H1 or 3H2 [d])		120 kg	120 kg	120 kg

[d] *These packagings shall not be used for substances of packing group I that may become liquid during carriage (see 4.1.3.4).*

[e] *These packagings shall not be used when substances being carried may become liquid during carriage (see 4.1.3.4).*

P002	PACKING INSTRUCTION (SOLIDS) (cont'd)		P002
	Maximum net mass (see 4.1.3.3.)		
Single packagings (cont'd):	**Packing group I**	**Packing group II**	**Packing group III**
Boxes			
steel (4A) [e]	Not allowed	400 kg	400 kg
aluminium (4B) [e]	Not allowed	400 kg	400 kg
natural wood (4C1) [e]	Not allowed	400 kg	400 kg
plywood (4D) [e]	Not allowed	400 kg	400 kg
reconstituted wood (4F) [e]	Not allowed	400 kg	400 kg
natural wood with sift-proof walls (4C2) [e]	Not allowed	400 kg	400 kg
fibreboard (4G) [e]	Not allowed	400 kg	400 kg
solid plastics (4H2) [e]	Not allowed	400 kg	400 kg
Bags			
bags (5H3, 5H4, 5L3, 5M2) [e]	Not allowed	50 kg	50 kg
Composite packagings			
plastics receptacle with outer steel, aluminium, plywood, fibre or plastics drum (6HA1, 6HB1, 6HG1 [e], 6HD1 [e], or 6HH1)	400 kg	400 kg	400 kg
plastics receptacle with outer steel or aluminium crate or box, wooden box, plywood box, fibreboard box or solid plastics box (6HA2, 6HB2, 6HC, 6HD2 [e], 6HG2 [e] or 6HH2)	75 kg	75 kg	75 kg
glass receptacle with outer steel, aluminium plywood or fibre drum (6PA1, 6PB1, 6PD1 [e] or 6PG1 [e]) or with outer steel or aluminium crate or box or with outer wooden, or fibreboard box or with outer wickerwork hamper (6PA2, 6PB2, 6PC, 6PD2 [e], or 6PG2 [e]) or with outer solid plastics or expanded plastics packaging (6PH2 or 6PH1 [e])	75 kg	75 kg	75 kg

[e] *These packagings shall not be used when the substances being carried may become liquid during carriage (see 4.1.3.4).*

Special packing provisions:

PP6 For UN No. 3249, the maximum net mass per package shall be 5 kg.

PP7 For UN No. 2000, celluloid may also be transported unpacked on pallets, wrapped in plastic film and secured by appropriate means, such as steel bands as a full load in closed vehicles or containers. Each pallet shall not exceed 1000 kg.

PP8 For UN No. 2002, packagings shall be so constructed that explosion is not possible by reason of increased internal pressure. Gas cylinders and gas receptacles shall not be used for these substances.

PP9 For UN Nos. 3175, 3243 and 3244, packagings shall conform to a design type that has passed a leakproofness test at the packing group II performance level.

PP11 For UN No. 1309, packing group III, and UN No. 1362, 5H1, 5L1 and 5M1 bags are allowed if they are overpacked in plastic bags or are wrapped in shrink or stretch wrap on pallets.

PP12 For UN Nos. 1361, 2213 and UN No. 3077, 5H1, 5L1 and 5M1 bags are allowed when carried in closed vehicles or containers.

PP13 For articles classified under UN No. 2870, only combination packagings meeting the packing group I performance level are authorized.

PP14 For UN Nos. 2211, 2698 and 3314, packagings are not required to meet the performance tests in Chapter 6.1.

PP15 For UN Nos. 1324 and 2623, packagings shall meet the packing group III performance level.

PP20 For UN No. 2217, any sift-proof, tearproof receptacle may be used.

PP30 For UN No. 2471, paper or fibre inner packagings are not permitted.

PP34 For UN No. 2969 (as whole beans), 5H1, 5L1 and 5M1 bags are permitted.

PP37 For UN Nos. 2590 and 2212, 5M1 bags are permitted. Packages shall be carried in closed vehicles or containers or as stretch or shrink-wrapped unit loads.

PP38 For UN No. 1309, packing group II, bags are permitted only in closed vehicles or containers.

P003	PACKING INSTRUCTION	P003

Dangerous goods shall be placed in suitable outer packagings. The packagings shall meet the provisions of **4.1.1.1, 4.1.1.2, 4.1.1.4, 4.1.1.8** and **4.1.3** and be so designed that they meet the construction requirements of 6.1.4. Outer packagings constructed of suitable material of adequate strength and design in relation to the packaging capacity and its intended use shall be used. Where this packing instruction is used for the transport of articles or inner packagings of combination packagings, the packaging shall be designed and constructed to prevent inadvertent discharge of articles during normal conditions of carriage.

Special packing provisions:

PP16 For UN No. 2800, batteries shall be protected from short circuits and shall be securely packed in strong outer packagings.

NOTE 1*: Non-spillable batteries which are an integral part of, and necessary for, the operation of mechanical or electronic equipment shall be securely fastened in the battery holder on the equipment and protected in such a manner as to prevent damage and short circuits.*

NOTE 2: *For used batteries (UN No. 2800), see P801a.*

PP19 For UN Nos. 1364 and 1365, carriage as bales is authorized.

PP20 For UN Nos. 1363, 1386, 1408 and 2793 any sift-proof, tearproof receptacle may be used.

PP32 UN Nos. 2857 and 3358 may be carried unpackaged, in crates or in appropriate overpacks.

P099	PACKING INSTRUCTION	P099

Only packagings which are approved by the competent authority may be used.

P101	PACKING INSTRUCTION	P101

Only packagings which are approved by the competent authority of the country of origin may be used. If the country of origin is not a Contracting Party to the ADR, the packaging shall be approved by the competent authority of the first country Contracting Party to ADR reached by the consignment. The State's distinguishing sign for motor vehicles in international traffic of the country for which the authority acts, shall be marked on the transport documents as follows:

"**Packaging approved by the competent authority of...**" (see 5.4.1.2.1 (e))

P110(a)	PACKING INSTRUCTION	P110(a)

RESERVED

NOTE*: This packing instruction in the UN Model Regulations is not admitted for carriage under ADR.*

P110(b)	PACKING INSTRUCTION	P110(b)
The following packagings are authorized, provided the general packing provisions of **4.1.1**, **4.1.3** and special packing provisions of **4.1.5** are met:		
Inner packagings and arrangements **Receptacles** metal wood rubber, conductive plastics, conductive **Bags** rubber, conductive plastics, conductive	**Intermediate packagings and arrangements** **Dividing partitions** metal wood plastics fibreboard	**Outer packagings and arrangements** **Boxes** natural wood, sift-proof wall (4C2) plywood (4D) reconstituted wood (4F)
Special packing provision: **PP42** For UN Nos. 0074, 0113, 0114, 0129, 0130, 0135 and 0224, the following conditions shall be met: (a) Inner packagings shall not contain more than 50 g of explosive substance (quantity corresponding to dry substance); (b) Compartments between dividing partitions shall not contain more than one inner packaging, firmly fitted; and (c) The outer packaging may be partitioned into up to 25 compartments.		

P111	PACKING INSTRUCTION	P111
The following packagings are authorized, provided the general packing provisions of **4.1.1, 4.1.3** and special packing provisions of **4.1.5** are met:		
Inner packagings and arrangements **Bags** paper, waterproofed plastics textile, rubberized **Sheets** plastics textile, rubberized	**Intermediate packagings and arrangements** Not necessary	**Outer packagings and arrangements** **Boxes** steel (4A) aluminium (4B) natural wood, ordinary (4C1) natural wood, sift-proof (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) plastics, expanded (4H1) plastics, solid (4H2) **Drums** steel, removable head (1A2) aluminium, removable head (1B2) plywood (1D) fibreboard (1G) plastics, removable head (1H2)
Special packing provision: **PP43** For UN No. 0159, inner packagings are not required when metal (1A2 or 1B2) or plastics (1H2) drums are used as outer packagings.		

P112(a)	PACKING INSTRUCTION (Solid wetted, 1.1D)	P112(a)

The following packagings are authorized, provided the general packing provisions of **4.1.1, 4.1.3** and special packing provisions of **4.1.5** are met:

Inner packagings and arrangements	Intermediate packagings and arrangements	Outer packagings and arrangements
Bags paper, multiwall, water resistant plastics textile textile, rubberized woven plastics **Receptacles** metal plastics	**Bags** plastics textile, plastic coated or lined **Receptacles** metal plastics	**Boxes** steel (4A) aluminium (4B) natural wood, ordinary (4C1) natural wood, sift-proof (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) plastics, expanded (4H1) plastics, solid (4H2) **Drums** steel, removable head (1A2) aluminium, removable head (1B2) fibre (1G) plastics, removable head (1H2)

Additional requirement:

Intermediate packagings are not required if leakproof removable head drums are used as the outer packaging.

Special packing provisions:

PP26 For UN Nos. 0004, 0076, 0078, 0154, 0219 and 0394, packagings shall be lead free.

PP45 For UN Nos. 0072 and 0226, intermediate packagings are not required.

P112(b)	PACKING INSTRUCTION (Solid dry, other than powder 1.1D)	P112(b)

The following packagings are authorized, provided the general packing provisions of **4.1.1, 4.1.3** and special packing provisions of **4.1.5** are met:

Inner packagings and arrangements	Intermediate packagings and arrangements	Outer packagings and arrangements
Bags paper, kraft paper, multiwall, water resistant plastics textile textile, rubberized woven plastics	**Bags** (for UN No. 0150 only) plastics textile, plastic coated or lined	**Bags** woven plastics, sift-proof (5H2) woven plastics, water-resistant (5H3) plastics, film (5H4) textile, sift-proof (5L2) textile, water resistant (5L3) paper, multiwall, water resistant (5M2) **Boxes** steel (4A) aluminium (4B) natural wood, ordinary (4C1) natural wood, sift-proof (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) plastics, expanded (4H1) plastics, solid (4H2) **Drums** steel, removable head (1A2) aluminium, removable head (1B2) fibre (1G) plastics, removable head (1H2)

Special packing provisions:

PP26 For UN Nos. 0004, 0076, 0078, 0154, 0216, 0219 and 0386, packagings shall be lead free.

PP46 For UN Nos. 0209, bags, sift-proof (5H2) are recommended for flake or prilled TNT in the dry state and a maximum net mass of 30 kg.

PP47 For UN Nos. 0222 and 0223, inner packagings are not required when the outer packaging is a bag.

P112(c)	PACKING INSTRUCTION (Solid dry powder 1.1D)	P112(c)

The following packagings are authorized, provided the general packing provisions of **4.1.1, 4.1.3** and special packing provisions of **4.1.5** are met:

Inner packagings and arrangements	Intermediate packagings and arrangements	Outer packagings and arrangements
Bags paper, multiwall, water resistant plastics woven plastics **Receptacles** fibreboard metal plastics wood	**Bags** paper, multiwall, water resistant with inner lining plastics **Receptacles** metal plastics	**Boxes** steel (4A) natural wood, ordinary (4C1) natural wood, sift-proof (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) plastics, solid (4H2) **Drums** steel, removable head (1A2) aluminium, removable head (1B2) fibre (1G)

Additional requirements:

1. Inner packagings are not required if drums are used as the outer packaging.

2. The packaging shall be sift-proof.

Special packing provisions:

PP26 For UN Nos. 0004, 0076, 0078, 0154, 0216, 0219 and 0386, packagings shall be lead free.

PP46 For UN No. 0209, bags, sift-proof (5H2) are recommended for flake or prilled TNT in the dry state and a maximum net mass of 30 kg.

PP48 For UN No. 0504, metal packagings shall not be used.

P113	PACKING INSTRUCTION	P113
The following packagings are authorized, provided the general packing provisions of **4.1.1, 4.1.3** and special packing provisions of **4.1.5** are met:		
Inner packagings and arrangements **Bags** paper plastics textile, rubberized **Receptacles** fibreboard metal plastics wood	**Intermediate packagings and arrangements** Not necessary	**Outer packagings and arrangements** **Boxes** steel (4A) natural wood, ordinary (4C1) natural wood, sift-proof walls (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) plastics, solid (4H2) **Drums** steel, removable head (1A2) aluminium, removable head (1B2) fibre (1G)
Additional requirement: The packaging shall be sift-proof.		
Special packing provisions: **PP49** For UN Nos. 0094 and 0305, no more than 50 g of substance shall be packed in an inner packaging. **PP50** For UN No. 0027, inner packagings are not necessary when drums are used as outer packagings. **PP51** For UN No. 0028, paper kraft or waxed paper sheets may be used as inner packagings.		

P114(a)	PACKING INSTRUCTION (Solid wetted)	P114(a)

The following packagings are authorized, provided the general packing provisions of **4.1.1, 4.1.3** and special packing provisions of **4.1.5** are met:

Inner packagings and arrangements	Intermediate packagings and arrangements	Outer packagings and arrangements
Bags plastics textile woven plastics **Receptacles** metal plastics	**Bags** plastics textile, plastic coated or lined **Receptacles** metal plastics	**Boxes** steel (4A) natural wood, ordinary (4C1) natural wood, sift-proof walls (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) plastics, solid (4H2) **Drums** steel, removable head (1A2) aluminium, removable head (1B2) plywood (1D) fibre (1G) plastics, removable head (1H2)

Additional require ment:

Intermediate packagings are not required if leakproof removable head drums are used as outer packagings.

Special packing provisions:

PP26 For UN Nos. 0077, 0132, 0234, 0235 and 0236, packagings shall be lead free.

PP43 For UN No. 0342, inner packagings are not required when metal (1A2 or 1B2) or plastics (1H2) drums are used as outer packagings.

P114(b)	PACKING INSTRUCTION (Solid dry)	P114(b)

The following packagings are authorized, provided the general packing provisions of **4.1.1, 4.1.3** and special packing provisions of **4.1.5** are met:

Inner packagings and arrangements	Intermediate packagings and arrangements	Outer packagings and arrangements
Bags paper, kraft plastics textile, sift-proof woven plastics, sift-proof **Receptacles** fibreboard metal paper plastics woven plastics, sift-proof	Not necessary	**Boxes** natural wood, ordinary (4C1) natural wood, sift-proof walls (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) **Drums** steel, removable head (1A2) aluminium, removable head (1B2) plywood (1D) fibre (1G) plastics, removable head (1H2)

Special packing provisions:

PP26 For UN Nos. 0077, 0132, 0234, 0235 and 0236, packagings shall be lead free.

PP50 For UN Nos. 0160 and 0161, inner packagings are not required if drums are used as outer packagings.

PP52 For UN Nos. 0160 and 0161, when metal drums (1A2 or 1B2) are used as outer packagings, metal packagings shall be so constructed that the risk of explosion, by reason of increased internal pressure from internal or external causes is prevented.

P115	PACKING INSTRUCTION	P115

The following packagings are authorized, provided the general packing provisions of **4.1.1, 4.1.3** and special packing provisions of **4.1.5** are met:

Inner packagings and arrangements	Intermediate packagings and arrangements	Outer packagings and arrangements
Receptacles plastics	**Bags** plastics in metal receptacles **Drums** metal	**Box**es natural wood, ordinary (4C1) natural wood, sift-proof walls (4C2) plywood (4D) reconstituted wood (4F) **Drums** steel, removable head (1A2) aluminium, removable head (1B2) plywood (1D) fibre (1G)

Special packing provisions:

PP45 For UN No. 0144, intermediate packagings are not required.

PP53 For UN Nos. 0075, 0143, 0495 and 0497, when boxes are used as outer packagings, inner packagings shall have taped screw cap closures and be not more than 5 litres capacity each. Inner packagings shall be surrounded with non-combustible absorbent cushioning materials. The amount of absorbent cushioning material shall be sufficient to absorb the liquid contents. Metal receptacles shall be cushioned from each other. Net mass of propellant is limited to 30 kg for each package when outer packagings are boxes.

PP54 For UN Nos. 0075, 0143, 0495 and 0497, when drums are used as outer packagings and when intermediate packagings are drums, they shall be surrounded with non-combustible cushioning material in a quantity sufficient to absorb the liquid contents. A composite packaging consisting of a plastics receptacle in a metal drum may be used instead of the inner and intermediate packagings. The net volume of propellant in each package shall not exceed 120 litres.

PP55 For UN No. 0144, absorbent cushioning material shall be inserted.

PP56 For UN No. 0144, metal receptacles may be used as inner packagings.

PP57 For UN Nos. 0075, 0143, 0495 and 0497, bags shall be used as intermediate packagings when boxes are used as outer packagings.

PP58 For UN Nos. 0075, 0143, 0495 and 0497, drums shall be used as intermediate packagings when drums are used as outer packagings.

PP59 For UN No. 0144, fibreboard boxes (4G) may be used as outer packagings.

PP60 For UN No. 0144, aluminium drums, removable head (1B2) shall not be used.

P116	PACKING INSTRUCTION	P116

The following packagings are authorized, provided the general packing provisions of **4.1.1, 4.1.3** and special packing provisions of **4.1.5** are met:

Inner packagings and arrangements	Intermediate packagings and arrangements	Outer packagings and arrangements
Bags paper, water and oil resistant plastics textile, plastic coated or lined woven plastics, sift-proof **Receptacles** fibreboard, water resistant metal plastics wood, sift-proof **Sheets** paper, water resistant paper, waxed plastics	Not necessary	**Bags** woven plastics (5H1) paper, multiwall, water resistant (5M2) plastics, film (5H4) textile, sift-proof (5L2) textile, water resistant (5L3) **Boxes** steel (4A) aluminium (4B) natural wood, ordinary (4C1) natural wood, sift-proof walls (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) plastics, solid (4H2) **Drums** steel, removable head (1A2) aluminium, removable head (1B2) fibre (1G) plastics, removable head (1H2) **Jerricans** steel, removable head (3A2) plastics, removable head (3H2)

Special packing provisions:

PP61 For UN Nos. 0082, 0241, 0331 and 0332, inner packagings are not required if leakproof removable head drums are used as outer packagings.

PP62 For UN Nos. 0082, 0241, 0331 and 0332, inner packagings are not required when the explosive is contained in a material impervious to liquid.

PP63 For UN No. 0081, inner packagings are not required when contained in rigid plastic which is impervious to nitric esters.

PP64 For UN No. 0331, inner packagings are not required when bags (5H2), (5H3) or (5H4) are used as outer packagings.

PP65 For UN Nos. 0082, 0241, 0331 and 0332, bags (5H2 or 5H3) may be used as outer packagings.

PP66 For UN No. 0081, bags shall not be used as outer packagings.

P130	PACKING INSTRUCTION	P130
The following packagings are authorized, provided the general packing provisions of **4.1.1, 4.1.3** and special packing provisions of **4.1.5** are met:		
Inner packagings and arrangements	**Intermediate packagings and arrangements**	**Outer packagings and arrangements**
Not necessary	Not necessary	**Boxes** steel (4A) aluminium (4B) natural wood, ordinary (4C1) natural wood, sift-proof walls (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) plastics, expanded (4H1) plastics, solid (4H2) **Drums** steel, removable head (1A2) aluminium, removable head (1B2) fibre (1G) plastics, removable head (1H2)

Special packing provision:

PP67 The following applies to UN Nos. 0006, 0009, 0010, 0015, 0016, 0018, 0019, 0034, 0035, 0038, 0039, 0048, 0056, 0137, 0138, 0168, 0169, 0171, 0181, 0182, 0183, 0186, 0221, 0243, 0244, 0245, 0246, 0254, 0280, 0281, 0286, 0287, 0297, 0299, 0300, 0301, 0303, 0321, 0328, 0329, 0344, 0345, 0346, 0347, 0362, 0363, 0370, 0412, 0424, 0425, 0434, 0435, 0436, 0437, 0438, 0451, 0488 and 0502: Large and robust explosives articles, normally intended for military use, without their means of initiation or with their means of initiation containing at least two effective protective features, may be carried unpackaged. When such articles have propelling charges or are self-propelled, their ignition systems shall be protected against stimuli encountered during normal conditions of carriage. A negative result in Test Series 4 on an unpackaged article indicates that the article can be considered for carriage unpackaged. Such unpackaged articles may be fixed to cradles or contained in crates or other suitable handling devices.

P131	PACKING INSTRUCTION	P131
The following packagings are authorized, provided the general packing provisions of **4.1.1, 4.1.3** and special packing provisions of **4.1.5** are met:		
Inner packagings and arrangements **Bags** paper plastics **Receptacles** fibreboard metal plastics wood **Reels**	**Intermediate packagings and arrangements** Not necessary	**Outer packagings and arrangements** **Boxes** steel (4A) aluminium (4B) natural wood, ordinary (4C1) natural wood, sift-proof walls (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) **Drums** steel, removable head (1A2) aluminium, removable head (1B2) fibre (1G) plastics, removable head (1H2)
Special packing provision: **PP68** For UN Nos. 0029, 0267 and 0455, bags and reels shall not be used as inner packagings.		

P132(a)	PACKING INSTRUCTION	P132(a)
(Articles consisting of closed metal, plastics or fibreboard casings that contain a detonating explosive, or consisting of plastics-bonded detonating explosives)		
The following packagings are authorized, provided the general packing provisions of **4.1.1, 4.1.3** and special packing provisions of **4.1.5** are met:		
Inner packagings and arrangements	**Intermediate packagings and arrangements**	**Outer packagings and arrangements**
Not necessary	Not necessary	**Boxes** steel (4A) aluminium (4B) wood, natural, ordinary (4C1) wood, natural, sift-proof walls (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) plastics, solid (4H2)

P132(b)	PACKING INSTRUCTION	P132(b)
(Articles without closed casings)		
The following packagings are authorized, provided the general packing provisions of **4.1.1, 4.1.3** and special packing provisions of **4.1.5** are met:		
Inner packagings and arrangements	**Intermediate packagings and arrangements**	**Outer packagings and arrangements**
Receptacles fibreboard metal plastics **Sheets** paper plastics	Not necessary	**Boxes** steel (4A) aluminium (4B) natural wood, ordinary (4C1) natural wood, sift-proof walls (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) plastics, solid (4H2)

P133	PACKING INSTRUCTION	P133
The following packagings are authorized, provided the general packing provisions of **4.1.1, 4.1.3** and special packing provisions of **4.1.5** are met:		
Inner packagings and arrangements	**Intermediate packagings and arrangements**	**Outer packagings and arrangements**
Receptacles fibreboard metal plastics wood **Trays, fitted with dividing partitions** fibreboard plastics wood	**Receptacles** fibreboard metal plastics wood	**Boxes** steel (4A) aluminium (4B) natural wood, ordinary (4C1) natural wood, sift-proof walls (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) plastics, solid (4H2)
Additional requirement: Receptacles are only required as intermediate packagings when the inner packagings are trays.		
Special packing provision: **PP69** For UN Nos. 0043, 0212, 0225, 0268 and 0306, trays shall not be used as inner packagings.		

P134	PACKING INSTRUCTION	P134
The following packagings are authorized, provided the general packing provisions **of 4.1.1, 4.1.3** and special packing provisions of **4.1.5** are met:		
Inner packagings and arrangements	**Intermediate packagings and arrangements**	**Outer packagings and arrangements**
Bags water resistant **Receptacles** fibreboard metal plastics wood **Sheets** fibreboard, corrugated **Tubes** fibreboard	Not necessary	**Boxes** steel (4A) aluminium (4B) natural wood, ordinary (4C1) natural wood, sift-proof walls (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) plastics, expanded (4H1) plastics, solid (4H2) **Drums** steel, removable head (1A2) aluminium, removable head (1B2)

P135	PACKING INSTRUCTION	P135
The following packagings are authorized, provided the general packing provisions of **4.1.1, 4.1.3** and special packing provisions of **4.1.5** are met:		
Inner packagings and arrangements	**Intermediate packagings and arrangements**	**Outer packagings and arrangements**
Bags paper plastics **Receptacles** fibreboard metal plastics wood **Sheets** paper plastics	Not necessary	**Boxes** steel (4A) aluminium (4B) natural wood, ordinary (4C1) natural wood, sift-proof walls (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) plastics, expanded (4H1) plastics, solid (4H2) **Drums** steel, removable head (1A2) aluminium, removable head (1B2) fibre (1G) plastics, removable head (1H2)

P136	PACKING INSTRUCTION	P136
The following packagings are authorized, provided the general packing provisions of **4.1.1, 4.1.3** and special packing provisions of **4.1.5** are met:		
Inner packagings and arrangements	**Intermediate packagings and arrangements**	**Outer packagings and arrangements**
Bags plastics textile Boxes fibreboard plastics wood **Dividing partitions in the outer packagings**	Not necessary	**Boxes** steel (4A) aluminium (4B) natural wood, ordinary (4C1) natural wood, sift-proof walls (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) plastics, solid (4H2) **Drums** steel, removable head (1A2) aluminium, removable head (1B2) fibre (1G) plastics, removable head (1H2)

P137	PACKING INSTRUCTION	P137
The following packagings are authorized, provided the general packing provisions of **4.1.1, 4.1.3** and special packing provisions of **4.1.5** are met:		
Inner packagings and arrangements **Bags** plastics **Boxes** fibreboard **Tubes** fibreboard metal plastics **Dividing partitions in the outer packagings**	**Intermediate packagings and arrangements** Not necessary	**Outer packagings and arrangements** **Boxes** steel (4A) aluminium (4B) natural wood, ordinary (4C1) natural wood, sift-proof walls (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) **Drums** steel, removable head (1A2) aluminium, removable head (1B2) plywood (1D) fibre (1G) plastics, removable head (1H2)
Special packing provision: **PP70** For UN Nos. 0059, 0439, 0440 and 0441, when the shaped charges are packed singly, the conical cavity shall face downwards and the package marked "THIS SIDE UP". When the shaped charges are packed in pairs, the conical cavities shall face inwards to minimize the jetting effect in the event of accidental initiation.		

P138	PACKING INSTRUCTION	P138
The following packagings are authorized, provided the general packing provisions of **4.1.1, 4.1.3** and special packing provisions of **4.1.5** are met:		
Inner packagings and arrangements **Bags** plastics	**Intermediate packagings and arrangements** Not necessary	**Outer packagings and arrangements** **Boxes** steel (4A) aluminium (4B) natural wood, ordinary (4C1) natural wood, sift-proof walls (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) plastics, solid (4H2) **Drums** steel, removable head (1A2) aluminium, removable head (1B2)
Additional requirement: If the ends of the articles are sealed, inner packagings are not necessary.		

P139	PACKING INSTRUCTION	P139
The following packagings are authorized, provided the general packing provisions of **4.1.1, 4.1.3** and special packing provisions of **4.1.5** are met:		
Inner packagings and arrangements	**Intermediate packagings and arrangements**	**Outer packagings and arrangements**
Bags plastics **Receptacles** fibreboard metal plastics wood **Reels** **Sheets** paper plastics	Not necessary	**Boxes** steel (4A) aluminium (4B) natural wood, ordinary (4C1) natural wood, sift-proof walls (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) plastics, solid (4H2) **Drums** steel, removable head (1A2) aluminium, removable head (1B2) plywood (1D) fibre (1G) plastics, removable head (1H2)

Special packing provisions:

PP71 For UN Nos. 0065, 0102, 0104, 0289 and 0290, the ends of the detonating cord shall be sealed, for example, by a plug firmly fixed so that the explosive cannot escape. The ends of flexible detonating cord shall be fastened securely.

PP72 For UN Nos. 0065 and 0289, inner packagings are not required when they are in coils.

P140	PACKING INSTRUCTION	P140
The following packagings are authorized, provided the general packing provisions **of 4.1.1, 4.1.3** and special packing provisions of **4.1.5** are met:		
Inner packagings and arrangements	**Intermediate packagings and arrangements**	**Outer packagings and arrangements**
Bags plastics **Reels** **Sheets** paper, kraft plastics	Not necessary	**Boxes** steel (4A) aluminium (4B) natural wood, ordinary (4C1) natural wood, sift-proof walls (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) plastics, solid (4H2) **Drums** steel, removable head (1A2) aluminium, removable head (1B2) fibre (1G)

Special packing provisions:

PP73 For UN No. 0105, no inner packagings are required if the ends are sealed.

PP74 For UN No. 0101, the packaging shall be sift-proof except when the fuse is covered by a paper tube and both ends of the tube are covered with removable caps.

PP75 For UN No. 0101, steel or aluminium boxes or drums shall not be used.

P141	PACKING INSTRUCTION	P141
The following packagings are authorized, provided the general packing provisions of **4.1.1, 4.1.3** and special packing provisions of **4.1.5** are met:		
Inner packagings and arrangements	**Intermediate packagings and arrangements**	**Outer packagings and arrangements**
Receptacles fibreboard metal plastics wood **Trays, fitted with dividing partitions** plastics wood **Dividing partitions in the outer packagings**	Not necessary	**Boxes** steel (4A) aluminium (4B) natural wood, ordinary (4C1) natural wood, sift-proof walls (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) plastics, solid (4H2) **Drums** steel, removable head (1A2) aluminium, removable head (1B2) fibre (1G) plastics, removable head (1H2)

P142	PACKING INSTRUCTION	P142
The following packagings are authorized, provided the general packing provisions **of 4.1.1, 4.1.3** and special packing provisions of **4.1.5** are met:		
Inner packagings and arrangements	**Intermediate packagings and arrangements**	**Outer packagings and arrangements**
Bags paper plastics **Receptacles** fibreboard metal plastics wood **Sheets** paper **Trays, fitted with dividing partitions** plastics	Not necessary	**Boxes** steel (4A) aluminium (4B) natural wood, ordinary (4C1) natural wood, sift-proof walls (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) plastics, solid (4H2) **Drums** steel, removable head (1A2) aluminium, removable head (1B2) fibre (1G) plastics, removable head (1H2)

P143	PACKING INSTRUCTION	P143
The following packagings are authorized, provided the general packing provisions of **4.1.1, 4.1.3** and special packing provisions of **4.1.5** are met:		
Inner packagings and arrangements **Bags** paper, kraft plastics textile textile, rubberized **Receptacles** fibreboard metal plastics **Trays, fitted with dividing partitions** plastics wood	**Intermediate packagings and arrangements** Not necessary	**Outer packagings and arrangements** **Boxes** steel (4A) aluminium (4B) natural wood, ordinary (4C1) natural wood, sift-proof walls (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) plastics, solid (4H2) **Drums** steel, removable head (1A2) aluminium, removable head (1B2) plywood (1D) fibre (1G) plastics, removable head (1H2)
Additional requirement: Instead of the above inner and outer packagings, composite packagings (6HH2) (plastics receptacle with outer solid plastics box) may be used.		
Special packing provision: **PP76** For UN Nos. 0271, 0272, 0415 and 0491, when metal packagings are used, metal packagings shall be so constructed that the risk of explosion, by reason of increase in internal pressure from internal or external causes is prevented.		

P144	PACKING INSTRUCTION	P144
The following packagings are authorized, provided the general packing provisions of **4.1.1, 4.1.3** and special packing provisions of **4.1.5** are met:		
Inner packagings and arrangements **Receptacles** fibreboard metal plastics **Dividing partitions in the outer packagings**	**Intermediate packagings and arrangements** Not necessary	**Outer packagings and arrangements** **Boxes** steel (4A) aluminium (4B) natural wood, ordinary with metal liner (4C1) plywood (4D) with metal liner reconstituted wood (4F) with metal liner plastics, expanded (4H1)
Special packing provision: **PP77** For UN Nos. 0248 and 0249, packagings shall be protected against the ingress of water. When water-activated contrivances are transported unpackaged, they shall be provided with at least two independent protective features which prevent the ingress of water.		

Type of packagings: Cylinder, tubes, pressure drums and bundles of cylinders

Cylinders, tubes, pressure drums and bundles of cylinders are authorised provided the special packing provisions of **4.1.6** and the provisions listed below under A, B, C and D are met:

A General

(1) Receptacles shall be so closed and leakproof as to prevent escape of the gases;

B Test pressure and filling ratios

(2) The minimum test pressure required for is 1 Mpa (10 bar):

(3) For compressed gases having a critical temperature below -50 °C the internal pressure (test pressure) to be applied in the hydraulic pressure test shall be at least one and one-half times the filling pressure at 15 °C

(4) For compressed gases having a critical temperature of -50 °C or above and for liquefied gases having a critical temperature below 70 °C, the degree of filling shall be such that the internal pressure at 65 °C does not exceed the test pressure of the receptacles;

For gases and gas mixtures with insufficient data, the maximum filling degree (FD) shall be determined as follows:

$$FD = 8.5 \times 10^{-4} \times d_g \times P_e$$

where
FD = maximum filling degree (in kg ·1-1)
dg = gas density (at 15 °C, 1 bar) (in kg/m3)
Pe = minimum test pressure (in bar)

If the density of the gas is unknown, the maximum filling degree shall be determined as follows:

$$FD = \frac{P_e \times MM \times 10^{-3}}{R \times 338}$$

where
FD = maximum filling degree (in kg ·1-1)
Pe = minimum test pressure (in bar)
MM = molecular mass (in g·mol-1)
R = 8,31451 x 10-2 bar ·1·mol-1 ·K-1 (gas constant)

(For gas mixtures the average molecular mass is to be taken, taking into account the concentrations of the various components):

(5) For liquefied gases having a critical temperature of 70 °C or above, the maximum mass of contents per litre of capacity (degree of filling) equals 0.95 times the density of the liquid phase at 50 °C (in kg/1); in addition, the vapour phase shall not disappear below 60 °C. The test pressure will be at least equal to the vapour pressure of the liquid at 70 °C, minus 100 kPa (1 bar).

For pure gases with insufficient data the maximum filling degree shall be determined as follows:

$$FD = (0.0032 \times BP - 0.24) \times d_1$$

where
FD = maximum filling degree (in kg ·1-1)
BP = boiling point (in Kelvin)
d_1 = density of the liquid at boiling point (in kg ·1-1)

(6) For UN No. 1001 acetylene, dissolved, once equilibrium has been achieved at 15 °C, the filling pressure shall not exceed the value prescribed by the competent authority for the porous mass. The quantity of solvent and the quantity of acetylene shall likewise correspond to the figures specified in the approval;

(7) Other test pressure and degree of filling may be used provided they satisfy the general requirements outlined in the previous paragraphs of this section B;

C. Periodic inspections

(8) Refillable receptacles shall be subjected to periodic inspections in accordance with the provisions of 6.2.1.6.

(9) If special requirements for certain substances do not appear in the table below, periodic inspections shall be carried out:

(a) Every 3 years in the case of receptacles intended for the carriage of gases of classification codes 1TC, 1TFC, 1TOC, 2TC, 2TFC and 2TOC;
(b) Every 5 years in the case of receptacles intended for the carriage of gases of classification codes 1T, 1TF, 1TO, 2T, 2TF and 2TO and gases of classification codes 4A, 4F and 4C;
(c) Every 10 years in the case of receptacles intended for the carriage of gases of classification codes 1A, 1O, 1F, 2A, 2O and 2F.

By derogation from this paragraph, the periodic inspection of receptacles which make use of composite materials (composite receptacles) shall be carried out at intervals determined by the competent authority of the Contracting Party to ADR which has approved the technical code for the design and construction.

D. Table

(10) The following table:

- identifies what types of receptacles are authorised for what gases;
- identifies the test pressure, degree of filling and limitation of capacity for the different gases, as well as restrictions concerning toxic gases with a LC_{50} less than 200 ppm;
- refers to additional requirements that are product specific.

(11) Keys for the column "receptacles"

(1) Cylinders;
(2) Tubes;
(3) Pressure drums;
(5) Bundles of cylinders.

(12) Keys for the column "Special requirements":

a: Aluminium alloys not allowed in contact with gas.
b: Valves made of copper are not accepted.
c: Metal parts in contact with the contents shall not contain more than 70% copper.
d: No receptacle may contain more than 5 kg of the substance.
e: The valve outlets shall be fitted with plugs or cap-nuts ensuring gas-tightness.
f: The necessary steps to prevent dangerous reactions (e.g. polymerisation, decomposition...) during carriage shall be taken. If necessary, stabilisation or addition of an inhibitor is required.
g: The use of test pressures other than those indicated are allowed provided the provisions of P200 (4) are followed.
h: If a monolithic material is used as a porous mass, the interval between inspections may be extended to 10 years.
i: Maximum filling according to the figures specified in the approval.
j: The test pressure and degree of filling shall be calculated in accordance with the provisions of P200 (3), (4) or (5).

k: The interval between tests may be extended to 10 years when receptacles are made of aluminium alloys.

l: Each cylinder in a frame (bundle) shall be fitted with an individual valve that shall be closed during carriage.

m: The interval between inspections for steel cylinders may be extended to 15 years:

(a) with the agreement of the competent authority (authorities) of the country (countries) where the periodic inspection and the carriage take place; and

(b) in accordance with the requirements of a technical code or a standard recognised by the competent authority, or standard EN 1440:1996 "Transportable refillable welded cylinders for liquefied petroleum gas (LPG) - Periodic requalification".

n:(1) allowed for carriage in capsules under the following conditions:

(a) The mass of gas shall not exceed 150 g per capsule;

(b) The capsules shall be free from faults liable to impair the strength;

(c) The leakproofness of the closure shall be ensured by an additional device (cap, crown, seal, binding, etc.) capable of preventing any leakage of the closure during carriage;

(d) The capsules shall be placed in an outer packaging of sufficient strength. A package shall not weigh more than 75 kg.

(2) not allowed for carriage in capsules:

(a) methylsilane or mixtures thereof, assigned to UN No. 3161;

(b) dimethylsilane, trimethylsilane or mixtures thereof, assigned to UN No. 3309;

(c) mixtures of UN No. 1589 cyanogen chloride, UN No. 2188 arsine, UN No. 2189 dichlorosilane, UN No. 2202 hydrogen selenide.

z: In the case of receptacles for the carriage of gases under a N.O.S entry, the following requirements shall be taken into account as applicable:

(1) The materials of which the receptacles and their closures are made shall not be liable to attack by the contents or form harmful or dangerous compounds therewith;

(2) The special requirements of each component shall be taken into account when selecting and filling the receptacles;

(3) The test pressure and degree of filling is to be calculated in accordance with the requirements of P200 (3), (4) or (5);

(4) Toxic gases and gas mixtures with a LC50 less than 200 ppm are not allowed for transport in tubes and pressure drums;

(5) The valves of receptacles for toxic gases and gas mixtures with a LC50 less than 200 ppm or of pyrophoric gases or flammable mixtures of gases containing more than 1% of pyrophoric compounds shall be fitted with gas tight plugs or cap-nuts. When these receptacles are manifolded in a bundle, each of them shall be fitted with an individual valve that shall be closed during carriage;

(6) The necessary steps to prevent dangerous reactions (i.e. polymerisation, decomposition) during carriage shall be taken. If necessary, stabilisation or addition of an inhibitor is required;

(7) Other criteria may be used for filling of welded steel cylinders intended for the carriage of substances of UN No. 1965:

(a) with the agreement of the competent authorities of the countries where the transport is carried out; and

(b) in compliance with the provisions of a national code or standard recognised by the competent authorities or standard EN 1439:1996 "Transportable refillable steel cylinders for liquefied petroleum Gases (LPG) - Procedures for checking before, during and after refilling)".

When the criteria for filling are different from those in P200(5), the transport document shall include the statement "Carriage in accordance with packing instruction P200, special requirement z" and the indication of the reference temperature used for the calculation of the filling factor.

E. Reference to standards

(13) The applicable requirements of this packing instruction are considered to have been complied with if the following standards, as relevant, are applied:

Applicable requirements	Reference	Title of document
P200 (6)	EN 1801: 1998	Transportable gas cylinders - Filling conditions for single acetylene cylinders (including list of permissible porous masses)
P200 (6)	EN 12755: 2000	Transportable gas cylinders - Filling conditions for acetylene bundles

UN No.	NAME AND DESCRIPTION	CLASSIFICATION CODE	PACKING	TEST			FILLING	SPECIAL
			TYPE OF RECEPTACLE	PRESSURE (T.P.)		PERIOD (years)[a]	MAX. FILL. DEGREE kg/l or MAX. FILL. PRESSURE MPa	REQUIREMENTS
				X FILL. PRESS.	MPa			
1001	ACETYLENE, DISSOLVED	4F	(1),(5)		6.0	5		c, h, i
1002	AIR, COMPRESSED	1A	(1),(2),(3),(5)	1.5		10	2/3 T.P.	
1005	AMMONIA, ANHYDROUS	2TC	(1),(2),(3),(5)		3.3	5	0.53	b, n
1006	ARGON, COMPRESSED	1A	(1),(2),(3),(5)	1.5		10	2/3 T.P.	
1008	BORON TRIFLUORIDE, COMPRESSED	1TC	(1),(2),(3),(5)		22.5	3	0.715	g
			(1),(2),(3),(5)		30.0		0.86	g
1009	BROMOTRIFLUOROMETHANE (REFRIGERANT GAS R13B1)	2A	(1),(2),(3),(5)		4.2	10	1.13	g, n
			(1),(2),(3),(5)		12.0	10	1.44	g, n
			(1),(2),(3),(5)		25.0	10	1.60	g, n
1010	1,2-BUTADIENE, INHIBITED, or	2F	(1),(2),(3),(5)		1.0	10	0.59	f, n
	1,3-BUTADIENE, INHIBITED, or							
	MIXTURES OF 1,3-BUTADIENE AND HYDROCARBONS, INHIBITED		(1),(2),(3),(5)		1.0	10	0.55	f, n
			(1),(2),(3),(5)		1.0	10	0.55	f, n
1011	BUTANE	2F	(1),(2),(3),(5)		1.0	10	0.51	n
1012	BUTYLENES MIXTURE or	2F	(1),(2),(3),(5)		1.0	10	0.5	j, n
1012	1-BUTYLENE or		(1),(2),(3),(5)		1.0	10	0.53	
1012	CIS-2-BUTENE or		(1),(2),(3),(5)		1.0	10	0.55	
1012	TRANS-2-BUTYLENE		(1),(2),(3),(5)		1.0	10	0.54	
1013	CARBON DIOXIDE	2A	(1),(2),(3),(5)		19.0	10	0.66	g, n
			(1),(2),(3),(5)		25.0	10	0.75	g, n
1014	CARBON DIOXIDE AND OXYGEN MIXTURE, COMPRESSED	1O	(1),(2),(3),(5)	1.5		10	2/3 T.P.	
1015	CARBON DIOXIDE AND NITROUS OXIDE MIXTURE	2A	(1),(3),(5)		25.0	10	0.75	g, n
1016	CARBON MONOXIDE, COMPRESSED	1TF	(1),(2),(3),(5)	1.5		5	2/3 T.P.	k
1017	CHLORINE	2TC	(1),(2),(3),(5)		2.2	5	1.25	a, n
1018	CHLORODIFLUORO-METHANE (REFRIGERANT GAS R22)	2A	(1),(2),(3),(5)		2.9	10	1.03	n
1020	CHLOROPENTAFLUORO-ETHANE (REFRIGERANT GAS R115)	2A	(1),(2),(3),(5)		2.5	10	1.08	n
1021	1-CHLORO-1,2,2,2-TETRAFLUOROETHANE (REFRIGERANT GAS R124)	2A	(1),(2),(3),(5)		1.2	10	1.2	n
1022	CHLOROTRIFLUORO-METHANE (REFRIGERANT GAS R13)	2A	(1),(2),(3),(5)		10.0	10	0.83	g, n
			(1),(2),(3),(5)		12.0	10	0.90	g, n
			(1),(2),(3),(5)		19.0	10	1.04	g, n
			(1),(2),(3),(5)		25.0	10	1.10	g, n
1023	COAL GAS, COMPRESED	1TF	(1),(2),(3),(5)	1.5		5	2/3 T.P.	
1026	CYANOGEN	2TF	(1),(2),(3),(5)		10.0	5	0.70	k, n
1027	CYCLOPROPANE	2F	(1),(2),(3),(5)		2.0	10	0.53	n
1028	DICHLORODIFLUORO-METHANE (REFRIGERANT GAS R12)	2A	(1),(2),(3),(5)		1.8	10	1.15	n
1029	DICHLOROFLUOROMETHANE (REFRIGERANT GAS R21)	2A	(1),(2),(3),(5)		1.0	10	1.23	n
1030	1,1-DIFLUOROETHANE (REFRIGERANT GAS R152a)	2F	(1),(2),(3),(5)		1.8	10	0.79	n
1032	DIMETHYLAMINE, ANHYDROUS	2F	(1),(2),(3),(5)		1.0	10	0.59	b, n
1033	DIMETHYL ETHER	2F	(1),(2),(3),(5)		1.8	10	0.58	n

P200	PACKING INSTRUCTION (cont'd)							P200
UN No.	NAME AND DESCRIPTION	CLASSIFI-CATION CODE	PACKING	TEST			FILLING	SPECIAL
			TYPE OF RECEPTACLE	PRESSURE (T.P.)		PERIOD (years)[a]	MAX. FILL. DEGREE kg/l or MAX. FILL. PRESSURE MPa	REQUIRE-MENTS
				X FILL. PRESS.	MPa			
1035	ETHANE	2F	(1),(2),(3),(5)		9.5	10	0.25	g, n
			(1),(2),(3),(5)		12	10	0.29	g, n
			(1),(2),(3),(5)		30	10	0.39	g, n
1036	ETHYLAMINE	2F	(1),(2),(3),(5)		1.0	10	0.61	b, n
1037	ETHYL CHLORIDE	2F	(1),(2),(3),(5)		1.0	10	0.80	a, n
1039	ETHYL METHYL ETHER	2F	(1),(2),(3),(5)		1.0	10	0.64	n
1040	ETHYLENE OXIDE or ETHYLENE OXIDE WITH NITROGEN up to a total pressure of 1MPa (10 bar) at 50°C	2TF	(1),(2),(3),(5)		1.5	5	0.78	f, n
1041	ETHYLENE OXIDE AND CARBON DIOXIDE MIXTURE with more than 9% ethylene oxide but not more than 87%	2F	(1),(2),(3),(5)		19	10	0.66	g, n
			(1),(2),(3),(5)		25	10	0.75	g, n
1045	FLUORINE, COMPRESSED	1TOC	(1),(5)		20.0	5	2.8 MPa	a, d, e, l
1046	HELIUM, COMPRESSED	1A	(1),(2),(3),(5)	1.5		10	2/3 T.P.	
1048	HYDROGEN BROMIDE, ANHYDROUS	2TC	(1),(2),(3),(5)		6.0	3	1.54	a, n
1049	HYDROGEN, COMPRESSED	1F	(1),(2),(3),(5)	1.5		10	2/3 T.P.	
1050	HYDROGEN CHLORIDE, ANHYDROUS	2TC	(1),(2),(3),(5)		10.0	3	0.30	a, g, n
			(1),(2),(3),(5)		12.0	3	0.56	a, g, n
			(1),(2),(3),(5)		15.0	3	0.67	a, g, n
			(1),(2),(3),(5)		20.0	3	0.74	a, g, n
1053	HYDROGEN SULPHIDE	2TF	(1),(2),(3),(5)		5.5	5	0.67	k, n
1055	ISOBUTYLENE	2F	(1),(2),(3),(5)		1.0	10	0.52	n
1056	KRYPTON, COMPRESSED	1A	(1),(2),(3),(5)	1.5		10	2/3 T.P.	
1058	LIQUEFIED GASES, non-flammable, charged with nitrogen, carbon dioxide or air	2A	(1),(2),(3),(5)	1.5		10		j, n
1060	METHYLACETYLENE AND PROPADIENE MIXTURE, STABILIZED	2F	(1),(2),(3),(5)			10		c, f, j, n
	Propadiene with 1% to 4% methylacetylene		(1),(2),(3),(5)		2.2	10	0.50	c, f, n
	Mixture P1		(1),(2),(3),(5)		3.0	10	0.49	c, f, n
	Mixture P2		(1),(2),(3),(5)		2.4	10	0.47	c, f, n
1061	METHYLAMINE, ANHYDROUS	2F	(1),(2),(3),(5)		1.3	10	0.58	b, n
1062	METHYL BROMIDE	2T	(1),(2)(3),(5)		1.0	5	1.51	a
1063	METHYL CHLORIDE (REFRIGERANT GAS R 40)	2F	(1),(2)(3),(5)		1.7	10	0.81	a, n
1064	METHYL MERCAPTAN	2TF	(1),(2)(3),(5)		1.0	5	0.78	k, n
1065	NEON, COMPRESSED	1A	(1),(2)(3),(5)	1.5		10	2/3 T.P.	
1066	NITROGEN, COMPRESSED	1A	(1),(2)(3),(5)	1.5		10	2/3 T.P.	
1067	DINITROGEN TETROXIDE (NITROGEN DIOXIDE)	2 TOC	(1),(3),(5)		1.0	3	1.30	e, l
1069	NITROSYL CHLORIDE	2TC	(1),(5)		1.3	3	1.10	e, l, n
1070	NITROUS OXIDE	2O	(1),(2)(3),(5)		18.0	10	0.68	g
			(1),(2)(3),(5)		22.5	10	0.74	g
			(1),(2)(3),(5)		25.0	10	0.75	g
1071	OIL GAS, COMPRESSED	1TF	(1),(2)(3),(5)	1.5		5	2/3 T.P.	
1072	OXYGEN, COMPRESSED	1O	(1),(2)(3),(5)	1.5		10	2/3 T.P.	

P200	PACKING INSTRUCTION (cont'd)							P200
UN No.	NAME AND DESCRIPTION	CLASSIFI-CATION CODE	PACKING	TEST			FILLING	SPECIAL
			TYPE OF RECEPTACLE	PRESSURE (T.P.)		PERIOD (years)[a]	MAX. FILL. DEGREE kg/l or MAX. FILL. PRESSURE MPa	REQUIRE-MENTS
				X FILL. PRESS.	MPa			
1076	PHOSGENE	2TC	(1),(3),(5)		2.0	3	1.23	e, l, n
1077	PROPYLENE	2F	(1),(2)(3),(5)		3.0	10	0.43	n
1078	REFRIGERANT GASES, N.O.S.	2A	(1),(2)(3),(5)			10		n, z
	Mixture F1		(1),(2)(3),(5)		1.2	10	1.23	
	Mixture F2		(1),(2)(3),(5)		1.8	10	1.15	
	Mixture F3		(1),(2)(3),(5)		2.9	10	1.03	
1079	SULPHUR DIOXIDE	2TC	(1),(2)(3),(5)		1.4	3	1.23	n
1080	SULPHUR HEXAFLUORIDE	2A	(1),(2)(3),(5)		7.0	10	1.04	g, n
			(1),(2)(3),(5)		14.0	10	1.33	g, n
			(1),(2)(3),(5)		16.0	10	1.37	g, n
1081	TETRAFLUOROETHYLENE, INHIBITED	2F	(1),(2)(3),(5)		20.0	10	0.5 MPa	f, n
1082	TRIFLUOROCHLORO-ETHYLENE, INHIBITED	2TF	(1),(2)(3),(5)		1.9	5	1.13	f, k, n
1083	TRIMETHYLAMINE, ANHYDROUS	2F	(1),(2)(3),(5)		1.0	10	0.56	b, n
1085	VINYL BROMIDE, INHIBITED	2F	(1),(2)(3),(5)		1.0	10	1.37	a, f, n
1086	VINYL CHLORIDE, INHIBITED	2F	(1),(2)(3),(5)		1.2	10	0.81	a, f, n
1087	VINYL METHYL ETHER, INHIBITED	2F	(1),(2)(3),(5)		1.0	10	0.67	f, n
1581	CHLOROPICRIN AND METHYL BROMIDE MIXTURE	2T	(1),(2)(3),(5)		1.0	5	1.51	a
1582	CHLOROPICRIN AND METHYL CHLORIDE MIXTURE	2T	(1),(2)(3),(5)		1.7	5	0.81	a
1589	CYANOGEN CHLORIDE, INHIBITED	2TC	(1),(5)		2.0	3	1.03	e, f, l
1612	HEXAETHYL TETRAPHOSPHATE AND COMPRESSED GAS MIXTURE	1T	(1),(2),(3),(5)	1.5		5	2/3 T.P,	
1660	NITRIC OXIDE, COMPRESSED	1TOC	(1),(5)	1.5		3	2/3 T.P.	e, l
1741	BORON TRICHLORIDE	2TC	(1),(2),(3),(5)		1.0	3	1.19	n
1749	CHLORINE TRIFLUORIDE	2TOC	(1),(2),(3),(5)		3.0	3	1.40	a
1858	HEXAFLUOROPROPYLENE (REFRIGERANT GAS R1216)	2A	(1),(2),(3),(5)		2.2	10	1.11	n
1859	SILICON TETRAFLUORIDE, COMPRESSED	1TC	(1),(2),(3),(5)		20	3	0.74	g
			(1),(2),(3),(5)		30		1.1	g
1860	VINYL FLUORIDE, INHIBITED	2F	(1),(2),(3),(5)		25.0	10	0.64	a, f, g, n
1911	DIBORANE, COMPRESSED	1TF	(1),(5)		25.0	5	0.072	e, f, l
1912	METHYLCHLORIDE AND METHYLENE CHLORIDE MIXTURE	2F	(1),(2),(3),(5)		1.7	10	0.81	a, n
1952	CARBON DIOXIDE AND ETHYLENE OXIDE MIXTURE with not more than 9% ethylene oxide	2A	(1),(2),(3),(5)		19	10	0.66	n
			(1),(2),(3),(5)		25	10	0.75	n
1953	COMPRESSED GAS, TOXIC, FLAMMABLE, N.O.S.	1TF	(1),(2),(3),(5)	1.5		5	2/3 T.P.	z
1954	COMPRESSED GAS, FLAMMABLE, N.O.S.	1F	(1),(2),(3),(5)	1.5		10	2/3 T.P.	z
1955	COMPRESSED GAS, TOXIC, N.O.S.	1T	(1),(2),(3),(5)	1.5		5	2/3 T.P.	z
1956	COMPRESSED GAS, N.O.S.	1A	(1),(2),(3),(5)	1.5		10	2/3 T.P.	z
1957	DEUTERIUM, COMPRESSED	1F	(1),(2),(3),(5)	1.5		10	2/3 T.P.	

UN No.	NAME AND DESCRIPTION	CLASSIFICATION CODE	PACKING	TEST			FILLING	SPECIAL
			TYPE OF RECEPTACLE	PRESSURE (T.P.)		PERIOD (years)[a]	MAX. FILL. DEGREE kg/l or MAX. FILL. PRESSURE MPa	REQUIREMENTS
				X FILL. PRESS.	MPa			
1958	DICHLOROTETRAFLUOROETHANE (REFRIGERANT GAS R114)	2A	(1),(2),(3),(5)		1.0	10	1.30	n
1959	1,1-DIFLUOROETHYLENE (REFRIGERANT GAS R1132a)	2F	(1),(2),(3),(5)		25	10	0.77	g, n
1962	ETHYLENE, COMPRESSED	1F	(1),(2),(3),(5)		22.5	10	0.34	g
			(1),(2),(3),(5)		30	10	0.37	g
1964	HYDROCARBON GAS MIXTURE, COMPRESSED, N.O.S.	1F	(1),(2),(3),(5)	1.5		10	2/3 T.P.	z
1965	HYDROCARBON GAS MIXTURE, LIQUEFIED, N.O.S.	2F	(1),(2),(3),(5)			10	[b]	m, n, z
	Mixture A		(1),(2),(3),(5)		1.0	10	0.50	
	Mixture AO1		(1),(2),(3),(5)		1.5	10	0.49	
	Mixture AO2		(1),(2),(3),(5)		1.5	10	0.48	
	Mixture AO		(1),(2),(3),(5)		1.5	10	0.47	
	Mixture A1		(1),(2),(3),(5)		2.0	10	0.46	
	Mixture B1		(1),(2),(3),(5)		2.5	10	0.45	
	Mixture B2		(1),(2),(3),(5)		2.5	10	0.44	
	Mixture B		(1),(2),(3),(5)		2.5	10	0.43	
	Mixture C		(1),(2),(3),(5)		3.0	10	0.42	
1967	INSECTICIDE GAS, TOXIC, N.O.S.	2T	(1),(2),(3),(5)			5		z
1968	INSECTICIDE GAS, N.O.S.	2A	(1),(2),(3),(5)			10		n, z
1969	ISOBUTANE	2F	(1),(2),(3),(5)		1.0	10	0.49	n
1971	METHANE, COMPRESSED or NATURAL GAS, COMPRESSED with high methane content	1F	(1),(2),(3),(5)	1.5		10	2/3 T.P	
1973	CHLORODIFLUOROMETHANE AND CHLOROPENTAFLUOROETHANE MIXTURE with fixed boiling point, with approximately 49% chlorodifluoromethane (REFRIGERANT GAS R502)	2A	(1),(2),(3),(5)		3.1	10	1.05	n
1974	CHLORODIFLUOROBROMOMETHANE (R12B1)	2A	(1),(2),(3),(5)		1.0	10	1.61	n
1975	NITRIC OXIDE AND DINITROGEN TETROXIDE MIXTURE (NITRIC OXIDE AND NITROGEN DIOXIDE MIXTURE)	2TOC	(1),(2),(3),(5)			3		e, j, l
1976	OCTAFLUOROCYCLOBUTANE (REFRIGERANT GAS RC318)	2A	(1),(2),(3),(5)		1.1	10	1.34	n
1978	PROPANE	2F	(1),(2),(3),(5)		2.5	10	0.42	n
1979	RARE GASES MIXTURE, COMPRESSED	1A	(1),(2),(3),(5)	1.5		10	2/3 T.P.	
1980	RARE GASES AND OXYGEN MIXTURE, COMPRESSED	1A	(1),(2),(3),(5)	1.5		10	2/3 T.P	
1981	RARE GASES AND NITROGEN MIXTURE, COMPRESSED	1A	(1),(2),(3),(5)	1.5		10	2/3 T.P.	
1982	TETRAFLUOROMETHANE, COMPRESSED (REFRIGERANT GAS R14, COMPRESSED)	1A	(1),(2),(3),(5)		20	10	0.62	g
			(1),(2),(3),(5)		30		0.94	g
1983	1-CHLORO-2,2,2-TRIFLUOROETHANE (REFRIGERANT GAS R133a)	2A	(1),(2),(3),(5)		1.0	10	1.18	n
1984	TRIFLUOROMETHANE (REFRIGERANT GAS R23)	2A	(1),(2),(3),(5)		19.0	10	0.87	g, n
			(1),(2),(3),(5)		25.0	10	0.95	g, n
2034	HYDROGEN AND METHANE MIXTURE, COMPRESSED	1F	(1),(2),(3),(5)	1.5		10	2/3 T.P.	
2035	1,1,1-TRIFLUOROETHANE (REFRIGERANT GAS R143a)	2F	(1),(2),(3),(5)		3.5	10	0.75	n

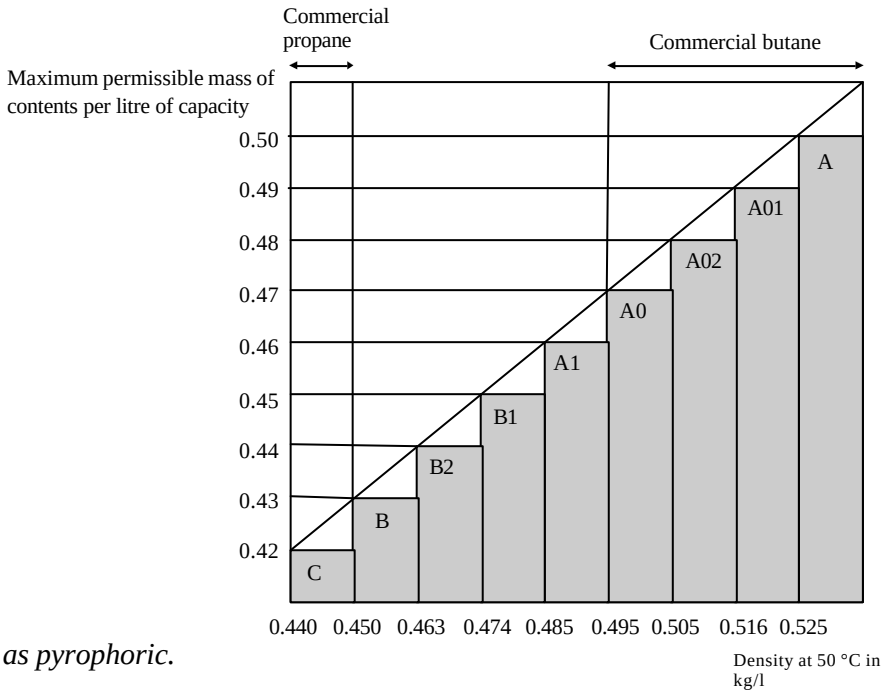
P200	PACKING INSTRUCTION (cont'd)							P200
UN No.	NAME AND DESCRIPTION	CLASSIFI-CATION CODE	PACKING	TEST			FILLING	SPECIAL
			TYPE OF RECEPTACLE	PRESSURE (T.P.)		PERIOD (years)[a]	MAX. FILL. DEGREE kg/l or MAX. FILL. PRESSURE MPa	REQUIRE-MENTS
				X FILL. PRESS.	MPa			
2036	XENON, COMPRESSED	1A	(1),(2),(3),(5)		13	10	1.24	g
2044	2,2-DIMETHYLPROPANE	2F	(1),(2),(3),(5)		1.0	10	0.53	n
2073	AMMONIA SOLUTION, relative density less than 0.88 at 15°C	4A						
	with more than 35% and not more than 40% ammonia		(1),(2),(3),(5)		1.0	5	0.80	
	with more than 40% and not more than 50% ammonia		(1),(2),(3),(5)		1.0	5	0.77	
2188	ARSINE	2TF	(1),(5)		4.2	5	1.10	e, l
2189	DICHLOROSILANE	2TFC	(1),(2),(3),(5)		1	3	0.90	
2190	OXYGEN DIFLUORIDE	1TOC	(1),(5)		20.0	3	2.8 MPa	a, d, e, l
2191	SULPHURYL FLUORIDE	2T	(1),(2),(3),(5)		5.0	5	1.10	k
2192	GERMANE[c]	2TF	(1),(5)		25.0	5	1.02	e, g, l, n
2193	HEXAFLUOROETHANE, COMPRESSED (REFRIGERANT GAS R116, COMPRESSED)	1A	(1),(2),(3),(5)		20	10	1.10	g
2194	SELENIUM HEXAFLUORIDE	2TC	(1),(5)		3.6	3	1.46	e, g, l, n
2195	TELLURIUM HEXAFLUORIDE	2TC	(1),(5)		2.0	3	1.0	e, l, n
2196	TUNGSTEN HEXAFLUORIDE	2TC	(1),(5)		1.0	3	2.70	a, e, l, n
2197	HYDROGEN IODIDE, ANHYDROUS	2TC	(1),(2),(3),(5)		2.3	3	2.25	a, n
2198	PHOSPHORUS PENTAFLUORIDE, COMPRESSED	1TC	(1),(5)		20	3	0.9	e, g, l
			(1),(5)		30		1.34	e, g, l
2199	PHOSPHINE[c]	2TF	(1),(5)		22.5	5	0.30	e, g, l, n
			(1),(5)		25.0	5	0.51	e, g, l, n
2200	PROPADIENE, INHIBITED	2F	(1),(2),(3),(5)		2.2	10	0.50	f, n
2202	HYDROGEN SELENIDE, ANHYDROUS	2TF	(1),(5)		3.1	5	1.60	e, l
2203	SILANE, COMPRESSED[c]	1F	(1),(2),(3),(5)		22.5	10	0.32	e, g, l
			(1),(2),(3),(5)		25.0	10	0.41	e, g, l
2204	CARBONYL SULPHIDE	2TF	(1),(2),(3),(5)		2.6	5	0.84	k, n
2417	CARBONYL FLUORIDE, COMPRESSED	1TC	(1),(2),(3),(5)		20	3	0.47	g
			(1),(2),(3),(5)		30		0.7	g
2418	SULPHUR TETRAFLUORIDE	2TC	(1),(5)		3.0	3	0.91	e, l, n
2419	BROMOTRIFLUORO-ETHYLENE	2F	(1),(2),(3),(5)		1.0	10	1.19	n
2420	HEXAFLUOROACETONE	2TC	(1),(2),(3),(5)		2.2	3	1.08	n
2422	OCTAFLUOROBUT-2-ENE (REFRIGERANT GAS R1318)	2A	(1),(2),(3),(5)		1.2	10	1.34	n
2424	OCTAFLUOROPROPANE (REFRIGERANT GAS R218)	2A	(1),(2),(3),(5)		2.5	10	1.09	n
2451	NITROGEN TRIFLUORIDE	1O	(1),(2),(3),(5)		20	10	0.5	g
			(1),(2),(3),(5)		30		0.75	g
2452	ETHYLACETYLENE, INHIBITED	2F	(1),(2),(3),(5)		1.0	10	0.57	c, f, n
2453	ETHYL FLUORIDE (REFRIGERANT GAS R161)	2F	(1),(2),(3),(5)		3.0	10	0.57	n
2454	METHYL FLUORIDE (REFRIGERANT GAS R41)	2F	(1),(2),(3),(5)		30.0	10	0.36	n
2517	1-CHLORO-1,1-DIFLUOROETHANE (REFRIGERANT GAS R142(b)	2F	(1),(2),(3),(5)		1.0	10	0.99	n

UN No.	NAME AND DESCRIPTION	CLASSIFI-CATION CODE	PACKING	TEST			FILLING	SPECIAL
			TYPE OF RECEPTACLE	PRESSURE (T.P.)		PERIOD (years)[a]	MAX. FILL. DEGREE kg/l or MAX. FILL. PRESSURE MPa	REQUIRE-MENTS
				X FILL. PRESS.	MPa			
2534	METHYLCHLOROSILANE	2TFC	(1),(2),(3),(5)			3		j, n
2548	CHLORINE PENTAFLUORIDE	2TOC	(1),(5)		1.3	3	1.49	a, e, l
2599	CHLOROTRIFLUORO-METHANE AND TRIFLUOROMETHANE, AZEOTROPIC MIXTURE with approximately 60% chlorotrifluoromethane (REFRIGERANT GAS R503)	2A	(1),(2),(3),(5)		3.1	10	0.11	n
			(1),(2),(3),(5)		4.2	10	0.20	n
			(1),(2),(3),(5)		10.0	10	0.66	n
2600	CARBON MONOXIDE AND HYDROGEN MIXTURE, COMPRESSED	1TF	(1),(2),(3),(5)	1.5		5	2/3 T.P.	k
2601	CYCLOBUTANE	2F	(1),(2),(3),(5)		1.0	10	0.63	n
2602	DICHLORODIFLUORO-METHANE AND 1,1-DIFLUOROETHANE, AZEOTROPIC MIXTURE with approximately 74% dichlorodifluoromethane (REFRIGERANT GAS R500)	2A	(1),(2),(3),(5)		2.2	10	1.01	n
2676	STIBINE	2TF	(1),(5)		2.0	5	1.2	e, l, n
2901	BROMINE CHLORIDE	2TOC	(1),(2),(3),(5)		1.0	3	1.5	a
3057	TRIFLUOROACETYL CHLORIDE	2TC	(1),(2),(3),(5)		1.7	3	1.17	n
3070	ETHYLENE OXIDE AND DICHLORODIFLUORO-METHANE MIXTURE with not more than 12.5% ethylene oxide	2A	(1),(2),(3),(5)		1.8	10	1.09	n
3083	PERCHLORYL FLUORIDE	2TO	(1),(2),(3),(5)		3.3	5	1.21	k
3153	PERFLUORO(METHYL VINYL ETHER)	2F	(1),(2),(3),(5)		2.0	10	0.75	n
3154	PERFLUORO(ETHYL VINYL ETHER)	2F	(1),(2),(3),(5)		1.0	10	0.98	n
3156	COMPRESSED GAS, OXIDIZING, N.O.S.	1O	(1),(2),(3),(5)	1.5		10	2/3 T.P.	z
3157	LIQUEFIED GAS, OXIDIZING, N.O.S.	2O	(1),(2),(3),(5)			10		z
3159	1,1,1,2-TETRAFLUOROETHANE (REFRIGERNAT GAS R134a)	2A	(1),(2),(3),(5)		2.2	10	1.04	n
3160	LIQUEFIED GAS, TOXIC, FLAMMABLE, N.O.S.	2TF	(1),(2),(3),(5)			5		n, z
3161	LIQUEFIED GAS, FLAMMABLE, N.O.S.	2F	(1),(2),(3),(5)			10		n, z
3162	LIQUEFIED GAS, TOXIC, N.O.S.	2T	(1),(2),(3),(5)			5		z
3163	LIQUEFIED GAS, N.O.S.	2A	(1),(2),(3),(5)			10		n, z
3220	PENTAFLUOROETHANE (REFRIGERANT GAS R125)	2A	(1),(2),(3),(5)		4.9	10	0.95	g, n
			(1),(2),(3),(5)		3.6	10	0.72	g, n
3252	DIFLUOROMETHANE (REFRIGERANT GAS R32)	2F	(1),(2),(3),(5)		4.8	10	0.78	n
3296	HEPTAFLUOROPROPANE (REFRIGERANT GAS R227)	2A	(1),(2),(3),(5)		1.5	10	1.2	n
3297	ETHYLENE OXIDE AND CHLOROTETRAFLUORO-ETHANE MIXTURE with not more than 8.8% ethylene oxide	2A	(1),(2),(3),(5)		1.0	10	1.16	n
3298	ETHYLENE OXIDE AND PENTAFLUOROETHANE MIXTURE with not more than 7.9% ethylene oxide	2A	(1),(2),(3),(5)		2.6	10	1.02	n

P200	PACKING INSTRUCTION (cont'd)							P200
UN No.	NAME AND DESCRIPTION	CLASSIFI-CATION CODE	PACKING	TEST			FILLING	SPECIAL
			TYPE OF RECEPTACLE	PRESSURE (T.P.)		PERIOD (years)[a]	MAX. FILL. DEGREE kg/l or MAX. FILL. PRESSURE MPa	REQUIRE-MENTS
				X FILL. PRESS.	MPa			
3299	ETHYLENE OXIDE AND TETRAFLUOROETHANE MIXTURE with not more than 5.6% ethylene oxide	2A	(1),(2),(3),(5)		1.7	10	1.03	n
3300	ETHYLENE OXIDE AND CARBON DIOXIDE MIXTURE with more than 87% ethylene oxide	2TF	(1),(2),(3),(5)		2.8	5	0.73	f, n
3303	COMPRESSED GAS, TOXIC, OXIDIZING, N.O.S.	1TO	(1),(2),(3),(5)	1.5		5	2/3 T.P.	z
3304	COMPRESSED GAS, TOXIC, CORROSIVE, N.O.S.	1TC	(1),(2),(3),(5)	1.5		3	2/3 T.P.	z
3305	COMPRESSED GAS, TOXIC, FLAMMABLE, CORROSIVE, N.O.S.	1TFC	(1),(2),(3),(5)	1.5		3	2/3 T.P.	z
3306	COMPRESSED GAS, TOXIC, OXIDIZING, CORROSIVE, N.O.S.	1TOC	(1),(2),(3),(5)	1.5		3	2/3 T.P.	z
3307	LIQUEFIED GAS, TOXIC, OXIDIZING, N.O.S.	2TO	(1),(2),(3),(5)			5		z
3308	LIQUEFIED GAS, TOXIC, CORROSIVE, N.O.S.	2TC	(1),(2),(3),(5)			3		z, n
3309	LIQUEFIED GAS, TOXIC, FLAMMABLE, CORROSIVE, N.O.S.	2TFC	(1),(2),(3),(5)			3		n, z
3310	LIQUEFIED GAS, TOXIC, OXIDIZING, CORROSIVE, N.O.S.	2TOC	(1),(2),(3),(5)			3		z
3318	AMMONIA SOLUTION, relative density less than 0.880 at 15°C in water, with more than 50% ammonia	4TC	(1),(2),(3),(5)			5		j
3337	REFRIGERANT GAS R404A	2A	(1),(2),(3),(5)		3.5	10	0.84	n
3338	REFRIGERANT GAS R407A	2A	(1),(2),(3),(5)		3.5	10	0.95	n
3339	REFRIGERANT GAS R407B	2A	(1),(2),(3),(5)		3.7	10	0.95	n
3340	REFRIGERANT GAS R407C	2A	(1),(2),(3),(5)		3.4	10	0.95	n
3354	INSECTICIDE GAS, FLAMMABLE, N.O.S.	2F	(1),(2),(3),(5)			10		n, z
3355	INSECTICIDE GAS, TOXIC, FLAMMABLE, N.O.S.	2TF	(1),(2),(3),(5)			5		n, z

a *Not applicable for receptacles made of composite materials.*

b *For mixtures of UN No. 1965, the maximum permissible filling mass per litre of capacity is as follows:*



c *Considered as pyrophoric.*

P201	PACKING INSTRUCTION	P201

This instruction applies to UN Nos. 3167, 3168 and 3169.

The following packagings are authorized:

(1) Compressed gas cylinders and gas receptacles conforming to the construction, testing and filling requirements approved by the competent authority;

(2) For non-toxic gases, combination packagings with hermetically sealed inner packagings of glass or metal with a maximum capacity of 5 litres per package which meet the packing group III performance level;

(3) For toxic gases, combination packagings with hermetically sealed inner packagings of glass or metal with a maximum capacity of 1 litre per package which meet the packing group III performance level.

P202	PACKING INSTRUCTION	P202

This instruction applies to UN No. 3353.

The following packagings are authorized:

Packagings conforming to the packing group III performance level.

Air bag inflators or modules or seat belts pretensioners may be carried unpackaged in dedicated handling devices, vehicles or closed vehicles or containers when moved from where they are manufactured to an assembly plant.

Additional requirements:

1. The packaging shall be designed and constructed to prevent inadvertent operation during normal conditions of carriage.

2. The pressure vessel shall be in accordance with the requirements of the competent authority for the gas(es) contained in the pressure vessel.

Type of packagings: Cryogenic receptacles

General instructions:

(1) The special packing provisions of 4.1.6 shall be met.

(2) The receptacles shall be so insulated that they cannot become coated with dew or hoar-frost.

(3) In the case of receptacles intended for the carriage of gases of classification code 3O, the material used to ensure the leakproofness of the joints or for the maintenance of the closures shall be compatible with the contents.

Particular instructions for closed cryogenic receptacles:

(4) The receptacles shall be fitted with safety valves.

(5) For refrigerated liquefied gases of classification codes 3A and 3O the degree of filling, at the filling temperature and at a pressure of 0.1 MPa (1 bar) shall not exceed 98% of the capacity.

(6) For refrigerated liquefied gases of classification code 3F the degree of filling shall remain below the level at which, if the contents were raised to the temperature at which the vapour pressure equalled the opening pressure of the relief valve, the volume would reach 95% of the capacity at that temperature.

(7) Receptacles shall be subjected to periodic inspections in accordance with the provisions of 6.2.1.6.

(8) Periodic inspections shall be carried out every 10 years.
By derogation from this date, the periodic inspection of receptacles which make use of composite materials (composite receptacles) may be carried out at intervals determined by the competent authority of the Contracting Party to ADR which has approved the technical code for the design and construction.

Particular instructions for open cryogenic receptacles:

(9) Open cryogenic receptacles are not allowed for flammable refrigerated liquefied gases of classification code 3F, and UN No. 2187 carbon dioxide, refrigerated liquid and its mixtures.

(10) The receptacles shall be equipped with devices which prevent the liquid from splashing out.

(11) Glass receptacles shall be double-walled vacuum insulated and surrounded by an absorbent insulating material; they shall be protected by iron-wire baskets and placed in metal cases. The metal cases for the glass receptacles and the other receptacles shall be fitted with means of handling.

(12) The openings of the receptacles shall be fitted with devices allowing gases to escape, preventing any splashing out of the liquid, and so fixed that they cannot fall out.

(13) In the case of UN No. 1073 oxygen refrigerated liquid and mixtures thereof, the devices referred to above and the absorbent insulating material surrounding the glass receptacles shall be made of incombustible materials.

Reference to standards (*reserved*)

P204	PACKING INSTRUCTION	P204

This packing instruction applies to UN No. 1950 aerosols and UN No. 2037 receptacles, small, containing gas (gas cartridges)

(1) The special packing provisions of **4.1.6** shall be met when applicable.

(2) Receptacles shall be so closed and leakproof as to prevent escape of the gases.

(3) For UN No. 1950 aerosols and UN No. 2037 receptacles, small, containing gas (gas cartridges):

(a) the internal pressure at 50 °C shall exceed neither two-thirds of the test pressure nor 1.32 MPa (13.2 bar).
(b) they shall be so filled that at 50 °C the liquid phase does not exceed 95% of their capacity.
(c) they shall satisfy a tightness (leakproofness) test in a hot-water bath:

- The temperature of the bath and the duration of the test shall be such that the internal pressure of each receptacle reaches at least 90% of the internal pressure that would be reached at 55 °C;
- However, if the contents are sensitive to heat or if the receptacles are made of a plastics material which softens at this temperature, the temperature of the bath shall be from 20 °C to 30 °C; in addition, one receptacle out of every 2000 shall be tested at the temperature prescribed in the foregoing indent;
- No leakage or permanent deformation shall occur. The provision concerning permanent deformation is not applicable to receptacles which, being made of plastics material, soften.

The requirements of instruction P204 (3)(c) are deemed to be met if the following standards are complied with:

- for aerosol dispensers (UN No. 1950 aerosols):
  Annex to Council Directive 75/324/EEC [a] as amended by Commission Directive 94/1/EC [b];
- for UN No. 2037 gas cartridges containing UN No. 1965 hydrocarbon gas mixture, liquefied:
  EN 417:1992 Non-refillable metallic gas cartridges for liquefied petroleum gases, with or without a valve, for use with portable appliances - Construction, inspection, testing and marking.

(4) For UN No. 1950 aerosols, only non-pyrophoric and non-toxic gases may be used as propellants, as constituents of propellants, or as filler gases.

(5) All compressed and liquefied gases, except the pyrophoric gases and very toxic gases (gases with an LC50 lower than 200 ppm), shall be accepted as filling gases for UN No. 2037 gas cartridges.

(6) Aerosols and gas cartridges shall be placed in wooden boxes or strong fibreboard or metal boxes; UN No. 1950 aerosols made of glass or synthetic material and liable to shatter shall be separated from one another by interposed sheets of fibreboard or of another suitable material.

(7) A package shall not weigh more than 50 kg if fibreboard boxes are used or more than 75 kg if other packagings are used.

(8) In the case of carriage by full load, metal articles may also be packed as follows: the articles shall be grouped together in units on trays and held in position with an appropriate plastics cover; these units shall be stacked and suitably secured on pallets.

[a] *European Communities Council Directive 75/324/EEC of 20 May 1975 on the approximation of the laws of the Member States (of the European Communities) concerning packagings for aerosols, published in the Official Journal of the European Communities No. L147 of 9 June 1975.*

[b] *European Commission Directive 94/1/EC of 6 January 1994 to align with Directive 75/324/EEC on the approximation of the laws of the Member States (of the European Union) concerning aerosol packagings to technical progress, published in the Official Journal of the European Communities No. L23 of 28 January 1994.*

P205	PACKING INSTRUCTION	P205

This packing instruction applies to UN No. 1057 lighters or lighter refills

(1)	The special packing provisions of **4.1.6** shall be met when applicable.
(2)	The articles shall comply with the provisions of the country in which they were filled.
(3)	Lighters and lighter refills shall be provided with protection against inadvertent discharge.
(4)	The liquid portion of the gas shall not exceed 85% of the capacity of the receptacle at 15 °C.
(5)	The receptacles, including the closures, shall be capable of withstanding an internal pressure of the liquefied petroleum gas at 55 °C.
(6)	The valve mechanisms and ignition devices shall be securely sealed, taped or otherwise fastened or designed to prevent operation or leakage of the contents during carriage.
(7)	The lighters or lighter refills shall be tightly packed to prevent inadvertent operation of the release devices.
(8)	Lighters shall contain not more than 10 g of liquefied petroleum gas. Lighter refills shall contain not more than 65 g of liquefied petroleum gas.
(9)	The lighters and lighter refills shall be packed in strong outer packagings conforming to 6.1.4 consisting of natural wood boxes (4C1, 4C2), plywood boxes (4D) or reconstituted wood boxes (4F) with a maximum gross mass of 75 kg, or fibreboard boxes (4G) with a maximum gross mass of 40 kg. The packagings shall be tested and approved in accordance with Chapter 6.1 for packing group II. Nevertheless, if these packagings have a maximum gross mass of not more than 2kg, compliance with the general provisions of 4.1.1.1, 4.1.1.2 and 4.1.1.5 to 4.1.1.7.

P206	**PACKING INSTRUCTION**	**P206**
This packing instruction applies to UN No. 3150 devices, small, hydrocarbon gas powered or hydrocarbon gas refills for small devices		
(1)	The special packing provisions of **4.1.6** when applicable shall be met.	
(2)	The articles shall comply with the provisions of the country in which they were filled.	
(3)	The devices and refills shall be packed in outer packagings conforming to 6.1.4 tested and approved in accordance with Chapter 6.1 for packing group II.	

P300	PACKING INSTRUCTION	P300
This instruction applies to UN No. 3064.		
The following packagings are authorized, provided that the general provisions of **4.1.1** and **4.1.3** are met: Combination packagings consisting of inner metal cans of not more than 1 litre capacity each and outer wooden boxes (4C1, 4C2, 4D or 4F) containing not more than 5 litres of solution.		
Additional requirements: 1. Metal cans shall be completely surrounded with absorbent cushioning material 2. Wooden boxes shall be completely lined with suitable material impervious to water and nitroglycerin.		

P301	PACKING INSTRUCTION	P301
This instruction applies to UN No. 3165.		
The following packagings are authorized, provided that the general provisions of **4.1.1** and **4.1.3** are met: (1) Aluminium pressure vessel made from tubing and having welded heads. Primary containment of the fuel within this vessel shall consist of a welded aluminium bladder having a maximum internal volume of 46 litres. The outer vessel shall have a minimum design gauge pressure of 1 275 kPa and a minimum burst gauge pressure of 2 755 kPa. Each vessel shall be leak checked during manufacture and before dispatch and shall be found leakproof. The complete inner unit shall be securely packed in non-combustible cushioning material, such as vermiculite, in a strong outer tightly closed metal packaging which will adequately protect all fittings. Maximum quantity of fuel per unit and package is 42 litres; (2) Aluminium pressure vessel. Primary containment of the fuel within this vessel shall consist of a welded vapour tight fuel compartment with an elastomeric bladder having a maximum internal volume of 46 litres. The pressure vessel shall have a minimum design gauge pressure of 2 860 kPa and a minimum burst gauge pressure of 5 170 kPa. Each vessel shall be leak-checked during manufacture and before dispatch and shall be securely packed in non-combustible cushioning material such as vermiculite, in a strong outer tightly closed metal packaging which will adequately protect all fittings. Maximum quantity of fuel per unit and package is 42 litres.		

P302	PACKING INSTRUCTION	P302

This instruction applies to UN No. 3269.

The following packagings are authorized, provided the general provisions of **4.1.1** and **4.1.3** are met:

Combination packagings which meet the packing group II or III performance level according to the criteria for Class 3, applied to the base material.
The base material and the activator (organic peroxide) shall be each separately packed in inner packagings.
The components may be placed in the same outer packaging provided they will not interact dangerously in the event of a leakage.
The activator shall have a maximum quantity of 125 ml per inner packaging if liquid, and 500 g per inner packaging if solid.

P400	PACKING INSTRUCTION	P400

The following packagings are authorized, provided that the general provisions of **4.1.1** and **4.1.3** are met (see also the Table in 4.1.4.4):

(1) Steel gas cylinders and gas receptacles, which shall comply with the appropriate requirements in the Table of 4.1.4.4. Valves shall be protected with steel valve protection caps or collars or the gas cylinders or receptacles shall be overpacked in strong wood, fibreboard or plastics boxes. Cylinders and gas receptacles shall be secured to prevent movement in the box and shall be packaged and carried so that the pressure relief devices remain in the vapour space of the cylinder during normal conditions of handling and carriage;

(2) Boxes (4A, 4B, 4C1, 4C2, 4D, 4F or 4G), drums (1A2, 1B2, 1N2, 1D or 1G) or jerricans (3A2 or 3B2) enclosing hermetically sealed metal cans with inner packagings of glass or metal, with a capacity of not more than 1 litre each, having threaded closures with gaskets. Inner packagings shall be cushioned on all sides with dry, absorbent, non-combustible material in a quantity sufficient to absorb the entire contents. Inner packagings shall not be filled to more than 90% of their capacity. Outer packagings shall have a maximum net mass of 125 kg;

(3) Steel, aluminium or metal drums (1A2, 1B2 or 1N2), jerricans (3A2 or 3B2) or boxes (4A or 4B) with a maximum net mass of 150 kg each with hermetically sealed inner metal cans not more than 4 litre capacity each, with threaded closures fitted with gaskets. Inner packagings shall be cushioned on all sides with dry, absorbent, non-combustible material in a quantity sufficient to absorb the entire contents. Each layer of inner packagings shall be separated by a dividing partition in addition to cushioning material. Inner packagings shall not be filled to more than 90% of their capacity.

P401	PACKING INSTRUCTION		P401
The following packagings are authorized, provided that the general provisions of **4.1.1** and **4.1.3** are met (see also the Table in 4.1.4.4):			
(1)	Steel gas cylinders and gas receptacles, which shall comply with the appropriate requirements in the Table of 4.1.4.4. Valves shall be protected with steel valve protection caps or collars or the gas cylinders or receptacles shall be overpacked in strong wood, fibreboard or plastic boxes. Cylinders and gas receptacles shall be secured to prevent movement in the box and shall be packaged and carried so that the pressure relief devices remain in the cylinder during normal conditions of handling and carriage;		
		Inner packaging	**Outer packaging**
(2)	Combination packages with inner packagings of glass metal or plastics which have threaded closures surrounded in inert cushioning and absorbent material in a quantity sufficient to absorb the entire contents.	1 *l*	30 kg maximum net mass

P402	PACKING INSTRUCTION		P402
The following packagings are authorized, provided that the general provisions of **4.1.1** and **4.1.3** are met (see also the Table in 4.1.4.4):			
(1)	Steel gas cylinders and gas receptacles, which shall comply with the appropriate requirements in the Table of 4.1.4.4. Valves shall be protected with steel valve protection caps or collars or the gas cylinders or receptacles shall be overpacked in strong wood, fibreboard or plastic boxes. Cylinders and gas receptacles shall be secured to prevent movement in the box and shall be packaged and transported so that the pressure relief devices remain in the vapour space of the cylinder during normal conditions of handling and carriage. Filling shall not be greater than 90% of the capacity of the cylinder.		
		Inner packaging	**Outer packaging**
(2)	Combination packages with inner packagings of glass, metal or plastics which have threaded closures surrounded in inert cushioning and absorbent material in a quantity sufficient to absorb the entire contents.	10 kg (glass) 15 kg (metal or plastic)	125 kg 125 kg
Special packing provision			
PP78	For UN No. 3130, the opening of receptacles shall be tightly closed by means of two devices in series, one of which shall be screwed or secured in an equivalent manner.		

P403	PACKING INSTRUCTION	P403
The following packagings are authorized, provided that the general provisions of **4.1.1** and **4.1.3** are met:		
Combination packagings:		
Inner packagings	**Outer packagings**	**Maximum net mass**
Glass 2 kg Plastics 15 kg Metal 20 kg Inner packagings shall have threaded closures	**Drums** steel (1A2) aluminium (1B2) metal, other than steel or aluminium (1N2) plastics (1H2) plywood (1D) fibre (1G) **Boxes** steel (4A) aluminium (4B) natural wood (4C1) natural wood with sift proof walls (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) expanded plastics (4H1) solid plastics (4H2) **Jerricans** steel (3A2) aluminium (3B2) plastics (3H2)	 400 kg 400 kg 400 kg 400 kg 400 kg 400 kg 400 kg 400 kg 250 kg 250 kg 250 kg 125 kg 125 kg 60 kg 250 kg 120 kg 120 kg 120 kg
Single packagings:		**Maximum net mass**
Drums steel(1A1, 1A2) aluminium (1B1, 1B2) metal other than steel or aluminium (1N1, 1N2) plastics (1H1, 1H2) **Jerricans** steel (3A1, 3A2) aluminium (3B1, 3B2) plastics (3H1, 3H2) **Composite packagings** plastics receptacle with outer steel or aluminium drums (6HA1 or 6HB1) plastics receptacle with outer fibre, plastics or plywood drums (6HG1, 6HH1 or 6HD1) plastics receptacle with outer steel or aluminium crate or box or with outer wooden, plywood, fibreboard or solid plastics boxes (6HA2, 6HB2, 6HC, 6HD2, 6HG2 or 6HH2)		 250 kg 250 kg 250 kg 250 kg 120 kg 120 kg 120 kg 250 kg 75 kg 75 kg
Additional requirement: Packagings shall be hermetically sealed.		

P404	PACKING INSTRUCTION	P404

This instruction applies to pyrophoric solids: UN Nos: 1370, 1383, 1854, 1855, 2005, 2008, 2545, 2546, 2846, 2881, 3052, 3200 and 3203.

The following packagings are authorized, provided that the general provisions of **4.1.1** and **4.1.3** are met:

(1) Combination packagings

Outer packagings:	(1A2, 1B2, 1N2, 1H2, 1D, 4A, 4B, 4C1, 4C2, 4D, 4F or 4H2)
Inner packagings:	Metal packagings with a capacity of not more than 15kg each. Inner packagings shall be hermetically sealed and have threaded closures;

(2) Metal packagings: (1A1, 1A2, 1B1, 1N1, 1N2, 3A1, 3A2, 3B1 and 3B2)
Maximum gross mass: 150 kg;

(3) Composite packagings: Plastics receptacle with outer steel or aluminium drum (6HA1 or 6HB1)
Maximum gross mass: 150 kg.

P405	PACKING INSTRUCTION	P405

This instruction applies to UN No. 1381.

The following packagings are authorized, provided that the general provisions of **4.1.1** and **4.1.3** are met:

(1) For UN No. 1381, phosphorus, wet:

(a) Combination packagings

Outer packagings: (4A, 4B, 4C1, 4C2, 4D or 4F)
Maximum net mass: 75 kg

Inner packagings:

(i) hermetically sealed metal cans, with a maximum net mass of 15kg; or

(ii) glass inner packagings cushioned on all sides with dry, absorbent, non-combustible material in a quantity sufficient to absorb the entire contents with a maximum net mass of 2 kg; or

(b) Drums (1A1, 1A2, 1B1, 1B2, 1N1 or 1N2); maximum net mass: 400 kg
Jerricans (3A1 or 3B1); maximum net mass: 120 kg.

These packagings shall be capable of passing the leakproofness test specified in 6.1.5.4 at the packing group II performance level;

(2) For UN No. 1381, dry phosphorus:

(a) When fused, drums (1A2, 1B2 or 1N2) with a maximum net mass of 400 kg; or

(b) In projectiles or hard cased articles when carried without Class 1 components: as specified by the competent authority.

P406	PACKING INSTRUCTION	P406

The following packagings are authorized, provided that the general provisions of **4.1.1** and **4.1.3** are met:

(1) Combination packagings

outer packagings: (4C1, 4C2, 4D, 4F, 4G, 4H1, 4H2, 1G, 1D, 1H2 or 3H2)

inner packagings: water-resistant packagings;

(2) Plastics, plywood or fibreboard drums (1H2, 1D or 1G) or boxes (4A, 4B, 4C1, 4D, 4F, 4C2, 4G and 4H2) with a water resistant inner bag, plastics film lining or water resistant coating;

(3) Metal drums (1A1, 1A2, 1B1, 1B2, 1N1 or 1N2), plastics drums (1H1 or 1H2), metal jerricans (3A1, 3A2, 3B1 or 3B2), plastics jerricans (3H1 or 3H2), plastics receptacle with outer steel or aluminium drums (6HA1 or 6HB1), plastics receptacle with outer fibre, plastics or plywood drums (6HG1, 6HH1 or 6HD1), plastics receptacle with outer steel or aluminium crate or box or with outer wooden, plywood, fibreboard or solid plastics boxes (6HA2, 6HB2, 6HC, 6HD2, 6HG2 or 6HH2).

Additional requirements:

1. Packagings shall be designed and constructed to prevent the loss of water or alcohol content or the content of the phlegmatizer.

2. Packagings shall be so constructed and closed so as to avoid an explosive overpressure or pressure build-up of more than 300 kPa (3 bar).

3. The type of packaging and maximum permitted quantity per package are limited when this packing instruction is applied in accordance with special provisions 15 or 18 of Chapter 3.3.

Special packing provisions:

PP24 For UN No. 2852, the quantity carried shall not exceed 500 g per package.

PP25 For UN No. 1347, the quantity carried shall not exceed 15 kg per package.

PP26 For UN Nos. 1310, 1320, 1321, 1322, 1344, 1347, 1348, 1349, 1517, 2907, 3317 and 3344 packagings shall be lead free.

P407	PACKING INSTRUCTION	P407

This instruction applies to UN Nos. 1331, 1944, 1945 and 2254.

The following packagings are authorized, provided that the general provisions of **4.1.1** and **4.1.3** are met:

Combination packagings comprising securely closed inner packagings to prevent accidental ignition under normal conditions of transport. The maximum net mass of the outer packagings shall not exceed 45 kg except for fibreboard boxes which shall not exceed 30 kg.

Additional requirement:

Matches shall be tightly packed.

Special packing provision:

PP27 UN No. 1331, Strike-anywhere matches shall not be packed in the same outer packaging with any other dangerous goods other than safety matches or wax Vesta matches, which shall be packed in separate inner packagings. Inner packagings shall not contain more than 700 strike-anywhere matches.

P408	PACKING INSTRUCTION	P408
This instruction applies to UN No. 3292.		
The following packagings are authorized, provided that the general provisions of **4.1.1** and **4.1.3** are met: (1) For cells: Outer packagings with sufficient cushioning material to prevent contact between cells and between cells and the internal surfaces of the outer packaging and to ensure that no dangerous movement of the cells within the outer packaging occurs during carriage. Packagings shall conform to the packing group II performance level; (2) For batteries: Batteries may be carried unpacked or in protective enclosures (e.g. in fully enclosed or wooden slatted crates). The terminals shall not support the weight of other batteries or materials packed with the batteries.		
Additional requirement: Batteries shall be protected against short circuit and shall be isolated in such a manner as to prevent short circuits.		

P409	PACKING INSTRUCTION	P409
This instruction applies to UN Nos. 2956, 3242 and 3251.		
The following packagings are authorized, provided that the general provisions of **4.1.1** and **4.1.3** are met: (1) Fibre drum (1G) which may be fitted with a liner or coating; maximum net mass: 50 kg; (2) Combination packagings: Fibreboard box (4G) with a single inner plastic bag; maximum net mass: 50 kg; (3) Combination packagings: Fibreboard box (4G) or fibre drum (1G) with plastics inner packagings each containing a maximum of 5 kg; maximum net mass: 25 kg.		

P410	PACKING INSTRUCTION		P410
The following packagings are authorized, provided that the general provisions of **4.1.1** and **4.1.3** are met:			
Combination packagings:			
Inner packagings	**Outer packagings**	**Maximum net mass**	
		Packing group II	**Packing group III**
Glass 10 kg Plastics [a] 30 kg Metal 40 kg Paper [a, b] 10 kg Fibre [a, b] 10 kg [a] *These packagings shall be sift-proof.* [b] *These inner packagings shall not be used when the substances being carried may become liquid during carriage.*	**Drums** steel (1A2) aluminium (1B2) metal other than steel or aluminium (1N2) plastics (1H2) plywood (1D) fibre (1G) [a] **Boxes** steel (4A) aluminium (4B) natural wood (4C1) natural wood with sift-proof walls (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) [a] expanded plastics (4H1) solid plastics (4H2) **Jerricans** steel (3A2) aluminium (3B2) plastics (3H2)	 400 kg 400 kg 400 kg 400 kg 400 kg 400 kg 400 kg 400 kg 400 kg 400 kg 400 kg 400 kg 400 kg 60 kg 400 kg 120 kg 120 kg 120 kg	 400 kg 400 kg 400 kg 400 kg 400 kg 400 kg 400 kg 400 kg 400 kg 400 kg 400 kg 400 kg 400 kg 60 kg 400 kg 120 kg 120 kg 120 kg
Single packagings:			
Drums steel (1A1 or 1A2) aluminium (1B1 or 1B2) metal other than steel or aluminium (1N1 or 1N2) plastics (1H1 or 1H2) **Jerricans** steel (3A1 or 3A2) aluminium (3B1 or 3B2) plastics (3H1 or 3H2)		 400 kg 400 kg 400 kg 400 kg 120 kg 120 kg 120 kg	 400 kg 400 kg 400 kg 400 kg 120 kg 120 kg 120 kg

P410	PACKING INSTRUCTION (cont'd)	P410
Single packagings (cont'd):	**Packing group II**	**Packing group III**
Boxes		
steel (4A) [c]	400 kg	400 kg
aluminium (4B) [c]	400 kg	400 kg
natural wood (4C1) [c]	400 kg	400 kg
plywood (4D) [c]	400 kg	400 kg
reconstituted wood (4F) [c]	400 kg	400 kg
natural wood with sift-proof walls (4C2) [c]	400 kg	400 kg
fibreboard (4G) [c]	400 kg	400 kg
solid plastics (4H2) [c]	400 kg	400 kg
Bags		
Bags (5H3, 5H4, 5L3, 5M2) [c, d]	50 kg	50 kg
Composite packagings		
plastics receptacle with outer steel, aluminium, plywood, fibre or plastics drum (6HA1, 6HB1, 6HG1, 6HD1, or 6HH1)	400 kg	400 kg
plastics receptacle with outer steel or aluminium crate or box, or outer wooden, plywood, fibreboard or solid plastics box (6HA2, 6HB2, 6HC, 6HD2, 6HG2 or 6HH2)	75 kg	75 kg
glass receptacle with outer steel, aluminium, plywood or fibre drum (6PA1, 6PB1, 6PD1 or 6PG1) or outer steel or aluminium crate or box or with outer wooden or fibreboard box or with outer wickerwork hamper (6PA2, 6PB2, 6PC, 6PD2, or 6PG2) or with outer solid or expanded plastics packaging (6PH1 or 6PH2)	75 kg	75 kg

[c] *These packagings shall not be used when the substances being carried may become liquid during carriage.*

[d] *These packagings shall only be used for packing group II substances when carried in a closed vehicle or container.*

Special packing provisions:

PP39 For UN No. 1378, for metal packagings a venting device is required.

PP40 For UN Nos. 1326, 1352, 1358, 1395, 1396, 1404, 1436, 1437, 1485, 1495, 1871, 2805, 3182 and 3247, packing group II, bags are not allowed.

P411	PACKING INSTRUCTION	P411
This instruction applies to UN No. 3270.		
The following packagings are authorized, provided that the general provisions of **4.1.1** and **4.1.3** are met: (1) Fibreboard box with a maximum gross mass of 30 kg; (2) Other packagings, provided that explosion is not possible by reason of increased internal pressure. Maximum net mass shall not exceed 30 kg.		

P500	PACKING INSTRUCTION	P500
This instruction applies to UN No. 3356.		
The general provisions of **4.1.1** and **4.1.3** shall be met. Packagings shall conform to the packing group II performance level. The generator(s) shall be carried in a package which meets the following requirements when one generator in the package is actuated: (a) Other generators in the package will not be actuated; (b) Packaging material will not ignite; and (c) The outside surface temperature of the completed package shall not exceed 100 °C.		

P501	PACKING INSTRUCTION	P501

This instruction applies to UN No. 2015.

The following packagings are authorized, provided that the general provisions of **4.1.1** and **4.1.3** are met:

Combination packagings:	**Inner packaging maximum capacity**	**Outer packaging maximum net mass**
(1) Boxes (4A, 4B, 4C1, 4C2, 4D, 4H2) or drums (1A2, 1B2, 1N2, 1H2, 1D) or jerricans (3A2, 3B2, 3H2) with glass, plastics or metal inner packagings	5 *l*	125 kg
(2) Fibreboard box (4G) or fibre drum (1G), with plastics or metal inner packagings each in a plastics bag	2 *l*	50 kg

Single packagings:	**Maximum capacity**
Drums	
steel (1A1) aluminium (1B1) metal other than steel or aluminium (1N1) plastics (1H1)	250 *l*
Jerricans steel (3A1) aluminium (3B1) plastics (3H1)	60 *l*
Composite packagings	
plastics receptacle with outer steel or aluminium drum (6HA1, 6HB1)	250 *l*
plastics receptacle with outer fibre, plastics or plywood drum (6HG1, 6HH1, 6HD1)	250 *l*
plastics receptacle with outer steel or aluminium crate or box or plastics receptacle with outer wooden, plywood, fibreboard or solid plastics box (6HA2, 6HB2, 6HC, 6HD2, 6HG2 or 6HH2)	60 *l*
glass receptacle with outer steel, aluminium, fibre, plywood, solid plastics or expanded plastics drum (6PA1, 6PB1, 6PG1, 6PD1, 6PH1 or 6PH2) or with outer steel or aluminium crate or box or with outer wooden or fibreboard box or with outer wickerwork hamper (6PA2, 6PB2, 6PC, 6PG2 or 6PD2)	60 *l*

Additional requirements:

1. Packagings shall have a maximum filling degree of 90%.

2. Packagings shall be vented.

P502	PACKING INSTRUCTION	P502
The following packagings are authorized, provided that the general provisions of **4.1.1** and **4.1.3** are met:		
Combination packagings:		
Inner packagings	**Outer packagings**	**Maximum net mass**
Glass 5 *l* Metal 5 *l* Plastics 5 *l*	**Drums**	
	steel (1A2)	125 kg
	aluminium (1B2)	125 kg
	metal other than steel or aluminium (1N2)	125 kg
	plastics (1H2)	125 kg
	plywood (1D)	125 kg
	fibre (1G)	125 kg
	Boxes	
	steel (4A)	125 kg
	aluminium (4B)	125 kg
	natural wood (4C1)	125 kg
	natural wood with sift-proof walls (4C2)	125 kg
	plywood (4D)	125 kg
	reconstituted wood (4F)	125 kg
	fibreboard (4G)	125 kg
	expanded plastics (4H1)	60 kg
	solid plastics (4H2)	125 kg
Single packagings:		**Maximum capacity**
Drums steel (1A1) aluminium (1B1) plastics (1H1)		250 *l*
Jerricans steel (3A1) aluminium (3B1) plastics (3H1)		60 *l*
Composite packagings		
plastics receptacle with outer steel or aluminium drum (6HA1, 6HB1)		250 *l*
plastics receptacle with outer fibre, plastics or plywood drum (6HG1, 6HH1, 6HD1)		250 *l*
plastics receptacle with outer steel or aluminium crate or box or plastics receptacle with outer wooden, plywood, fibreboard or solid plastics box (6HA2, 6HB2, 6HC, 6HD2, 6HG2 or 6HH2)		60 *l*
glass receptacle with outer steel, aluminium, fibre, plywood, solid plastics or expanded plastics drum (6PA1, 6PB1, 6PG1, 6PD1, 6PH1 or 6PH2) or with outer steel or aluminium crate or box or with outer wooden or fibreboard box or with outer wickerwork hamper (6PA2, 6PB2, 6PC, 6PG2 or 6PD2)		60 *l*
Special packing provision: PP28 For UN No. 1873, only glass inner packagings and glass inner receptacles are authorized respectively for combination packagings and composite packagings.		

P503	PACKING INSTRUCTION	P503
The following packagings are authorized, provided that the general provisions of **4.1.1** and **4.1.3** are met:		
Combination packagings:		
Inner packagings	**Outer packagings**	**Maximum net mass**
Glass 5 kg. Metal 5 kg Plastics 5 kg	**Drums** steel (1A2) aluminium (1B2) metal other than steel or aluminium (1N2) plastics (1H2) plywood (1D) fibre (1G) **Boxes** steel (4A) aluminium (4B) natural wood (4C1) natural wood with sift-proof walls (4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) expanded plastics (4H1) solid plastics (4H2)	 125kg 125kg 125kg 125kg 125kg 125kg 125 kg 125 kg 125 kg 125 kg 125 kg 125 kg 40 kg 60 kg 125 kg
Single packagings:		
Metal drums (1A1, 1A2, 1B1, 1B2, 1N1 or 1N2) with a maximum net mass of 250 kg. Fibreboard (1G) or plywood drums (1D) fitted with inner liners with a maximum net mass of 200 kg.		

P504	PACKING INSTRUCTION	P504
The following packagings are authorized, provided that the general provisions of **4.1.1** and **4.1.3** are met:		
Combination packagings:		**Maximum net mass**
(1)	Glass receptacles with a maximum capacity of 5 litres in 1A2, 1B2, 1N2, 1H2, 1D, 1G, 4A, 4B, 4C1, 4C2, 4D, 4F, 4G, 4H2 outer packagings	75 kg
(2)	Plastics receptacles with a maximum capacity of 30 litres in 1A2, 1B2, 1N2, 1H2, 1D, 1G, 4A, 4B, 4C1, 4C2, 4D, 4F, 4G, 4H2 outer packagings	75 kg
(3)	Metal receptacles with a maximum capacity of 40 litres in 1G, 4F or 4G outer packagings	125 kg
(4)	Metal receptacles with a maximum capacity of 40 litres in 1A2, 1B2, 1N2, 1H2, 1D, 4A, 4B, 4C1, 4C2, 4D, 4H2 outer packagings	225 kg
Single packagings:		**Maximum capacity**
Drums		
steel, non-removable head (1A1)		250 *l*
steel, removable head (1A2)		250 *l*
aluminium, non-removable head (1B1)		250 *l*
aluminium, removable head (1B2)		250 *l*
metal other than steel or aluminium, non-removable head (1N1)		250 *l*
metal other than steel or aluminium, removable head (1N2)		250 *l*
plastics, non-removable head (1H1)		250 *l*
plastics, removable head (3H2)		250 *l*
Jerricans		
steel, non-removable head (3A1)		60 *l*
steel, removable head (3A2)		60 *l*
aluminium, non-removable head (3B1)		60 *l*
aluminium, removable head (3B2)		60 *l*
plastics, non-removable head (3H1)		60 *l*
plastics, removable head (3H2)		60 *l*
Composite packagings:		
plastics receptacle with outer steel or aluminium drum (6HA1, 6HB1)		250 *l*
plastics receptacle with outer fibre, plastics or plywood drum (6HG1, 6HH1, 6HD1)		120 *l*
plastics receptacle with outer steel or aluminium crate or box or plastics receptacle with outer wooden, plywood, fibreboard or solid plastics box (6HA2, 6HB2, 6HC, 6HD2, 6HG2 or 6HH2)		60 *l*
glass receptacle with outer steel, aluminium, fibre, plywood, solid plastics or expanded plastics drum (6PA1, 6PB1, 6PG1, 6PD1, 6PH1 or 6PH2) or with outer steel or aluminium crate or box or with outer wooden fibreboard box or with outer wickerwork hamper (6PA2, 6PB2, 6PC, 6PG2 or 6PD2)		60 *l*

Special packing provisions:

PP10 For UN No. 2014 PG II and UN No. 2984 PG III, the packaging shall be vented.

PP29 For UN No. 2014, maximum degree of filling shall be 90%.

P520 **PACKING INSTRUCTION** **P520**

This instruction applies to organic peroxides of Class 5.2 and self-reactive substances of Class 4.1

The packagings listed below are authorized provided the general provisions of **4.1.1** and **4.1.3** and special provisions of **4.1.7** are met.

The packing methods are designated OP1 to OP8. The packing methods appropriate for the individual currently assigned organic peroxides and self-reactive substances are listed in 4.1.7.1.3, 2.2.41.4 and 2.2.52.4. The quantities specified for each packing method are the maximum quantities authorized per package. The following packagings are authorized:

(1) Combination packagings with outer packagings comprising boxes (4A, 4B, 4C1, 4C2, 4D, 4F, 4G, 4H1 and 4H2), drums (1A2, 1B2, 1G, 1H2 and 1D), jerricans (3A2, 3B2 and 3H2);

(2) Single packagings consisting of drums (1A1, 1A2, 1B1, 1B2, 1G, 1H1, 1H2 and 1D) and jerricans (3A1, 3A2, 3B1, 3B2, 3H1 and 3H2);

(3) Composite packagings with plastics inner receptacles (6HA1, 6HA2, 6HB1, 6HB2, 6HC, 6HD1, 6HD2, 6HG1, 6HG2, 6HH1 and 6HH2).

Maximum quantity per packaging/package [a] for packing methods OP1 to OP8

Packing Method / **Maximum Quantity**	OP1	OP2 [a]	OP3	OP4 [a]	OP5	OP6	OP7	OP8
Maximum mass (kg) for solids and for combination packagings (liquid and solid)	0.5	0.5/10	5	5/25	25	50	50	200 [b]
Maximum contents in litres for liquids [c]	0.5	-	5	-	30	60	60	225 [d]

[a] *If two values are given, the first applies to the maximum net mass per inner packaging and the second to the maximum net mass of the complete package.*

[b] *60 kg for jerricans / 100 kg for boxes.*

[c] *Viscous substances shall be treated as solids when they do not meet the criteria provided in the definition for "liquids" presented in 1.2.1.*

[d] *60 litres for jerricans.*

Additional requirements:

1. Metal packagings, including inner packagings of combination packagings and outer packagings of combination or composite packagings may only be used for packing methods OP7 and OP8.

2. In combination packagings, glass receptacles may only be used as inner packagings with maximum contents of 0.5 kg for solids or 0.5 litre for liquids.

3. In combination packagings, cushioning materials shall not be readily combustible.

4. The packaging of an organic peroxide or self-reactive substance required to bear an "EXPLOSIVE" subsidiary risk label shall also comply with the provisions given in 4.1.5.10 and 4.1.5.11.

Special packing provisions:

PP21 For certain self-reactive substances of types B or C, UN Nos. 3221, 3222, 3223, 3224, 3231, 3232, 3233 and 3234, a smaller packaging than that allowed by packing methods OP5 or OP6 respectively shall be used (see 4.1.6 and 2.2.41.4).

PP22 UN No. 3241, 2-Bromo-2-nitropropane-1, 3-diol, shall be packed in accordance with packing method OP6.

P600	PACKING INSTRUCTION	P600
This instruction applies to UN Nos. 1700, 2016 and 2017.		
The following packagings are authorized, provided the general provisions of **4.1.1** and **4.1.3** are met: Outer packagings (1A2, 1B2, 1N2, 1H2, 1D, 1G, 4A, 4B, 4C1, 4C2, 4D, 4F, 4G, 4H2) meeting the packing group II performance level. The articles shall be individually packaged and separated from each other using partitions, dividers, inner packagings or cushioning material to prevent inadvertent discharge during normal conditions of carriage. Maximum net mass: 75 kg		

P601	PACKING INSTRUCTION	P601

The following packagings are authorized provided the general provisions of **4.1.1** and **4.1.3** are met (see also the Table of 4.1.4.4):

(1) Combination packagings consisting of glass inner packagings not exceeding 1 litre in capacity packed with absorbent material sufficient to absorb the entire contents and inert cushioning material placed in metal receptacles which are individually packed in 1A2, 1B2, 1N2, 1H2, 1D, 1G, 4A, 4B, 4C1, 4C2, 4D, 4F, 4G or 4H2 outer packagings with a maximum gross mass of 15 kg. Inner packagings shall not be filled to more than 90% of their capacity. The closure of each inner packaging shall be physically held in place by any means capable of preventing back-off or loosening of the closure by impact or vibration during carriage;

(2) Combination packagings consisting of metal inner packagings or additionally, for UN No. 1744 only, in polyvinylidene fluoride (PVDF) inner packagings, not exceeding 5 litres in capacity individually packed with absorbent material sufficient to absorb the contents and inert cushioning material in 1A2, 1B2, 1N2, 1H2, 1D, 1G, 4A, 4B, 4C1, 4C2, 4D, 4F, 4G or 4H2 outer packagings with a maximum gross mass of 75 kg. Inner packagings shall not be filled to more than 90% of their capacity. The closure of each inner packaging shall be physically held in place by any means capable of preventing back-off or loosening of the closure by impact or vibration during carriage;

(3) Combination packagings:

Outer packagings: Plastic or steel drums, removable head (1A2 or 1H2) tested in accordance with the test requirements in 6.1.5 as combination packagings as assembled for carriage;

Inner packagings:

Drums and composite packagings (1A1, 1B1, 1N1, 1H1 or 6HA1) meeting the requirements of Chapter 6.1 for single packagings, subject to the following conditions:

(a) The hydraulic pressure test shall be conducted at a pressure of at least 0.3 MPa (gauge pressure);

(b) The design and production leakproofness tests shall be conducted at a test pressure of 30 kPa;

(c) They shall be isolated from the outer drum by the use of inert shock-mitigating cushioning material which surrounds the inner packaging on all sides;

(d) Their capacity shall not exceed 125 litres; and

(e) Closures shall be of a screw cap type that are:

(i) physically held in place by any means capable of preventing back-off or loosening of the closure by impact or vibration during carriage; and

(ii) provided with a cap seal;

(f) The inner packaging shall be tested periodically at least every 5 years according to (a) and (b);

(g) The complete packaging shall be visually inspected to the satisfaction of the competent authority at least every 3 years;

(h) The outer and inner packaging shall bear in clearly legible and durable characters:

(i) the date (month, year) of the initial test and the latest periodic test and inspection;

(ii) The stamp of the expert who carried out the test and inspection;

(4) Gas cylinders and gas receptacles, which shall comply with the appropriate requirements of the Table of 4.1.4.4.

P602	PACKING INSTRUCTION	P602

The following packagings are authorised provided the general provisions of **4.1.1** and **4.1.3** are met:

(1) Combination packagings consisting of glass inner packagings packed with absorbent material sufficient to absorb the entire contents and inert cushioning material placed in metal receptacles which are individually packed in 1A2, 1B2, 1N2, 1H2, 1D, 1G, 4A, 4B, 4C1, 4C2, 4D, 4F, 4G or 4H2 outer packagings with a maximum gross mass of 50 kg. Inner packagings shall not be filled to more than 90% of their capacity. The closure of each inner packaging shall be physically held in place by any means capable of preventing back-off or loosening of the closure by impact or vibration during carriage. Inner packagings shall not exceed 1 litre in capacity;

(2) Combination packagings consisting of metal inner packagings individually packed with absorbent material sufficient to absorb the entire contents and inert cushioning material in 1A2, 1B2, 1N2, 1H2, 1D, 1G, 4A, 4B, 4C1, 4C2, 4D, 4F, 4G or 4H2 outer packagings with a maximum gross mass of 75 kg. Inner packagings shall not be filled to more than 90% of their capacity. The closure of each inner packaging shall be physically held in place by any means capable of preventing back-off or loosening of the closure by impact or vibration during carriage. Inner packagings shall not exceed 5 litres in capacity;

(3) Drums and composite packagings (1A1, 1B1, 1N1, 1H1 or 6HA1), subject to the following conditions:

  (a) The hydraulic pressure test shall be conducted at a pressure of at least 0.3 MPa (gauge pressure);

  (b) The design and production leakproofness tests shall be conducted at a test pressure of 30 kPa; and

  (c) Closures shall be of a screw cap type that are:

    (i) physically held in place by any means capable of preventing back-off or loosening of the closure by impact or vibration during carriage; and
    (ii) provided with a cap seal;

(4) Gas cylinders and gas receptacles with a minimum test pressure of 1 MPa (gauge pressure) conforming to the provisions of P200. No cylinder may be equipped with any pressure relief device. Gas cylinders and gas receptacles shall have their valves protected.

P620	PACKING INSTRUCTION	P620

This instruction applies to UN Nos. 2814 and 2900.

The following packagings are authorized provided the special packing provisions of **4.1.8** are met:

Packagings meeting the requirements of Chapter 6.3 and approved accordingly consisting of:

(a) Inner packagings comprising:

(i) leakproof primary receptacle(s);

(ii) a leakproof secondary packaging;

(iii) other than for solid infectious substances, an absorbent material in sufficient quantity to absorb the entire contents placed between the primary receptacle(s) and the secondary packaging; if multiple primary receptacles are placed in a single secondary packaging, they shall be individually wrapped so as to prevent contact between them;

(b) An outer packaging of adequate strength for its capacity, mass and intended use. The smallest external dimension shall be at least 100 mm.

Additional requirements:

1. Inner packagings containing infectious substances shall not be consolidated with inner packagings containing unrelated types of goods. Complete packages may be overpacked in accordance with the provisions of 1.2.1 and 5.1.2; such an overpack may contain dry ice.

2. Other than for exceptional consignments, e.g. whole organs which require special packaging, the following additional requirements shall apply:

(a) Lyophilized substances:

Primary receptacles shall be flame-sealed glass ampoules or rubber-stoppered glass vials fitted with metal seals;

(b) Liquid or solid substances:

(i) Substances consigned at ambient temperatures or at a higher temperature. Primary receptacles shall be of glass, metal or plastics. Positive means of ensuring a leakproof seal shall be provided, e.g. a heat seal, a skirted stopper or a metal crimp seal. If screw caps are used, they shall be reinforced with adhesive tape;

(ii) Substances consigned refrigerated or frozen. Ice, dry ice or other refrigerant shall be placed around the secondary packaging(s) or alternatively in an overpack with one or more complete packages marked in accordance with 6.3.1.1. Interior supports shall be provided to secure secondary packaging(s) or packages in position after the ice or dry ice has dissipated. If ice is used, the outer packaging or overpack shall be leakproof. If dry ice is used, the outer packaging or overpack shall permit the release of carbon dioxide gas. The primary receptacle and the secondary packaging shall maintain their integrity at the temperature of the refrigerant used;

(iii) Substances consigned in liquid nitrogen. Plastics primary receptacles capable of withstanding very low temperature shall be used. The secondary packaging shall also be capable of withstanding very low temperatures, and in most cases will need to be fitted over the primary receptacle individually. Provisions for the consignment of liquid nitrogen shall also be fulfilled in accordance with the requirements of P200. The primary receptacle and the secondary packaging shall maintain their integrity at the temperature of the liquid nitrogen.

3. Whatever the intended temperature of the consignment, the primary receptacle or the secondary packaging shall be capable of withstanding without leakage an internal pressure producing a pressure differential of not less than 95 kPa and temperatures in the range -40 °C to +55 °C.

P621	PACKING INSTRUCTION	P621
This instruction applies to UN No. 3291.		
The following packagings are authorized provided the general provisions of **4.1.1** and **4.1.3** are met: (1) Rigid, leakproof packagings meeting the requirements of Chapter 6.1 for solids, at the packing group II performance level, provided there is sufficient absorbent material to absorb the entire amount of liquid present and the packaging is capable of retaining liquids; (2) For packages containing larger quantities of liquid, rigid packagings meeting the requirements of Chapter 6.1 at the packing group II performance level for liquids.		
Additional requirement: Packagings intended to contain sharp objects such as broken glass and needles shall be resistant to puncture and retain liquids under the performance test conditions in Chapter 6.1.		

P650	PACKING INSTRUCTION	P650
This instruction applies to diagnostic specimens		
Diagnostic specimens may be carried in either: (1) Packagings that meet the following conditions: (a) The primary receptacles do not contain more than 100 ml; (b) The outer packaging does not contain more than 500 ml; (c) The primary receptacles are leakproof; and (d) The packagings are in accordance with P620. However, it need not be subjected to the tests; or (2) Packagings that comply with standard EN 829:1996.		

P800	PACKING INSTRUCTION	P800

This instruction applies to UN Nos. 2809 and 2803.

The following packagings are authorized, provided the general provisions of **4.1.1** and **4.1.3** are met:

(1) Cylinders in accordance with P200; or

(2) Steel flasks or bottles with threaded closures with a capacity not exceeding 2.5 l; or

(3) Combination packagings which conform to the following requirements:

(a) Inner packagings shall comprise glass, metal or rigid plastics intended to contain liquids with a maximum net mass of 15 kg each;

(b) The inner packagings shall be packed with sufficient cushioning material to prevent breakage;

(c) Either the inner packagings or the outer packagings shall have inner liners or bags of strong leakproof and puncture-resistant material impervious to the contents and completely surrounding the contents to prevent it from escaping from the package irrespective of its position or orientation;

(d) The following outer packagings and maximum net masses are authorized:

Outer packaging:	**Maximum net mass**
Drums	
steel (1A2)	400 kg
metal other than steel or aluminium (1N2)	400 kg
plastics (1H2)	400 kg
plywood (1D)	400 kg
fibre (1G)	400 kg
Boxes	
steel (4A)	400 kg
natural wood (4C1)	250 kg
natural wood with sift-proof walls (4C2)	250 kg
plywood (4D)	250 kg
reconstituted wood (4F)	125 kg
fibreboard (4G)	125 kg
expanded plastics (4H1)	60 kg
solid plastics (4H2)	125 kg

Special packing provision:

PP41 For UN No. 2803, when it is necessary to carry gallium at low temperatures in order to maintain it in a completely solid state, the above packagings may be overpack ed in a strong, water-resistant outer packaging which contains dry ice or other means of refrigeration. If a refrigerant is used, all of the above materials used in the packaging of gallium shall be chemically and physically resistant to the refrigerant and shall have impact resistance at the low temperatures of the refrigerant employed. If dry ice is used, the outer packaging shall permit the release of carbon dioxide gas.

P801	PACKING INSTRUCTION	P801

This instruction applies to new and used batteries assigned to UN Nos. 2794, 2795 or 3028.

The following packagings are authorized, provided the general provisions of **4.1.1** and **4.1.3** are met:

(1) Rigid outer packagings;

(2) Wooden slatted crates;

(3) Pallets.

Additional requirements:

1. Batteries shall be protected against short circuits.

2. Batteries stacked shall be adequately secured in tiers separated by a layer of non conductive material.

3. Battery terminals shall not support the weight of other superimposed elements.

4. Batteries shall be packaged or secured to prevent inadvertent movement. Any cushioning material used shall be inert.

P801a	PACKING INSTRUCTION	P801a

This instruction applies to used batteries of UN Nos. 2794, 2795 , 2800 and 3028.

Stainless steel or solid plastics battery boxes of a capacity of up to 1 m3 are authorized provided the following provisions are met:

(a) The battery boxes shall be resistant to the corrosive substances contained in the storage batteries;

(b) Under normal conditions of carriage, no corrosive substance shall leak from the battery boxes and no other substance (e.g. water) shall enter the battery boxes. No dangerous residues of corrosive substances contained in the storage batteries shall adhere to the outside of the battery boxes;

(c) The battery boxes shall not be loaded with storage batteries to a height greater than the height of their sides;

(d) No storage battery containing substances or other dangerous goods which may react dangerously with one another shall be placed in a battery box;

(e) The battery boxes shall be either:

(i) covered; or

(ii) carried in closed or sheeted vehicles or containers.

P802	PACKING INSTRUCTION	P802

The following packagings are authorized, provided the general provisions of **4.1.1** and **4.1.3** are met:

(1) Combination packagings:
Outer packagings: 1A2, 1B2, 1N2, 1H2, 1D, 4A, 4B, 4C1, 4C2, 4D, 4F, or 4H2;
maximum net mass: 75 kg.
Inner packagings: glass or plastics; maximum capacity: 10 litres;

(2) Combination packagings:
Outer packagings: 1A2, 1B2, 1N2, 1H2, 1D, 1G, 4A, 4B, 4C1, 4C2, 4D, 4F, 4G or 4H2;
maximum net mass: 125 kg.
Inner packagings: metal; maximum capacity: 40 litres;

(3) Composite packagings: Glass receptacle with outer steel, aluminium, plywood or solid plastics drum (6PA1, 6PB1, 6PD1, or 6PH2) or with outer steel or aluminium crate or box or with outer wooden box or with outer wickerwork hamper (6PA2, 6PB2, 6PC or 6PD2); maximum capacity: 60 litres;

(4) Austenitic steel drums (1A1) with a maximum capacity of 250 litres;

(5) Gas cylinders conforming to the construction, testing and filling requirements approved by the competent authority.

P803	PACKING INSTRUCTION	P803

This instruction applies to UN No. 2028.

The following packagings are authorized, provided the general provisions of **4.1.1** and **4.1.3** are met:

(1) Drums (1A2, 1B2, 1N2, 1H2, 1D, 1G);

(2) Boxes (4A, 4B, 4C1, 4C2, 4D, 4F, 4G, 4H2).

Maximum net mass: 75 kg.

The articles shall be individually packaged and separated from each other using partitions, dividers, inner packagings or cushioning material to prevent inadvertent discharge during normal conditions of carriage.

P900	PACKING INSTRUCTION	P900
(Reserved)		

P901	PACKING INSTRUCTION	P901
This instruction applies to UN No. 3316.		
The following packagings are authorized, provided the general provisions of **4.1.1** and **4.1.3** are met: Packagings conforming to the performance level consistent with the packing group assigned to the kit as a whole (see 3.3.1, special provision 251). Maximum quantity of dangerous goods per outer packaging: 10 kg.		
Additional requirement: Dangerous goods in kits shall be packed in inner packagings which shall not exceed either 250 ml or 250 g and shall be protected from other materials in the kit.		

P902	PACKING INSTRUCTION	P902
This instruction applies to UN No. 3268.		
The following packagings are authorized, provided the general provisions of **4.1.1** and **4.1.3** are met: Packagings conforming to the packing group III performance level. Each packaging shall conform to special provision 235 (see 3.3.1) and shall conform to the packing group III performance level. The packaging shall be designed and constructed to prevent movement of the articles and inadvertent discharge during normal conditions of carriage. The articles may also be carried unpackaged in dedicated handling devices, vehicles or containers when moved from where they are manufactured to an assembly plant.		

P903	PACKING INSTRUCTION	P903
This instruction applies to UN Nos. 3090 and 3091.		
The following packagings are authorized, provided the general provisions of **4.1.1** and **4.1.3** are met: Packagings conforming to the packing group II performance level. When lithium cells and batteries are packed with equipment, they shall be packed in inner fibreboard packagings that meet the requirements for packing group II. When lithium cells and batteries included in Class 9 are contained in equipment, the equipment shall be packed in strong outer packagings in such a manner as to prevent accidental operation during carriage.		
Additional requirement: Batteries shall be protected against short circuit.		

P903a	PACKING INSTRUCTION	P903a

This instruction applies to used cells and batteries of UN Nos. 3090 and 3091.

The following packagings are authorized, provided the general provisions of **4.1.1** and **4.1.3** are met:

Packagings conforming to the packing group II performance level.

Non-approved packagings shall, however, be permitted provided that:

- they meet the general provisions of 4.1.1 and 4.1.3;
- the cells and batteries are packed and stowed so as to prevent any risk of short circuits;
- the packages weigh not more than 30 kg.

Additional requirement:

Batteries shall be protected against short circuit.

P904	PACKING INSTRUCTION	P904

This instruction applies to UN No. 3245.

The following packagings are authorized, provided the general provisions of **4.1.1** and **4.1.3** are met:

(1) Packagings according to P001 or P002;

(2) Packagings, which need not conform to the packaging test requirements of Part 6, but conforming to the following:

(a) An inner packaging comprising:

(i) a watertight primary receptacle(s);

(ii) a watertight secondary packaging which is leakproof;

(iii) 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;

(b) An outer packaging of adequate strength for its capacity, mass and intended use, and with a minimum external dimension of 100 mm;

(3) For substances consigned in liquid nitrogen: Plastics primary receptacles capable of withstanding very low temperatures shall be used. The secondary packaging shall also be capable of withstanding very low temperatures, and in most cases will need to be fitted over the primary receptacle individually. Provisions for the consignment of liquid nitrogen shall also be fulfilled in accordance with the requirements of P200. The primary receptacle and the secondary packaging shall maintain their integrity at the temperature of the liquid nitrogen.

P905	PACKING INSTRUCTION	P905

This instruction applies to UN Nos. 3072 and 2990.

Any suitable packaging is authorized, provided the general provisions of **4.1.1** and **4.1.3** are met, except that packagings need not conform to the requirements of Part 6.

When the life saving appliances are constructed to incorporate or are contained in rigid outer weatherproof casings (such as for lifeboats), they may be carried unpackaged.

Additional requirements:

1. All dangerous substances and articles contained as equipment within the appliances shall be secured to prevent inadvertent movement and in addition:

   (a) Signal devices of Class 1 shall be packed in plastics or fibreboard inner packagings;

   (b) Non-flammable, non-toxic gases shall be contained in cylinders as specified by the competent authority, which may be connected to the appliance;

   (c) Electric storage batteries (Class 8) and lithium batteries (Class 9) shall be disconnected or electrically isolated and secured to prevent any spillage of liquid; and

   (d) Small quantities of other dangerous substances (for example in Classes 3, 4.1 and 5.2) shall be packed in strong inner packagings.

2. Preparation for transport and packaging shall include provisions to prevent any accidental inflation of the appliance.

P906	PACKING INSTRUCTION	P906

This instruction applies to UN Nos. 2315, 3151 and 3152.

The following packagings are authorized, provided the general provisions of **4.1.1** and **4.1.3** are met:

(1) For liquids and solids containing or contaminated with PCBs: Packagings in accordance with P001 or P002, as appropriate;

(2) For transformers and condensers and other devices: Leakproof packagings which are capable of containing, in addition to the devices, at least 1.25 times the volume of the liquid PCBs present in them. There shall be sufficient absorbent material in the packagings to absorb at least 1.1 times the volume of liquid which is contained in the devices. In general, transformers and condensers shall be carried in leakproof metal packagings which are capable of holding, in addition to the transformers and condensers, at least 1.25 times the volume of the liquid present in them.

Notwithstanding the above, liquids and solids not packaged in accordance with P001 and P002 and unpackaged transformers and condensers may be carried in cargo transport units fitted with a leakproof metal tray to a height of at least 800 mm, containing sufficient inert absorbent material to absorb at least 1.1 times the volume of any free liquid.

Additional requirement:

Adequate provisions shall be taken to seal the transformers and condensers to prevent leakage during normal conditions of carriage.

R001	PACKING INSTRUCTION		R001
The following packagings are authorized provided the general provisions of **4.1.1** and **4.1.3** are met:			
Light gauge metal packagings	**Maximum capacity/maximum net mass**		
	Packing group I	**Packing group II**	**Packing group III**
Steel non-removable head (0A1)	Not allowed	40 *l* / 50 kg	40 *l* / 50 kg
Steel removable head (0A2)2	Not allowed	40 *l* / 50 kg	40 *l* / 50 kg
[a] *Not allowed for UN No. 1261 NITROMETHANE.*			
***NOTE 1**: This instruction applies to solids and liquids (provided the design type is tested and marked appropriately).* ***NOTE 2**: For Class 3, packing group II, these packagings may be used only for substances with no subsidiary risk and a vapour pressure of not more than 110 kPa at 50 °C and for slightly toxic pesticides.*			
Special packing provision: **RR3** For UN Nos. 1204 and 3256, light gauge metal packagings are not permitted.			

4.1.4.2 ***Packing instructions concerning the use of IBCs***

IBC01	PACKING INSTRUCTION	IBC01
The following IBCs are authorized, provided the general provisions of **4.1.1**, **4.1.2** and **4.1.3** are met: Metal (31A, 31B and 31N).		
Additional requirement: Only liquids with a vapour pressure less than or equal to 110 kPa at 50 °C, or 130 kPa at 55 °C, are authorized.		
Special packing provision: **B12** For UN No. 3130, the openings of receptacles for this substance shall be tightly closed by means of two devices in series, one of which shall be screwed or secured in an equivalent manner.		

IBC02	PACKING INSTRUCTION	IBC02

The following IBCs are authorized, provided the general provisions of **4.1.1**, **4.1.2** and **4.1.3** are met:

(1) Metal (31A, 31B and 31N);

(2) Rigid plastics (31H1 and 31H2);

(3) Composite (31HZ1).

Additional requirement:

Only liquids with a vapour pressure less than or equal to 110 kPa at 50 °C, or 130 kPa at 55 °C, are authorized.

Special packing provisions:

B5 For UN Nos. 1791, 2014 and 3149, IBCs shall be provided with a device to allow venting during carriage. The inlet to the venting device shall be sited in the vapour space of the IBC under maximum filling conditions during carriage.

B7 For UN Nos. 1222 and 1865, IBCs with a capacity greater than 450 litres are not permitted due to the substance's potential for explosion when carried in large volumes.

B8 The pure form of this substance shall not be transported in IBCs since it is known to have a vapour pressure of more than 110 kPa at 50 °C or 130 kPa at 55 °C.

B11 Bottom openings are permitted provided they are fitted with two closure devices in series.

IBC03	PACKING INSTRUCTION	IBC03

The following IBCs are authorized, provided the general provisions of **4.1.1**, **4.1.2** and **4.1.3** are met:

(1) Metal (31A, 31B and 31N);

(2) Rigid plastics (31H1 and 31H2);

(3) Composite (31HZ1, 31HA2, 31HB2, 31HN2, 31HD2 and 31HH2).

Additional requirement:

Only liquids with a vapour pressure less than or equal to 110 kPa at 50 °C, or 130 kPa at 55 °C, are authorized.

Special packing provision:

B8 The pure form of this substance shall not be carried in IBCs since it is known to have a vapour pressure of more than 110 kPa at 50 °C or 130 kPa at 55 °C.

IBC04	PACKING INSTRUCTION	IBC04
The following IBCs are authorized, provided the general provisions of **4.1.1**, **4.1.2** and **4.1.3** are met: Metal (11A, 11B, 11N, 21A, 21B, 21N, 31A, 31B and 31N).		
Special packing provision: **B1** For packing group I substances, IBCs shall be carried in closed vehicles or containers.		

IBC05	PACKING INSTRUCTION	IBC05
The following IBCs are authorized, provided the general provisions of **4.1.1**, **4.1.2** and **4.1.3** are met: (1) Metal (11A, 11B, 11N, 21A, 21B, 21N, 31A, 31B and 31N); (2) Rigid plastics (11H1, 11H2, 21H1, 21H2, 31H1 and 31H2); (3) Composite (11HZ1, 21HZ1 and 31HZ1).		
Special packing provisions: **B1** For packing group I substances, IBCs shall be carried in closed vehicles or containers. **B2** For packing group II solid substances, IBCs other than metal or rigid plastics IBCs shall be carried in closed vehicles or containers.		

IBC06	PACKING INSTRUCTION	IBC06
The following IBCs are authorized, provided the general provisions of **4.1.1**, **4.1.2** and **4.1.3** are met: (1) Metal (11A, 11B, 11N, 21A, 21B, 21N, 31A, 31B and 31N); (2) Rigid plastics (11H1, 11H2, 21H1, 21H2, 31H1 and 31H2); (3) Composite (11HZ1, 11HZ2, 21HZ1, 21HZ2, 31HZ1 and 31HZ2).		
Additional requirement: Composite IBCs 11HZ2, 21HZ2 and 31HZ2 shall not be used when the substances being carried may become liquid during carriage.		
Special packing provisions: **B1** For packing group I substances, IBCs shall be transported in closed vehicles or containers. **B2** For packing group II solid substances, IBCs other than metal or rigid plastics IBCs shall be carried in closed vehicles or containers.		

IBC07	PACKING INSTRUCTION	IBC07

The following IBCs are authorized, provided the general provisions of **4.1.1**, **4.1.2** and **4.1.3** are met:

(1) Metal (11A, 11B, 11N, 21A, 21B, 21N, 31A, 31B and 31N);

(2) Rigid plastics (11H1, 11H2, 21H1, 21H2, 31H1 and 31H2);

(3) Composite (11HZ1, 11HZ2, 21HZ1, 21HZ2, 31HZ1 and 31HZ2);

(4) Wooden (11C, 11D and 11F).

Additional requirement:

Liners of wooden IBCs shall be sift-proof.

Special packing provisions:

B1 For packing group I substances, IBCs shall be carried in closed vehicles or containers.

B2 For packing group II solid substances, IBCs other than metal or rigid plastics IBCs shall be carried in closed vehicles or containers.

IBC08	PACKING INSTRUCTION	IBC08

The following IBCs are authorized, provided the general provisions of **4.1.1**, **4.1.2** and **4.1.3** are met:

(1) Metal (11A, 11B, 11N, 21A, 21B, 21N, 31A, 31B and 31N);

(2) Rigid plastics (11H1, 11H2, 21H1, 21H2, 31H1 and 31H2);

(3) Composite (11HZ1, 11HZ2, 21HZ1, 21HZ2, 31HZ1 and 31HZ2);

(4) Fibreboard (11G);

(5) Wooden (11C, 11D and 11F);

(6) Flexible (13H1, 13H2, 13H3, 13H4, 13H5, 13L1, 13L2, 13L3, 13L4, 13M1 and 13M2).

Special packing provisions:

B2 For packing group II solid substances, IBCs other than metal or rigid plastics IBCs shall be carried in closed vehicles or containers.

B3 Flexible IBCs shall be sift-proof and water-resistant or shall be fitted with a sift-proof and water-restistant liner.

B4 Flexible, fibreboard or wooden IBCs shall be sift-proof and water-resistant or shall be fitted with a sift-proof and water-resistant liner.

B6 For UN Nos. 1363, 1364, 1365, 1386, 1841, 2211, 2217, 2793 and 3314, IBCs are not required to meet the IBC testing requirements of Chapter 6.5.

IBC99	PACKING INSTRUCTION	IBC99

Only IBCs which are approved by the competent authority may be used.

IBC100	PACKING INSTRUCTION	IBC100

This instruction applies to UN Nos. 0082, 0241, 0331 and 0332.

The following IBCs are authorized, provided the general provisions of **4.1.1**, **4.1.2** and **4.1.3** and special provisions of 4.1.5 are met:

(1) Metal (11A, 11B, 11N, 21A, 21B, 21N, 31A, 31B and 31N);

(2) Flexible (13H2, 13H3, 13H4, 13L2, 13L3, 13L4 and 13M2);

(3) Rigid plastics (11H1, 11H2, 21H1, 21H2, 31H1 and 31H2);

(4) Composite (11HZ1, 11HZ2, 21HZ1, 21HZ2, 31HZ1 and 31HZ2).

Additional requirements:

1. IBCs shall only be used for free flowing substances.

2. Flexible IBCs shall only be used for solids.

Special packing provisions:

B9 For UN No. 0082, this packing instruction may only be used when the substances are mixtures of ammonium nitrate or other inorganic nitrates with other combustible substances which are not explosive ingredients. Such explosives shall not contain nitroglycerin, similar liquid organic nitrates, or chlorates. Metal IBCs are not authorized.

B10 For UN No. 0241, this packing instruction may only be used for substances which consist of water as an essential ingredient and high proportions of ammonium nitrate or other oxidizing substances some or all of which are in solution. The other constituents may include hydrocarbons or aluminium powder, but shall not include nitro-derivatives such as trinitrotoluene. Metal IBCs are not authorized.

IBC 520	PACKING INSTRUCTION				IBC520
This instruction applies to organic peroxides and self-reactive substances of type F.					
The IBCs listed below are authorized for the formulations listed, provided the general provisions of **4.1.1**, **4.1.2** and **4.1.3** and special provisions of **4.1.7.2** are met. For formulations not listed below, only IBCs which are approved by the competent authority may be used (see 4.1.7.2.2).					
UN No.	**Organic peroxide**	**Type of IBC**	**Maximum quantity (litres)**	**Control temper-ature**	**Emer-gency temper-ature**
3109	**ORGANIC PEROXIDE, TYPE F, LIQUID** tert-Butyl hydroperoxide, not more than 72% with water	31A	1 250		
	tert-Butyl peroxyacetate, not more than 32% in diluent type A	31A 31HA1	1 250 1 000		
	tert-Butyl peroxy-3,5,5-trimethylhexanoate, not more than 32% in diluent type A	31A 31HA1	1 250 1 000		
	Cumyl hydroperoxide, not more than 90% in diluent type A	31HA1	1 250		
	Dibenzoyl peroxide, not more than 42% as a stable dispersion in water	31H1	1 000		
	Di-tert-butyl peroxide, not more than 52% in diluent type A	31A 31HA1	1 250 1 000		
	1,1-Di-(tert-butylperoxy) cyclohexane, not more than 42% in diluent type A	31H1	1 000		
	Dilauroyl peroxide, not more than 42%, stable dispersion, in water	31HA1	1 000		
	Isopropyl cumyl hydroperoxide, not more than 72% in diluent type A	31HA1	1 250		
	p-Menthyl hydroperoxide, not more than 72% in diluent type A	31HA1	1 250		
	Peroxyacetic acid, stabilized, not more than 17%	31H1 31HA1 31A	1 500 1 500 1 500		

3119	**ORGANIC PEROXIDE, TYPE F, LIQUID, TEMPERATURE CONTROLLED**				
	tert-Butyl peroxy-2-ethylhexanoate, not more than 32% in diluent type B	31HA1 31A	1 000 1 250	+30 °C +30 °C	+35 °C +35 °C
	tert-Butyl peroxyneodecanoate, not more than 32% in diluent type A.	31A	1 250	0 °C	+10 °C
	tert-Butyl peroxyneodecanoate, not more than 42% stable dispersion, in water	31A	1 250	- 5 °C	+ 5 °C
	tert-Butyl peroxypivalate, not more than 27% in diluent type B	31HA1 31A	1 000 1 250	+10 °C +10 °C	+15 °C +15 °C
	Cumyl peroxyneodecanoate, not more than 52%, stable dispersion, in water	31A	1 250	-15 °C	- 5 °C
	Di-(4-tert-butylcyclohexyl) peroxydicarbonate, not more than 42%, stable dispersion, in water	31HA1	1 000	+30 °C	+35 °C
	Dicetyl peroxydicarbonate, not more than 42%, stable dispersion, in water	31HA1	1 000	+30 °C	+35 °C
	Di-(2-ethylhexyl) peroxydicarbonate, not more than 52%, stable dispersion, in water	31A	1 250	-20 °C	-10 °C
	Dimyristyl peroxydicarbonate, not more than 42%, stable dispersion, in water	31HA1	1 000	+15 °C	+20 °C
	Di-(3,5,5-trimethylhexanoyl) peroxide, not more than 38% in diluent type A	31HA1 31A	1 000 1 250	+10 °C +10 °C	+15 °C +15 °C
	Di-(3,5,5-trimethylhexanoyl) peroxide, not more than 52%, stable dispersion, in water	31A	1 250	+10 °C	+15 °C
	1,1,3,3-Tetramethylbutyl peroxyneodecanoate, not more than 52%, stable dispersion, in water	31A	1 250	- 5 °C	+ 5 °C

Additional requirements:

1. IBCs shall be provided with a device to allow venting during carriage. The inlet to the pressure-relief device shall be sited in the vapour space of the IBC under maximum filling conditions during carriage.

2. To prevent explosive rupture of metal IBCs or composite IBCs with complete metal casing, the emergency-relief devices shall be designed to vent all the decomposition products and vapours evolved during self-accelerating decomposition or during a period of not less than one hour of fire-engulfment as calculated by the formula in 4.2.1.13.8. The control and emergency temperatures specified in this packing instruction are based on a non-insulated IBC. When consigning an organic peroxide in an IBC in accordance with this instruction, it is the responsibility of the consignor to ensure that:

   (a) the pressure and emergency relief devices installed on the IBC are designed to take appropriate account of the self-accelerating decomposition of the organic peroxide and of fire-engulfment; and

   (b) when applicable, the control and emergency temperatures indicated are appropriate, taking into account the design (e.g. insulation) of the IBC to be used.

IBC620	PACKING INSTRUCTION	IBC620
This instruction applies to UN No. 3291.		
The following IBCs are authorized, provided the general provisions of **4.1.1**, **4.1.2** and **4.1.3** are met: Rigid, leakproof IBCs conforming to the packing group II performance level.		
Additional requirements: 1. There shall be sufficient absorbent material to absorb the entire amount of liquid present in the IBC. 2. IBCs shall be capable of retaining liquids. 3. IBCs intended to contain sharp objects such as broken glass and needles shall be resistant to puncture.		

4.1.4.3 ***Packing instructions concerning the use of large packagings***

LP01	**PACKING INSTRUCTION (LIQUIDS)**	**LP01**

The following large packagings are authorized provided the general provision of **4.1.1** and **4.1.3** are met:

Inner packagings	**Large outer packagings**	**Packing group I**	**Packing group II**	**Packing group III**
Glass 10 litre Plastics 30 litre Metal 40 litre	Steel (50A) Aluminium (50B) Metal other than steel or aluminium (50N) Rigid plastics (50H) Natural wood (50C) Plywood (50D) Reconstituted wood (50F) Fibreboard (50G)	Not allowed	Not allowed	Maximum capacity: 3 m^3

LP02	**PACKING INSTRUCTION (SOLIDS)**	**LP02**

The following large packagings are authorized provided the general provisions of **4.1.1** and **4.1.3** are met:

Inner packagings		**Large outer packagings**	**Packing group I**	**Packing group II**	**Packing group III**
Glass	10kg	Steel (50A) Aluminium (50B) Metal other than steel or aluminium (50N) Rigid plastics (50H) Natural wood (50C) Plywood (50D) Reconstituted wood (50F) Fibreboard (50G)	Not allowed	Not allowed	Maximum capacity: 3 m^3
Plastics **[b]**	50kg				
Metal	50 kg				
Paper **[a, b]**	50 kg				
Fibre **[a, b]**	50 kg				

a *These inner packagings shall not be used when the substances being carried may become liquid during carriage.*

b *These inner packagings shall be sift-proof.*

LP99	**PACKING INSTRUCTION**	**LP99**

Only large packagings which are approved by the competent authority may be used (see 4.1.3.7).

LP101	PACKING INSTRUCTION	LP101
The following packagings are authorized, provided the general provisions of **4.1.1** and **4.1.3** and special provisions of 4.1.5 are met:		
Inner packagings	**Intermediate packagings**	**Large packagings**
Not necessary	Not necessary	Steel (50A) Aluminium (50B) Metal other than steel or aluminium (50N) Rigid plastics (50H) Natural wood (50C) Plywood (50D) Reconstituted wood (50F) Fibreboard (50G)

Special packing provision:

L1 For UN Nos. 0006, 0009, 0010, 0015, 0016, 0018, 0019, 0034, 0035, 0038, 0039, 0048, 0056, 0137, 0138, 0168, 0169, 0171, 0181, 0182, 0183, 0186, 0221, 0243, 0244, 0245, 0246, 0254, 0280, 0281, 0286, 0287, 0297, 0299, 0300, 0301, 0303, 0321, 0328, 0329, 0344, 0345, 0346, 0347, 0362, 0363, 0370, 0412, 0424, 0425, 0434, 0435, 0436, 0437, 0438, 0451, 0488 and 0502:
Large and robust explosives articles, normally intended for military use, without their means of initiation or with their means of initiation containing at least two effective protective features, may be carried unpackaged. When such articles have propelling charges or are self-propelled, their ignition systems shall be protected against stimuli encountered during normal conditions of carriage. A negative result in Test Series 4 on an unpackaged article indicates that the article can be considered for carriage unpackaged. Such unpackaged articles may be fixed to cradles or contained in crates or other suitable handling devices.

LP102	PACKING INSTRUCTION	LP102
The following packagings are authorized, provided the general provisions of **4.1.1** and **4.1.3** and special provisions of **4.1.5** are met:		
Inner packagings	**Intermediate packagings**	**Outer packagings**
Bags water resistant **Receptacles** fibreboard metal plastics wood **Sheets** fibreboard, corrugated **Tubes** fibreboard	Not necessary	Steel (50A) Aluminium (50B) Metal other than steel or aluminium (50N) Rigid plastics (50H) Natural wood (50C) Plywood (50D) Reconstituted wood (50F) Fibreboard (50G)

LP621	PACKING INSTRUCTION	LP621

This instruction applies to UN No. 3291.

The following large packagings are authorized, provided the general provisions of **4.1.1** and **4.1.3** and the special provisions of **4.1.8** are met:

(1) For clinical waste placed in inner packagings: Rigid, leakproof large packagings conforming to the requirements of Chapter 6.6 for solids, at the packing group II performance level, provided there is sufficient absorbent material to absorb the entire amount of liquid present and the large packaging is capable of retaining liquids;

(2) For packages containing larger quantities of liquid: Large rigid packagings conforming to the requirements of Chapter 6.6, at the packing group II performance level, for liquids.

Additional requirement:

Large packagings intended to contain sharp objects such as broken glass and needles shall be resistant to puncture and retain liquids under the performance test conditions in Chapter 6.6.

4.1.4.4 ***Particular requirements applicable to the use of pressure receptacles for substances other than those of Class 2.***

When gas cylinders or gas receptacles are used as packaging for substances assigned to packing instructions P400, P401, P402 or P601, they shall be constructed, tested, filled and marked according to the corresponding requirements (PR1 to PR6) as mentioned in the table below for each UN number.

TABLE

LIST OF PARTICULAR REQUIREMENTS (PR)
FOR GAS CYLINDERS AND RECEPTACLES

Requirement Code	**UN Nos.**	**Applicable construction, testing, filling and marking requirements**
PR1	1366 1370 1380 1389 1391 1411 1421 1928 2003 2445 2845 2870 3049 3050 3051 3052 3053 3076 3129 3130 3148 3194 3203 3207 3254	The substances classified under these UN numbers shall be packed in hermetically closing metal receptacles which are not affected by the contents and have a capacity of not more than 450 litres. The receptacles shall be subjected to the initial test and periodic tests every five years at a pressure of not less than 1MPa (10 bar) (gauge pressure). The receptacles shall not be filled to more than 90% of their capacity; however, a space of at least 5% shall remain empty for safety when the liquid is at an average temperature of 50 °C. During carriage, the liquid shall be under a layer of inert gas the gauge pressure of which shall be not less than 50 kPa (0.5 bar). The receptacles shall carry a data plate with the following particulars entered in a durable form: - substance or substances [a] accepted for carriage; - tare [b] of the receptacle, including accessories; - test pressure [b] (gauge pressure); - date (month, year) of the last test undergone; - stamp of the expert who carried out the test; - capacity [b] of the receptacle; - maximum mass of filling allowed [b]

[a] *The name may be replaced by a generic description covering substances of a similar nature and also compatible with the characteristics of the receptacle.*

[b] *The units of measurement to be added each time after the numerical values.*

Pressure receptacle requirements	UN Nos.	Applicable construction, testing, filling and marking requirements
PR2	1183 1242 1295 2988	The substances classified under these UN number shall be packed in corrosion-resistant steel receptacles with a maximum capacity of 450 litres. The closing device of the receptacle shall be protected by a cap. The receptacles shall be subjected to the initial test and periodic tests every five years at a pressure of not less than 0.4 MPa (4 bar) (gauge pressure). The maximum permissible mass of filling per litre of capacity for trichlorosilane, ethyldichlorosilane and methyldichlorosilane shall not exceed 1.14 kg, 0.93 kg or 0.95 kg respectively, if the filling is carried out by mass; if the filling is by volume, the degree of filling shall not exceed 85%. The receptacles shall also carry a plate showing the following particulars in a durable form: - description of the substance(s) accepted for carriage, or for chlorosilanes : "chlorosilanes, Class 4.3"; - tare [b] of the receptacle, including accessories; - test pressure [b] (gauge pressure); - date (month, year) of the last test undergone; - stamp of the expert who carried out the test; - capacity [b] of the receptacle; - maximum degree of filling allowed by mass [b] for each substance accepted for carriage.

[b] *The units of measurement to be added each time after the numerical values.*

Pressure receptacle requirements	UN Nos.	Applicable construction, testing, filling and marking requirements
PR3	1092 1251 1259 1605 1613 1994 3294	The substances classified under these UN numbers shall be packed in metal receptacles fitted with completely leakproof closing devices which shall, if necessary, be secured against mechanical damage by protective caps. Steel receptacles of a capacity not exceeding 150 litres shall have a minimum wall thickness of 3 mm, and larger steel receptacles and receptacles made of other materials shall have walls at least thick enough to guarantee equivalent mechanical strength. The maximum capacity of receptacles permitted shall be 250 litres. The mass of the contents shall be not more than 1 kg of liquid per litre of capacity. Before being used for the first time, the receptacles shall undergo a hydraulic pressure test at a pressure of not less than 1 MPa (10 bar) (gauge pressure). The pressure test shall be repeated every five years and shall include a meticulous inspection of the inside of the receptacle and a check of the tare. The receptacles shall bear the following particulars in clearly legible and durable characters: - substance or substances [a] accepted for carriage; - the name of the owner of the receptacle; - the tare [b] of the receptacle, including such fittings and accessories as valves, protective caps, etc; - the date (month, year) of the initial test and of the most recent test, and the stamp of the expert who carried out the test; - the maximum permissible mass of the contents of the receptacle in kg; - the internal pressure (test pressure) to be applied in the hydraulic pressure test.

[a] *The name may be replaced by a generic description covering substances of a similar nature and also compatible with the characteristics of the receptacle.*

[b] *The units of measurement to be added each time after the numerical values.*

Pressure receptacle requirements	UN Nos.	Applicable construction, testing, filling and marking requirements
PR4	1185	This substance shall be packed in steel receptacles of sufficient thickness, which shall be closed by a screw-threaded bung and a screw-threaded protective cap or equivalent device leakproof both to liquid and to vapour. The receptacles shall initially and periodically, at least every five years, be tested at a pressure of at least 1 MPa (10 bar) (gauge pressure) in accordance with 6.2.1.5 and 6.2.1.6. The mass of the contents shall not exceed 0.67 kg per litre of capacity. A package shall not weigh more than 75 kg. Receptacles shall bear, in clearly legible and durable characters: - the name or mark of the manufacturer and the number of the receptacle; - the word "ethyleneimine"; - the tare [b] of the receptacle and its maximum permitted mass[b] when filled; - the date (month and year) of the initial test and of the most recent test undergone; - the stamp of the expert who carried out the tests and examinations.

[b] *The units of measurement to be added each time after the numerical values.*

Pressure receptacle requirements	UN Nos.	Applicable construction, testing, filling and marking requirements
PR5	2480 2481	The substances classified under this UN number shall be packed in receptacles made of pure aluminium having a wall thickness of not less than 5 mm or in receptacles of stainless steel. The receptacles shall be fully welded. They shall initially and periodically, at least every five years, be tested at a pressure of at least 0.5 MPa (5 bar) (gauge pressure) in accordance with 6.2.1.5 and 6.2.1.6. They shall be so closed as to be leakproof by means of two closures one above the other, one of which shall be screw-threaded or secured in an equally effective manner. The degree of filling shall be not more than 90 %. Drums weighing more than 100 kg shall be fitted with rolling hoops or stiffening ribs. The receptacles shall bear, in clearly legible and durable characters: - the name or mark of the manufacturer and the number of the receptacle; - substance or substances [a] accepted for carriage; - the tare [b] of the receptacle and its maximum permitted mass when filled; - the date (month and year) of the initial test and of the most recent test undergone; - the stamp of the expert who carried out the tests and examinations.

[a] *The name may be replaced by a generic description covering substances of a similar nature and also compatible with the characteristics of the receptacle.*

[b] *The units of measurement to be added each time after the numerical values.*

Pressure receptacle requirements	UN No.	Applicable construction, testing, filling and marking requirements
PR6	1744	Bromine containing less than 0.005% water, or between 0.005% and 0.2% water, provided that in the latter case measures are taken to prevent corrosion of the lining of the receptacles, may be carried in receptacles satisfying the following conditions: (a) The receptacles shall be made of steel and be equipped with a leakproof lining made of lead or of some other material affording equivalent protection and with a hermetic closure; receptacles made of monel metal or nickel, or with a nickel lining, shall also be permitted; (b) The capacity of the receptacles shall not exceed 450 litres; (c) The receptacles shall not be filled to more than 92% of their capacity or more than 2.86 kg per litre of capacity; (d) The receptacles shall be welded and designed for a calculation pressure of not less than 2.1 MPa (21 bar) gauge pressure. The materials and workmanship shall in other respects meet the relevant requirements of Chapter 6.2. The initial test of unlined steel receptacles shall be subject to the requirements of 6.2.1.5; (e) The closures shall project as little as possible from the receptacle and be fitted with protective caps. The closures and caps shall be fitted with gaskets made of a material not capable of being attacked by bromine. The closures shall be in the upper part of the receptacles in such a manner that they can in no case be in permanent contact with the liquid phase; (f) The receptacles shall be provided with fittings enabling them to stand stably upright, and with lifting attachments (rings, flanges, etc.) at the top, which shall be tested at twice the working load. Before being put into service, the receptacles shall be subjected to a leakproofness test at a pressure of at least 200 kPa (2 bar) gauge pressure.

Pressure receptacle requirements	UN No.	Applicable construction, testing, filling and marking requirements
PR6 (cont'd)		The leakproofness test shall be repeated every two years and shall be accompanied by an internal inspection of the receptacle and a check of its tare. The test and the inspection shall be carried out under the supervision of an expert approved by the competent authority. The receptacles shall bear, in clearly legible and durable characters: - the name or the mark of the manufacturer and the number of the receptacle, - the word "Bromine", - tare [b] mass of the receptacle and the permissible maximum mass [b] of the filled receptacle, - date (month, year) of the initial test and of the latest periodical test, - stamp of the expert who carried out the tests and examinations.

[b] *The units of measurement to be added each time after the numerical values.*

4.1.5 Special packing provisions for goods of Class 1

4.1.5.1 The general provisions of Section 4.1.1 shall be met.

4.1.5.2 All packagings for Class 1 goods shall be so designed and constructed that:

(a) They will protect the explosives, prevent them escaping and cause no increase in the risk of unintended ignition or initiation when subjected to normal conditions of carriage including foreseeable changes in temperature, humidity and pressure;

(b) The complete package can be handled safely in normal conditions of carriage; and

(c) The packages will withstand any loading imposed on them by foreseeable stacking to which they will be subject during carriage so that they do not add to the risk presented by the explosives, the containment function of the packagings is not harmed, and they are not distorted in a way or to an extent which will reduce their strength or cause instability of a stack.

4.1.5.3 All explosive substances and articles, as prepared for carriage, shall have been classified in accordance with the procedures detailed in 2.2.1.

4.1.5.4 Class 1 goods shall be packed in accordance with the appropriate packing instruction shown in Column (8) of Table A of Chapter 3.2, as detailed in 4.1.4.

4.1.5.5 Packagings, including IBCs and large packagings shall conform to the requirements of Chapter 6.1, 6.5 or 6.6, respectively, and shall meet the test requirements of 6.1.5, 6.5.4 or 6.6.5, respectively, for packing group II, subject to 4.1.1.13, 6.1.2.4 and 6.5.1.4.4. Packagings other than metal packagings meeting the test criteria of packing group I may be used. To avoid unnecessary confinement, metal packagings of packing group I shall not be used.

4.1.5.6 The closure device of packagings containing liquid explosives shall ensure a double protection against leakage.

4.1.5.7 The closure device of metal drums shall include a suitable gasket; if a closure device includes a screw-thread, the ingress of explosive substances into the screw-thread shall be prevented.

4.1.5.8 Packagings for water soluble substances shall be water resistant. Packagings for desensitized or phlegmatized substances shall be closed to prevent changes in concentration during carriage.

4.1.5.9 When the packaging includes a double envelope filled with water which may freeze during transport, a sufficient quantity of an anti-freeze agent shall be added to the water to prevent freezing. Anti-freeze that could create a fire hazard because of its inherent flammability shall not be used.

4.1.5.10 Nails, staples and other closure devices made of metal without protective covering shall not penetrate to the inside of the outer packaging unless the inner packaging adequately protects the explosives against contact with the metal.

4.1.5.11 Inner packagings, fittings and cushioning materials and the placing of explosive substances or articles in packages shall be accomplished in a manner which prevents the explosive substances or articles from becoming loose in the outer packaging under normal conditions of carriage. Metallic components of articles shall be prevented from making contact with metal packagings. Articles containing explosive substances not enclosed in an outer casing

shall be separated from each other in order to prevent friction and impact. Padding, trays, partitioning in the inner or outer packaging, mouldings or receptacles may be used for this purpose.

4.1.5.12 Packagings shall be made of materials compatible with, and impermeable to, the explosives contained in the package, so that neither interaction between the explosives and the packaging materials, nor leakage, causes the explosive to become unsafe to carriage, or the hazard division or compatibility group to change.

4.1.5.13 The ingress of explosive substances into the recesses of seamed metal packagings shall be prevented.

4.1.5.14 Plastics packagings shall not be liable to generate or accumulate sufficient static electricity so that a discharge could cause the packaged explosive substances or articles to initiate, ignite or function.

4.1.5.15 Large and robust explosives articles, normally intended for military use, without their means of initiation or with their means of initiation containing at least two effective protective features, may be carried unpackaged. When such articles have propelling charges or are self-propelled, their ignition systems shall be protected against stimuli encountered during normal conditions of carriage. A negative result in Test Series 4 on an unpackaged article indicates that the article can be considered for carriage unpackaged. Such unpackaged articles may be fixed to cradles or contained in crates or other suitable handling, storage or launching devices in such a way that they will not become loose during normal conditions of carriage.

Where such large explosive articles are as part of their operational safety and suitability tests subjected to test regimes that meet the intentions of ADR and such tests have been successfully undertaken, the competent authority may approve such articles to be carried in accordance with ADR.

4.1.5.16 Explosive substances shall not be packed in inner or outer packagings where the differences in internal and external pressures, due to thermal or other effects, could cause an explosion or rupture of the package.

4.1.5.17 Whenever loose explosive substances or the explosive substance of an uncased or partly cased article may come into contact with the inner surface of metal packagings (1A2, 1B2, 4A, 4B and metal receptacles), the metal packaging shall be provided with an inner liner or coating (see 4.1.1.2).

4.1.5.18 Packing instruction P101 may be used for any explosive provided the packaging has been approved by a competent authority regardless of whether the packaging complies with the packing instruction assignment in Column (8) of Table A of Chapter 3.2.

4.1.6 Special packing provisions for goods of Class 2

4.1.6.1 Receptacles, including their closures, shall be selected to contain a gas or a mixture of gases according to the requirements of 6.2.1.2 "Materials of receptacles" and the requirements of the relevant packing instructions of 4.1.4.

4.1.6.2 A change of use of a refillable receptacle shall include emptying, purging and evacuation operations to the extent necessary for safe operation (see also table of standards at the end of this section).

***NOTE 1**: Refillable receptacles for the transport of gases of Class 2 shall be periodically inspected according to the periodicity set out in the relevant packing instructions (P200 or P203) and according to the provisions detailed in 6.2.1.6 "Periodic inspection".*

***NOTE 2**: Receptacles ready for shipment shall be marked and labelled according to the provisions set out in chapter 5.2.*

4.1.6.3 Receptacles except open cryogenic receptacles, including their closures, shall conform to the design, construction, inspection and testing requirements detailed in Chapter 6.2. When outer packagings are prescribed, the receptacles shall be firmly secured therein. Unless otherwise specified in the relevant packing instructions, receptacles may be enclosed in outer packagings either singly or in groups.

4.1.6.4 Valves (cocks) shall be effectively protected from damage which could cause gas release if the receptacle falls, and during carriage and stacking. This requirement is deemed to be complied with if one or more of the following conditions are fulfilled (see also table of standards at the end of this section):

(a) Valves are placed inside the neck of the receptacle and protected by a screw-threaded plug;

(b) Valves are protected by caps. Caps shall possess vent-holes of sufficient cross-sectional area to evacuate gases if leakage occurs at the valves;

(c) Valves are protected by shrouds or guards;

(d) Valves are designed and constructed in such a way that their ability to withstand damage without leakage of product has been demonstrated;

(e) Valves are placed inside a protective frame;

(f) Receptacles are carried in protective boxes or frames.

4.1.6.5 Receptacles, containing pyrophoric gases or very toxic gases (gases with an LC_{50} lower than 200 ppm) shall have their valve(s) openings fitted with gas-tight plugs or cap nuts which shall be made of a material not liable to attack by the contents of the receptacle.

4.1.6.6 Receptacles may be carried after the expiry of the time-limit set for the periodic test prescribed for the purpose of undergoing the test.

4.1.6.7 Requirements of the following packing provisions are considered to have been complied with if the following standards, as relevant, are applied:

Applicable paragraphs	**Reference**	**Title of document**
4.1.6.2	EN 1795:1997	Gas cylinders (excluding LPG) - Procedures for change of gas service.
4.1.6.4	EN 962:1996/A2:2000	Valve protection caps and valve guards for industrial and medical gas cylinders - Design, construction and tests

4.1.7 Special packing provisions for organic peroxides (Class 5.2) and self-reactive substances of Class 4.1

4.1.7.1 *Use of packagings*

4.1.7.1.1 Packagings for organic peroxides and self-reactive substances shall meet the requirements of Chapter 6.1 or of Chapter 6.6 at the packing group II performance level. To avoid unnecessary confinement, metal packagings meeting the test criteria of packing group I shall not be used.

4.1.7.1.2 The packing methods for organic peroxides and self-reactive substances are listed in packing instruction 520 and are designated OP1 to OP8. The quantities specified for each packing method are the maximum quantities authorized per package.

4.1.7.1.3 The packing methods appropriate for the individual currently assigned organic peroxides and self-reactive substances are listed in 2.2.41.4 and 2.2.52.4.

4.1.7.1.4 For new organic peroxides, new self-reactive substances or new formulations of currently assigned organic peroxides or self-reactive substances, the following procedure shall be used to assign the appropriate packing method:

(a) ORGANIC PEROXIDE, TYPE B or SELF-REACTIVE SUBSTANCE, TYPE B:

Packing method OP5 shall be assigned, provided that the organic peroxide (or self-reactive substance) satisfies the criteria of 20.4.3 (b) (resp. 20.4.2 (b)) of the Manual of Tests and Criteria in a packaging authorized by the packing method. If the organic peroxide (or self-reactive substance) can only satisfy these criteria in a smaller packaging than those authorized by packing method OP5 (viz. one of the packagings listed for OP1 to OP4), then the corresponding packing method with the lower OP number is assigned;

(b) ORGANIC PEROXIDE, TYPE C or SELF-REACTIVE SUBSTANCE, TYPE C:

Packing method OP6 shall be assigned, provided that the organic peroxide (or self-reactive substance) satisfies the criteria of 20.4.3 (c) (resp. 20.4.2 (c)) of the Manual of Tests and Criteria in a packaging authorized by the packing method. If the organic peroxide (or self-reactive substance) can only satisfy these criteria in a smaller packaging than those authorized by packing method OP6 then the corresponding packing method with the lower OP number is assigned;

(c) ORGANIC PEROXIDE, TYPE D or SELF-REACTIVE SUBSTANCE, TYPE D:

Packing method OP7 shall be assigned to this type of organic peroxide or self-reactive substance;

(d) ORGANIC PEROXIDE, TYPE E or SELF-REACTIVE SUBSTANCE, TYPE E:

Packing method OP8 shall be assigned to this type of organic peroxide or self-reactive substance;

(e) ORGANIC PEROXIDE, TYPE F or SELF-REACTIVE SUBSTANCE, TYPE F:

Packing method OP8 shall be assigned to this type of organic peroxide or self-reactive substance.

4.1.7.2 *Use of intermediate bulk containers*

4.1.7.2.1 The currently assigned organic peroxides specifically listed in the table of 2.2.52.4 and indicated with the letter "N" in the "Packing Method" column of that table may be carried in IBCs in accordance with packing instruction IBC520.

4.1.7.2.2 Other organic peroxides and self-reactive substances of type F may be carried in IBCs under conditions established by the competent authority of the country of origin when, on the basis of the appropriate tests, that competent authority is satisfied that such carriage may be safely conducted. The tests undertaken shall include those necessary:

(a) To prove that the organic peroxide (or self-reactive substance) complies with the principles for classification given in 20.4.3 (f) [resp. 20.4.2 (f)] of the Manual of Tests and Criteria, exit box F of Figure 20.1 (b) of the Manual;

(b) To prove the compatibility of all materials normally in contact with the substance during carriage;

(c) To determine, when applicable, the control and emergency temperatures associated with the carriage of the product in the IBC concerned as derived from the SADT;

(d) To design, when applicable, pressure and emergency relief devices; and

(e) To determine if any special provisions are necessary for safe carriage of the substance.

If the country of origin is not a Contracting Party to ADR, the classification and transport conditions shall be recognized by the competent authority of the first country Contracting Party to ADR reached by the consignment.

4.1.8 Special packing provisions for infectious substances (Class 6.2)

4.1.8.1 Consignors of infectious substances shall ensure that packages are prepared in such a manner that they arrive at their destination in good condition and present no hazard to persons or animals during carriage.

4.1.8.2 The definitions in 1.2.1 and the general provisions of 4.1.1.1 to 4.1.1.14, except 4.1.1.3 and 4.1.1.9 to 4.1.1.12, apply to infectious substances packages.

4.1.8.3 An itemized list of contents shall be enclosed between the secondary packaging and the outer packaging.

4.1.8.4 Before an empty packaging is returned to the consignor, or sent elsewhere, it shall be thoroughly disinfected or sterilized and any label or marking indicating that it had contained an infectious substance shall be removed or obliterated.

4.1.9 Special packing provisions for Class 7

4.1.9.1 ***General***

4.1.9.1.1 Radioactive material, packagings and packages shall meet the requirements of Chapter 6.4. The quantity of radioactive material in a package shall not exceed the limits specified in 2.2.7.7.1.

4.1.9.1.2 The non-fixed contamination on the external surfaces of any package shall be kept as low as practicable and, under routine conditions of transport, shall not exceed the following limits:

(a) 4 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters; and

(b) 0.4 Bq/cm^2 for all other alpha emitters.

These limits are applicable when averaged over any area of 300 cm^2 of any part of the surface.

4.1.9.1.3 A package shall not contain any other items except such articles and documents as are necessary for the use of the radioactive material. This requirement shall not preclude the carriage of low specific activity material or surface contaminated objects with other items. The carriage of such articles and documents in a package, or of low specific activity material or surface contaminated objects with other items may be permitted provided that there is no interaction between them and the packaging or its radioactive contents that would reduce the safety of the package.

4.1.9.1.4 Except as provided in 7.5.11, CV33, the level of non-fixed contamination on the external and internal surfaces of overpacks, containers, tanks and intermediate bulk containers shall not exceed the limits specified in 4.1.9.1.2.

4.1.9.1.5 Radioactive material with a subsidiary risk shall be carried in packagings, IBCs or tanks fully complying with the requirements of the relevant chapters of Part 6 as appropriate, as well as applicable requirements of Chapters 4.1 , 4.2 or 4.3 for that subsidiary risk.

4.1.9.2 ***Requirements and controls for carriage of LSA material and SCO***

4.1.9.2.1 The quantity of LSA material or SCO in a single Industrial package Type 1 (Type IP-1), Industrial package Type 2 (Type IP-2), Industrial package Type 3 (Type IP-3), or object or collection of objects, whichever is appropriate, shall be so restricted that the external radiation level at 3 m from the unshielded material or object or collection of objects does not exceed 10 mSv/h.

4.1.9.2.2 LSA material and SCO which is or contains fissile material shall meet the applicable requirements of 7.5.11, CV33 and 6.4.11.1.

4.1.9.2.3 LSA material and SCO in groups LSA-I and SCO-I may be carried unpackaged under the following conditions:

(a) All unpackaged material other than ores containing only naturally occurring radionuclides shall be carried in such a manner that under routine conditions of carriage there will be no escape of the radioactive contents from the vehicle nor will there be any loss of shielding;

(b) Each vehicle shall be under exclusive use, except when only carrying SCO-I on which the contamination on the accessible and the inaccessible surfaces is not greater than ten times the applicable level specified in 2.2.7.2; and

(c) For SCO-I where it is suspected that non-fixed contamination exists on inaccessible surfaces in excess of the values specified in 2.2.7.5 (a)(i), measures shall be taken to ensure that the radioactive material is not released into the vehicle.

4.1.9.2.4 LSA material and SCO, except as otherwise specified in 4.1.9.2.3, shall be packaged in accordance with the table below:

Industrial package requirements for LSA material and SCO

Radioactive contents	Industrial package type	
	Exclusive use	**Not under exclusive use**
LSA-I		
Solid [a]	Type IP-1	Type IP-1
Liquid	Type IP-1	Type IP-2
LSA-II		
Solid	Type IP-2	Type IP-2
Liquid and gas	Type IP-2	Type IP-3
LSA-III	Type IP-2	Type IP-3
SCO-I [a]	Type IP-1	Type IP-1
SCO-II	Type IP-2	Type IP-2

[a] *Under the conditions specified in 4.1.9.2.3, LSA-I material and SCO-I may be carried unpackaged.*

4.1.10 Special provisions for mixed packing

4.1.1.10.1 When mixed packing is permitted in accordance with the provisions of this section, different dangerous goods or dangerous goods and other goods may be packed together in combination packagings conforming to 6.1.4.2.1, provided that they do not react dangerously with one another and that all other relevant provisions of this Chapter are complied with.

NOTE 1*: See also 4.1.1.5 and 4.1.1.6.*

NOTE 2*: For goods of Class 7, see 4.1.9.*

4.1.10.2 Except for packages containing Class 1 goods only or Class 7 goods only, if wooden or fibreboard boxes are used as outer packagings, a package containing different goods packed together shall not weigh more than 100 kg.

4.1.10.3 Unless otherwise prescribed by a special provision applicable according to 4.1.10.4, dangerous goods of the same class and the same classification code may be packed together.

4.1.10.4 When indicated for a given entry in Column (9b) of Table A of Chapter 3.2, the following special provisions shall apply to the mixed packing of the goods assigned to that entry with other goods in the same package.

MP 1 May only be packed together with goods of the same type within the same compatibility group.

MP 2 Shall not be packed together with other goods.

MP 3 Mixed packing of UN No. 1873 with UN No. 1802 is permitted.

MP 4 Shall not be packed together with goods of other classes or with goods which are not subject to the requirements of ADR. However, if this organic peroxide is a hardener or compound system for Class 3 substances, mixed packing is permitted with these substances of Class 3.

MP 5 UN No. 2814 and UN No. 2900 may be packed together in a combination packaging in conformity with P620. They shall not be packed together with

other goods; this does not apply to diagnostic specimens packed in accordance with P650 or to substances added as coolants, e.g. ice, dry ice or refrigerated liquid nitrogen.

MP 6 Shall not be packed together with other goods. This does not apply to substances added as coolants, e.g. ice, dry ice or refrigerated liquid nitrogen.

MP 7 May - in quantities not exceeding 5 litres per inner packaging - be packed together in a combination packaging conforming to 6.1.4.21:

- with goods of the same class covered by other classification codes when mixed packing is also permitted for these; or

- with goods which are not subject to the requirements of ADR,

provided they do not react dangerously with one another.

MP 8 May - in quantities not exceeding 3 litres per inner packaging - be packed together in a combination packaging conforming to 6.1.4.21:

- with goods of the same class covered by other classification codes when mixed packing is also permitted for these; or

- with goods which are not subject to the requirements of ADR,

provided they do not react dangerously with one another.

MP 9 May be packed together in an outer packaging for combination packagings in accordance with 6.1.4.21:

- with other goods of Class 2;

- with goods of other classes, when the mixed packing is also permitted for these; or

- with goods which are not subject to the requirements of ADR,

provided they do not react dangerously with one another.

MP 10 May - in quantities not exceeding 5 kg per inner packaging - be packed together in a combination packaging conforming to 6.1.4.21:

- with goods of the same class covered by other classification codes or with goods of other classes, when mixed packing is also permitted for these; or

- with goods which are not subject to the requirements of ADR,

provided they do not react dangerously with one another.

MP 11 May - in quantities not exceeding 5 kg per inner packaging - be packed together in a combination packaging conforming to 6.1.4.21:

- with goods of the same class covered by other classification codes or with goods of other classes (except substances of packing group I or II of Class 5.1) when mixed packing is also permitted for these; or

- with goods which are not subject to the requirements of ADR,

provided they do not react dangerously with one another.

MP 12 May - in quantities not exceeding 5 kg per inner packaging - be packed together in a combination packaging conforming to 6.1.4.21:

- with goods of the same class covered by other classification codes or with goods of other classes (except substances of packing group I or II of Class 5.1) when mixed packing is also permitted for these; or

- with goods which are not subject to the requirements of ADR,

provided they do not react dangerously with one another.

Packagings shall not weigh more than 45 kg. If fibreboard boxes are used as outer packagings however, a package shall not weigh more than 27 kg.

MP 13 May - in quantities not exceeding 3 kg per inner packaging and per package - be packed together in a combination packaging conforming to 6.1.4.21:

- with goods of the same class covered by other classification codes or with goods of other classes, when mixed packing is also permitted for these; or

- with goods which are not subject to the requirements of ADR,

provided they do not react dangerously with one another.

MP 14 May - in quantities not exceeding 6 kg per inner packaging - be packed together in a combination packaging conforming to 6.1.4.21:

- with goods of the same class covered by other classification codes or with goods of other classes, when mixed packing is also permitted for these; or

- with goods which are not subject to the requirements of ADR,

provided they do not react dangerously with one another.

MP 15 May - in quantities not exceeding 3 litres per inner packaging - be packed together in a combination packaging conforming to 6.1.4.21:

- with goods of the same class covered by other classification codes or with goods of other classes, when mixed packing is also permitted for these; or

- with goods which are not subject to the requirements of ADR,

provided they do not react dangerously with one another.

MP 16 May - in quantities not exceeding 3 litres per inner packaging and per package - be packed together in a combination packaging conforming to 6.1.4.21:

- with goods of the same class covered by other classification codes or with goods of other classes, when mixed packing is also permitted for these; or

- with goods which are not subject to the requirements of ADR,

provided they do not react dangerously with one another.

MP 17 May - in quantities not exceeding 0.5 litre per inner packaging and 1 litre per package - be packed together in a combination packaging conforming to 6.1.4.21:

- with goods of other classes, except Class 7, when mixed packing is also permitted for these; or

- with goods which are not subject to the requirements of ADR,

provided they do not react dangerously with one another.

MP 18 May - in quantities not exceeding 0.5 kg per inner packaging and 1 kg per package - be packed together in a combination packaging conforming to 6.1.4.21:

- with goods or articles of other classes, except Class 7, when mixed packing is also permitted for these; or

- with goods which are not subject to the requirements of ADR,

provided they do not react dangerously with one another.

MP 19 May - in quantities not exceeding 5 litres per inner packaging - be packed together in a combination packaging conforming to 6.1.4.21:

- with goods of the same class covered by other classification codes or with goods of other classes, when mixed packing is also permitted for these; or

- with goods which are not subject to the requirements of ADR, provided they do not react dangerously with one another.

MP 20 May be packed together with substances covered by the same UN number.

Shall not be packed together with goods and articles of Class 1 having different UN numbers.

Shall not be packed together with goods of other classes or with goods which are not subject to the requirements of ADR.

MP 21 May be packed together with articles covered by the same UN number.

Shall not be packed together with goods of Class 1 having different UN numbers, except for

(a) their own means of initiation, provided that

(i) the means of initiation will not function under normal conditions of carriage; or

(ii) such means have at least two effective protective features which prevent explosion of an article in the event of accidental functioning of the means of initiation; or

(iii) when such means do not have two effective protective features (i.e. means of initiation assigned to compatibility group B), in the opinion of the competent authority of the country of origin[2], the accidental functioning of the means of initiation does not cause the explosion of an article under normal conditions of carriage;

(b) articles of compatibility groups C, D and E.

Shall not be packed together with goods of other classes or with goods which are not subject to the requirements of ADR.

When goods are packed together in accordance with this special provision, account shall be taken of a possible amendment of the classification of packages in accordance with 2.2.1.1. For the description of the goods in the transport document, see 5.4.1.2.1 (b).

MP 22 May be packed together with articles covered by the same UN number.

Shall not be packed together with goods of Class 1 having different UN numbers, except for

(a) their own means of initiation, provided that the means of initiation will not function under normal conditions of carriage;

(b) articles of compatibility groups C, D and E.

Shall not be packed together with goods of other classes or with goods which are not subject to the requirements of ADR.

When goods are packed together in accordance with this special provision, account shall be taken of a possible amendment of the classification of packages in accordance with 2.2.1.1. For the description of the goods in the transport document, see 5.4.1.2.1 (b).

MP 23 May be packed together with articles covered by the same UN number.

Shall not be packed together with goods and articles of Class 1 having different UN numbers ; however, exception is made for their own means of initiation, provided that the means of initiation will not function under normal conditions of carriage.

Shall not be packed together with goods of other classes or with goods which are not subject to the requirements of ADR.

When goods are packed together in accordance with this special provision, account shall be taken of a possible amendment of the classification of packages in accordance with 2.2.1.1. For the description of the goods in the transport document, see 5.4.1.2.1 (b).

MP 24 May be packed together with goods with the UN numbers shown in the table below, under the following conditions :

[2] *If the country of origin is not a Contracting Party to ADR, the approval shall require validation by the competent authority of the first country Contracting Party to ADR reached by the consignment.*

- if a letter A is indicated in the table, the goods with those UN numbers may be included in the same package without any special limitation of mass;

- if a letter B is indicated in the table, the goods with those UN numbers may be included in the same package up to a total mass of 50 kg of explosive substances.

When goods are packed together in accordance with this special provision, account shall be taken of a possible amendment of the classification of packages in accordance with 2.2.1.1. For the description of the goods in the transport document, see 5.4.1.2.1 (b).

UN No.	0012	0014	0027	0028	0044	0054	0160	0161	0186	0191	0194	0195	0197	0238	0240	0312	0333	0334	0335	0336	0337	0373	0405	0428	0429	0430	0431	0432
0012		A																										
0014	A																											
0027				B	B		B	B																				
0028			B		B		B	B																				
0044			B	B			B	B																				
0054									B	B	B	B	B	B	B	B						B	B	B	B	B	B	B
0160			B	B	B			B																				
0161			B	B	B		B																					
0186						B				B	B	B	B	B	B	B						B	B	B	B	B	B	B
0191						B			B		B	B	B	B	B	B						B	B	B	B	B	B	B
0194						B			B	B		B	B	B	B	B						B	B	B	B	B	B	B
0195						B			B	B	B		B	B	B	B						B	B	B	B	B	B	B
0197						B			B	B	B	B		B	B	B						B	B	B	B	B	B	B
0238						B			B	B	B	B	B		B	B						B	B	B	B	B	B	B
0240						B			B	B	B	B	B	B		B						B	B	B	B	B	B	B
0312						B			B	B	B	B	B	B	B							B	B	B	B	B	B	B
0333																		A	A	A	A							
0334																	A		A	A	A							
0335																	A	A		A	A							
0336																	A	A	A		A							
0337																	A	A	A	A								
0373						B			B	B	B	B	B	B	B	B							B	B	B	B	B	B
0405						B			B	B	B	B	B	B	B	B						B		B	B	B	B	B
0428						B			B	B	B	B	B	B	B	B						B	B		B	B	B	B
0429						B			B	B	B	B	B	B	B	B						B	B	B		B	B	B
0430						B			B	B	B	B	B	B	B	B						B	B	B	B		B	B
0431						B			B	B	B	B	B	B	B	B						B	B	B	B	B		B
0432						B			B	B	B	B	B	B	B	B						B	B	B	B	B	B	

CHAPTER 4.2

USE OF PORTABLE TANKS

NOTE: *For fixed tanks (tank-vehicles), demountable tanks and tank-containers and tank-swap bodies, with shells made of metallic materials, and battery-vehicles and multiple element gas containers (MEGCs), see Chapter 4.3; for fibre-reinforced plastics tanks, see Chapter 4.4; for vacuum operated waste tanks, see Chapter 4.5.*

4.2.1 General provisions for the use of portable tanks for the carriage of substances of Classes 3 to 9

4.2.1.1 This section provides general provisions applicable to the use of portable tanks for the carriage of substances of Classes 3, 4.1, 4.2, 4.3, 5.1, 5.2, 6.1, 6.2, 7, 8 and 9. In addition to these general provisions, portable tanks shall conform to the design, construction, inspection and testing requirements detailed in 6.7.2. Substances shall be carried in portable tanks conforming to the applicable portable tank instruction identified in Column (10) of the Table A of Chapter 3.2 and described in 4.2.4.2.6 (T1 to T23) and the portable tank special provisions assigned to each substance in Column (11) of Table A of Chapter 3.2 and described in 4.2.4.3.

4.2.1.2 During carriage, portable tanks shall be adequately protected against damage to the shell and service equipment resulting from lateral and longitudinal impact and overturning. If the shell and service equipment are so constructed as to withstand impact or overturning it need not be protected in this way. Examples of such protection are given in 6.7.2.17.5.

4.2.1.3 Certain substances are chemically unstable. They are accepted for carriage only when the necessary steps have been taken to prevent their dangerous decomposition, transformation or polymerization during carriage. To this end, care shall in particular be taken to ensure that shells do not contain any substances liable to promote these reactions.

4.2.1.4 The temperature of the outer surface of the shell excluding openings and their closures or of the thermal insulation shall not exceed 70 °C during carriage. When substances are carried at elevated temperatures in either liquid or solid state, the shell shall be thermally insulated to meet this condition.

4.2.1.5 Empty portable tanks not cleaned and not gas-free shall comply with the same provisions as portable tanks filled with the previous substance.

4.2.1.6 Substances shall not be carried in the same or in adjoining compartments of shells when they may react dangerously with each other (see definition for "dangerous reaction" in 1.2.1).

4.2.1.7 The design approval certificate, the test report and the certificate showing the results of the initial inspection and test for each portable tank issued by the competent authority or its authorized body shall be retained by the authority or body and the owner. Owners shall be able to provide this documentation upon the request of any competent authority.

4.2.1.8 Unless the name of the substance(s) being carried appears on the metal plate described in 6.7.2.20.2 a copy of the certificate specified in 6.7.2.18.1 shall be made available upon the request of a competent authority or its authorized body and readily provided by the consignor, consignee or agent, as appropriate.

4.2.1.9 ***Degree of filling***

4.2.1.9.1 Prior to filling, the consignor shall ensure that the appropriate portable tank is used and that the portable tank is not filled with substances which in contact with the materials of the shell, gaskets, service equipment and any protective linings, are likely to react dangerously with them to form dangerous products or appreciably weaken these materials. The consignor may need to consult the manufacturer of the substance in conjunction with the competent authority for guidance on the compatibility of the substance with the portable tank materials.

4.2.1.9.1.1 Portable tanks shall not be filled above the extent provided in 4.2.1.9.2 to 4.2.1.9.6. The applicability of 4.2.1.9.2, 4.2.1.9.3 or 4.2.1.9.5.1 to individual substances is specified in the applicable portable tank instruction or special provisions in 4.2.4.2.6 or 4.2.4.3 and Column (10) or (11) of Table A of Chapter 3.2.

4.2.1.9.2 The maximum degree of filling (in %) for general use is determined by the formula :

$$\textit{Degree of filling} = \frac{97}{1 + a\,(tr - tf)}$$

4.2.1.9.3 The maximum degree of filling (in %) for liquids of Class 6.1 and Class 8, in packing groups I and II, and liquids with an absolute vapour pressure of more than 175 kPa (1.75 bar) at 65 °C, is determined by the formula:

$$\textit{Degree of filling} = \frac{95}{1 + a\,(tr - tf)}$$

4.2.1.9.4 In these formulae, α is the means coefficient of cubical expansion of the liquid between the mean temperature of the liquid during filling (t_f) and the maximum mean bulk temperature during carriage (t_r) (both in °C). For liquids carried under ambient conditions α could be calculated by the formula:

$$a = \frac{d_{15} - d_{50}}{35 d_{50}}$$

in which d_{15} and d_{50} are the densities of the liquid at 15 °C and 50 °C, respectively.

4.2.1.9.4.1 The maximum mean bulk temperature (t_r) shall be taken as 50 °C except that, for journeys under temperature or extreme climatic conditions, the competent authorities concerned may agree to a lower or require a higher temperature, as appropriate.

4.2.1.9.5 The provisions of 4.2.1.9.2 to 4.2.1.9.4.1 do not apply to portable tanks which contain substances maintained at a temperature above 50 °C during carriage (eg by means of a heating device). For portable tanks equipped with a heating device, a temperature regulator shall be used to ensure the maximum degree of filling is not more than 95% full at any time during carriage.

4.2.1.9.5.1 The maximum degree of filling (in %) for liquids carried under elevated temperature conditions is determined by the formula:

$$\textit{Degree of filling} = 95 \frac{d_r}{d_f}$$

in which d_r and d_f are the densities of the liquid at the mean temperature of the liquid during filling and the maximum mean bulk temperature during carriage respectively.

4.2.1.9.6 Portable tanks shall not be offered for carriage:

(a) With a degree of filling, for liquids having a viscosity less than 2 680 mm^2/s at 20 °C or maximum temperature of the substance during carriage in the case of the heated substance, of more than 20% but less than 80% unless the shells of portable tanks are divided, by partitions or surge plates, into sections of not more than 7 500 litres capacity;

(b) With residue of substances previously carried adhering to the outside of the shell or service equipment;

(c) When leaking or damaged to such an extent that the integrity of the portable tank or its lifting or securing arrangements may be affected; and

(d) Unless the service equipment has been examined and found to be in good working order.

4.2.1.9.7 Forklift pockets of portable tanks shall be closed off when the tank is filled. This provision does not apply to portable tanks which according to 6.7.3.13.4 need not be provided with a means of closing off the forklift pockets.

4.2.1.10 ***Additional provisions applicable to the carriage of Class 3 substances in portable tanks***

4.2.1.10.1 All portable tanks intended for the carriage of flammable liquids shall be closed and be fitted with relief devices in accordance with 6.7.2.8 to 6.7.2.15.

4.2.1.10.1.1 For portable tanks intended for use only on land, open venting systems may be used if allowed according to Chapter 4.3.

4.2.1.11 ***Additional provisions applicable to the carriage of Classes 4.1, 4.2 or 4.3 substances (other than Class 4.1 self-reactive substances) in portable tanks***

(Reserved)

NOTE*: For Class 4.1 self-reactive substances, see 4.2.1.13.1.*

4.2.1.12 ***Additional provisions applicable to the carriage of Class 5.1 substances in portable tanks***

(Reserved)

4.2.1.13 ***Additional provisions applicable to the carriage of Class 5.2 substances and Class 4.1 self-reactive substances in portable tanks***

4.2.1.13.1 Each substance shall have been tested and a report submitted to the competent authority of the country of origin for approval. Notification thereof shall be sent to the competent authority of the country of destination. The notification shall contain relevant transport information and the report with test results. The tests undertaken shall include those necessary:

(a) To prove the compatibility of all materials normally in contact with the substance during carriage;

(b) To provide data for the design of the pressure and emergency relief devices taking into account the design characteristics of the portable tank.

Any additional provision necessary for safe carriage of the substance shall be clearly described in the report.

4.2.1.13.2 The following provisions apply to portable tanks intended for the carriage of Type F organic peroxides or Type F self-reactive substances with a Self-Accelerating Decomposition Temperature (SADT) of 55 °C or more. In case of conflict these provisions prevail over those specified in Section 6.7.2. Emergencies to be taken into account are self-accelerating decomposition of the substance and fire-engulfment as described in 4.2.1.13.8.

4.2.1.13.3 The additional provisions for carriage of organic peroxides or self-reactive substances with a SADT less than 55 °C in portable tanks shall be specified by the competent authority of the country of origin. Notification thereof shall be sent to the competent authority of the country of destination.

4.2.1.13.4 The portable tank shall be designed for a test pressure of at least 0.4 MPa (4 bar).

4.2.1.13.5 Portable tanks shall be fitted with temperature sensing devices.

4.2.1.13.6 Portable tanks shall be fitted with pressure-relief devices and emergency-relief devices. Vacuum-relief devices may also be used. Pressure-relief devices shall operate at pressures determined according to both the properties of the substance and the construction characteristics of the portable tank. Fusible elements are not allowed in the shell.

4.2.1.13.7 The pressure-relief devices shall consist of spring-loaded valves fitted to prevent significant build-up within the portable tank of the decomposition products and vapours released at a temperature of 50 °C. The capacity and start-to-discharge pressure of the relief valves shall be based on the results of the tests specified in 4.2.1.13.1. The start-to-discharge pressure shall, however, in no case be such that liquid would escape from the valve(s) if the portable tank were overturned.

4.2.1.13.8 The emergency-relief devices may be of the spring-loaded or frangible types, or a combination of the two, designed to vent all the decomposition products and vapours evolved during a period of not less than one hour of complete fire-engulfment as calculated by the following formula:

$$q = 70961 \times F \times A^{0.82}$$

where:

q =	heat absorption	[W]
A =	wetted area	[m^2]
F =	insulation factor	

F = 1 for non-insulated shells, or

$$F = \frac{U\,(923 - T)}{47032} \quad \textit{for insulated shells}$$

where:

K =	heat conductivity of insulation layer	[W·m^{-1}·K^{-1}]
L =	thickness of insulation layer	[m]
U =	K/L = heat transfer coefficient of the insulation	[W·m^{-2}·K^{-1}]
T =	temperature of the substance at relieving conditions	[K]

The start-to-discharge pressure of the emergency-relief device(s) shall be higher than that specified in 4.2.1.13.7 and based on the results of the tests referred to in 4.2.1.13.1. The emergency-relief devices shall be dimensioned in such a way that the maximum pressure in the portable tank never exceeds the test pressure of the tank.

***NOTE**: An example of a method to determine the size of emergency-relief devices is given in Appendix 5 of the "Manual of Tests and Criteria".*

4.2.1.13.9 For insulated portable tanks the capacity and setting of emergency-relief device(s) shall be determined assuming a loss of insulation from 1% of the surface area.

4.2.1.13.10 Vacuum-relief devices and spring-loaded valves shall be provided with flame arresters. Due attention shall be paid to the reduction of the relief capacity caused by the flame arrester.

4.2.1.13.11 Service equipment such as valves and external piping shall be so arranged that no substance remains in them after filling the portable tank.

4.2.1.13.12 Portable tanks may be either insulated or protected by a sun-shield. If the SADT of the substance in the portable tank is 55 °C or less, or the portable tank is constructed of aluminium, the portable tank shall be completely insulated. The outer surface shall be finished in white or bright metal.

4.2.1.13.13 The degree of filling shall not exceed 90% at 15 °C.

4.2.1.13.14 The marking as required in 6.7.2.20.2 shall include the UN number and the technical name with the approved concentration of the substance concerned.

4.2.1.13.15 Organic peroxides and self-reactive substances specifically listed in portable tank instruction T23 in 4.2.4.2.6 may be carried in portable tanks.

4.2.1.14 ***Additional provisions applicable to the carriage of Class 6.1 substances in portable tanks***

(Reserved)

4.2.1.15 ***Additional provisions applicable to the carriage of Class 7 substances in portable tanks***

4.2.1.15.1 Portable tanks used for the carriage of radioactive material shall not be used for the carriage of other goods.

4.2.1.15.2 The degree of filling for portable tanks shall not exceed 90% or, alternatively, any other value approved by the competent authority.

4.2.1.16 ***Additional provisions applicable to the carriage of Class 8 substances in portable tanks***

4.2.1.16.1 Pressure-relief devices of portable tanks used for the carriage of Class 8 substances shall be inspected at intervals not exceeding one year.

4.2.1.17 ***Additional provisions applicable to the carriage of Class 9 substances in portable tanks***

(Reserved)

4.2.2 General provisions for the use of portable tanks for the carriage of non-refrigerated liquefied gases

4.2.2.1 This section provides general provisions applicable to the use of portable tanks for the carriage of non-refrigerated liquefied gases.

4.2.2.2 Portable tanks shall conform to the design, construction, inspection and testing requirements detailed in 6.7.3. Non-refrigerated liquefied gases shall be carried in portable tanks conforming to portable tank instruction T50 as described in 4.2.4.2.6 and any portable tank special provisions assigned to specific non-refrigerated liquefied gases in Column (11) of Table A of Chapter 3.2 and described in 4.2.4.3.

4.2.2.3 During carriage, portable tanks shall be adequately protected against damage to the shell and service equipment resulting from lateral and longitudinal impact and overturning. If the shell and service equipment are so constructed as to withstand impact or overturning it need not be protected in this way. Examples of such protection are given in 6.7.3.13.5.

4.2.2.4 Certain non-refrigerated liquefied gases are chemically unstable. They are accepted for carriage only when the necessary steps have been taken to prevent their dangerous decomposition, transformation or polymerization during carriage. To this end, care shall in particular be taken to ensure that portable tanks do not contain any non-refrigerated liquefied gases liable to promote these reactions.

4.2.2.5 Unless the name of the gas(es) being carried appears on the metal plate described in 6.7.3.16.2, a copy of the certificate specified in 6.7.3.14.1 shall be made available upon a competent authority request and readily provided by the consignor, consignee or agent, as appropriate.

4.2.2.6 Empty portable tanks not cleaned and not gas-free shall comply with the same provisions as portable tanks filled with the previous non-refrigerated liquefied gas.

4.2.2.7 ***Filling***

4.2.2.7.1 Prior to filling the consignor shall ensure that the portable tank is approved for the non-refrigerated liquefied gas to be carried and that the portable tank is not loaded with non-refrigerated liquefied gases which in contact with the materials of the shell, gaskets, service equipment and any protective linings, are likely to react dangerously with them to form dangerous products or appreciably weaken these materials. During filling, the temperature of the non-refrigerated liquefied gas shall fall within the limits of the design temperature range.

4.2.2.7.2 The maximum mass of non-refrigerated liquefied gas per litre of shell capacity (kg/l) shall not exceed the density of the non-refrigerated liquefied gas at 50 °C multiplied by 0.95. Furthermore, the shell shall not be liquid-full at 60 °C.

4.2.2.7.3 Portable tanks shall not be filled above their maximum permissible gross mass and the maximum permissible load mass specified for each gas to be carried.

4.2.2.8 Portable tanks shall not be offered for carriage:

(a) In an ullage condition liable to produce an unacceptable hydraulic force due to surge within the shell;

(b) When leaking;

(c) When damaged to such an extent that the integrity of the tank or its lifting or securing arrangements may be affected; and

(d) Unless the service equipment has been examined and found to be in good working order.

4.2.2.9 Forklift pockets of portable tanks shall be closed off when the tank is filled. This provision does not apply to portable tanks which according to 6.7.4.12.4 need not be provided with a means of closing off the forklift pockets.

4.2.3 General provisions for the use of portable tanks for the carriage of refrigerated liquefied gases

4.2.3.1 This section provides general provisions applicable to the use of portable tanks for the carriage of refrigerated liquefied gases.

4.2.3.2 Portable tanks shall conform to the design, construction, inspection and testing requirements detailed in 6.7.4. Refrigerated liquefied gases shall be carried in portable tanks conforming to portable tank instruction T75 as described in 4.2.4.2.6 and the portable tank special provisions assigned to each substance in Column (11) of Table A of Chapter 3.2 and described in 4.2.4.3.

4.2.3.3 During carriage, portable tanks shall be adequately protected against damage to the shell and service equipment resulting from lateral and longitudinal impact and overturning. If the shell and service equipment are so constructed as to withstand impact or overturning it need not be protected in this way. Examples of such protection are provided in 6.7.4.12.5.

4.2.3.4 Unless the name of the gas(es) being carried appears on the metal plate described in 6.7.4.15.2, a copy of the certificate specified in 6.7.4.13.1 shall be made available upon a competent authority request and readily provided by the consignor, consignee or agent, as appropriate.

4.2.3.5 Empty portable tanks not cleaned and not gas-free shall comply with the same provisions as portable tanks filled with the previous substance.

4.2.3.6 *Filling*

4.2.3.6.1 Prior to filling the consignor shall ensure that the portable tank is approved for the refrigerated liquefied gas to be carried and that the portable tank is not loaded with refrigerated liquefied gases which in contact with the materials of the shell, gaskets, service equipment and any protective linings, are likely to react dangerously with them to form dangerous products or appreciably weaken these materials. During filling, the temperature of the refrigerated liquefied gas shall be within the limits of the design temperature range.

4.2.3.6.2 In estimating the initial degree of filling the necessary holding time for the intended journey including any delays which might be encountered shall be taken into consideration. The initial degree of filling of the shell, except as provided for in 4.2.3.6.3 and 4.2.3.6.4, shall be such that if the contents, except helium, were to be raised to a temperature at which the vapour pressure is equal to the maximum allowable working pressure (MAWP) the volume occupied by liquid would not exceed 98%.

4.2.3.6.3 Shells intended for the carriage of helium can be filled up to but not above the inlet of the pressure-relief device.

4.2.3.6.4 A higher initial degree of filling may be allowed, subject to approval by the competent authority, when the intended duration of carriage is considerably shorter than the holding time.

4.2.3.7 ***Actual holding time***

4.2.3.7.1 The actual holding time shall be calculated for each journey in accordance with a procedure recognized by the competent authority, on the basis of the following:

(a) The reference holding time for the refrigerated liquefied gas to be carried (see 6.7.4.2.8.1) (as indicated on the plate referred to in 6.7.4.15.1);

(b) The actual filling density;

(c) The actual filling pressure;

(d) The lowest set pressure of the pressure limiting device(s).

4.2.3.7.2 The actual holding time shall be marked either on the portable tank itself or on a metal plate firmly secured to the portable tank, in accordance with 6.7.4.15.2.

4.2.3.8 Portable tanks shall not be offered for carriage:

(a) In an ullage condition liable to produce an unacceptable hydraulic force due to surge within the shell;

(b) When leaking;

(c) When damaged to such an extent that the integrity of the portable tank or its lifting or securing arrangements may be affected;

(d) Unless the service equipment has been examined and found to be in good working order;

(e) Unless the actual holding time for the refrigerated liquefied gas being carried has been determined in accordance with 4.2.3.7 and the portable tank is marked in accordance with 6.7.4.15.2; and

(f) Unless the duration of carriage, after taking into consideration any delays which might be encountered, does not exceed the actual holding time.

4.2.3.9 Forklift pockets of portable tanks shall be closed off when the tank is filled. This provision does not apply to portable tanks which according to 6.7.4.12.4, need not be provided with a means of closing off the forklift pockets.

4.2.4 Portable tank instructions and special provisions

4.2.4.1 ***General***

4.2.4.1.1 This section includes the portable tank instructions and special provisions applicable to dangerous goods authorized to be carried in portable tanks. Each portable tank instruction is identified by an alpha-numeric code (e.g. T1). Column (10) of Table A of Chapter 3.2 indicates the portable tank instruction that shall be used for each substance permitted for carriage in a portable tank. When no portable tank instruction appears in Column (10) for a specific dangerous goods entry then carriage of the substance in portable tanks is not permitted unless a competent authority approval is granted as detailed in 6.7.1.3. Portable tank special provisions are assigned to specific dangerous goods in Column (11) of Table A of Chapter 3.2. Each portable tank special provision is identified by an alpha-numeric code (e.g. TP1). A listing of the portable tank special provisions is provided in 4.2.4.3.

4.2.4.2 ***Portable tank instructions***

4.2.4.2.1 Portable tank instructions apply to dangerous goods of Classes 2 to 9. Portable tank instructions provide specific information relevant to portable tanks provisions applicable to specific substances. These provisions shall be met in addition to the general provisions in this Chapter and the general requirements in Chapter 6.7.

4.2.4.2.2 For substances of Classes 3 to 9, the portable tank instructions indicate the applicable minimum test pressure, the minimum shell thickness (in reference steel), bottom opening requirements and pressure relief requirements. In portable tank instruction T23, self-reactive substances of Class 4.1 and Class 5.2 organic peroxides permitted to be carried in portable tanks are listed along with the applicable control and emergency temperatures.

4.2.4.2.3 Non-refrigerated liquefied gases are assigned to portable tank instruction T50. T50 provides the maximum allowable working pressures, the requirements for the openings below liquid level, pressure-relief requirements and maximum filling density requirements for non-refrigerated liquefied gases permitted for carriage in portable tanks.

4.2.4.2.4 Refrigerated liquefied gases are assigned to portable tank instruction T75.

4.2.4.2.5 *Determination of the appropriate portable tank instructions*

When a specific portable tank instruction is specified in Column (10) of Table A of Chapter 3.2 for a specific dangerous goods entry additional portable tanks which possess higher minimum test pressures, greater shell thicknesses, more stringent bottom opening and pressure-relief device arrangements may be used. The following guidelines apply to determining the appropriate portable tanks which may be used for carriage of particular substances:

Portable tank instruction specified	**Portable tank instructions also permitted**
T1	T2, T3, T4, T5, T6, T7, T8, T9, T10, T11, T12, T13, T14, T15, T16, T17, T18, T19, T20, T21, T22
T2	T4, T5, T6, T7, T8, T9, T10, T11, T12, T13, T14, T15, T16, T17, T18, T19, T20, T21, T22
T3	T4, T5, T6, T7, T8, T9, T10, T11, T12, T13, T14, T15, T16, T17, T18, T19, T20, T21, T22
T4	T5, T6, T7, T8, T9, T10, T11, T12, T13, T14, T15, T16, T17, T18, T19, T20, T21, T22
T5	T10, T14, T19, T20, T22
T6	T7, T8, T9, T10, T11, T12, T13, T14, T15, T16, T17, T18, T19, T20, T21, T22
T7	T8, T9, T10, T11, T12, T13, T14, T15, T16, T17, T18, T19, T20, T21, T22
T8	T9, T10, T13, T14, T19, T20, T21, T22
T9	T10, T13, T14, T19, T20, T21, T22
T10	T14, T19, T20, T22
T11	T12, T13, T14, T15, T16, T17, T18, T19, T20, T21, T22
T12	T14, T16, T18, T19, T20, T22
T13	T14, T19, T20, T21, T22
T14	T19, T20, T22
T15	T16, T17, T18, T19, T20, T21, T22
T16	T18, T19, T20, T22
T17	T18, T19, T20, T21, T22
T18	T19, T20, T22
T19	T20, T22
T20	T22
T21	T22
T22	None
T23	None

4.2.4.2.6 *Portable tank instructions*

T1 - T22	**PORTABLE TANK INSTRUCTIONS**	**T1 - T22**

These portable tank instructions apply to liquid and solid substances of Classes 3 to 9. The general provisions of Section 4.2.1 and the requirements of Section 6.7.2 shall be met.

Portable tank instruction	**Minimum test pressure (bar)**	**Minimum shell thickness (in mm-reference steel) (see 6.7.2.4)**	**Pressure-relief requirements (see 6.7.2.8)**	**Bottom opening requirements (see 6.7.2.6)**
T1	1.5	See 6.7.2.4.2	Normal	See 6.7.2.6.2
T2	1.5	See 6.7.2.4.2	Normal	See 6.7.2.6.3
T3	2.65	See 6.7.2.4.2	Normal	See 6.7.2.6.2
T4	2.65	See 6.7.2.4.2	Normal	See 6.7.2.6.3
T5	2.65	See 6.7.2.4.2	See 6.7.2.8.3	Not Allowed
T6	4	See 6.7.2.4.2	Normal	See 6.7.2.6.2
T7	4	See 6.7.2.4.2	Normal	See 6.7.2.6.3
T8	4	See 6.7.2.4.2	Normal	Not allowed
T9	4	6mm	Normal	Not allowed
T10	4	6mm	See 6.7.2.8.3	Not allowed
T11	6	See 6.7.2.4.2	Normal	See 6.7.2.6.3
T12	6	See 6.7.2.4.2	See 6.7.2.8.3	See 6.7.2.6.3
T13	6	6mm	Normal	Not allowed
T14	6	6mm	See 6.7.2.8.3	Not allowed
T15	10	See 6.7.2.4.2	Normal	See 6.7.2.6.3
T16	10	See 6.7.2.4.2	See 6.7.2.8.3	See 6.7.2.6.3
T17	10	6mm	Normal	See 6.7.2.6.3
T18	10	6mm	See 6.7.2.8.3	See 6.7.2.6.3
T19	10	6mm	See 6.7.2.8.3	Not allowed
T20	10	8mm	See 6.7.2.8.3	Not allowed
T21	10	10mm	Normal	Not allowed
T22	10	10mm	See 6.7.2.8.3	Not allowed

T23 **PORTABLE TANK INSTRUCTION** **T23**

This portable tank instruction applies to self-reactive substances of Class 4.1 and organic peroxides of Class 5.2. The general provisions of Section 4.2.1 and the requirements of Section 6.7.2 shall be met. The additional provisions specific to self-reactive substances of Class 4.1 and organic peroxides of Class 5.2 in 4.2.1.13 shall also be met.

UN No.	Substance	Minimum test pressure (bar)	Minimum shell thickness (mm-reference steel)	Bottom opening requi-rements	Pressure-relief requi-rements	Degree of filling	Control tempe-rature	Emergency tempe-rature
3109	ORGANIC PEROXIDE, TYPE F, LIQUID tert-Butyl hydro-peroxide [a], not more than 72% with water Cumyl hydro-peroxide, not more than 90% in diluent type A Di-tert-butyl peroxide, not more than 32% in diluent type A Isopropyl cumyl hydro-peroxide, not more than 72% in diluent type A p-Menthyl hydro-peroxide, not more than 72% in diluent type A Pinanyl hydro-peroxide, not more than 50% in diluent type A	4	See 6.7.2.4.2	See 6.7.2.6.3	See 6.7.2.8.2 4.2.1.13.6 4.2.1.13.7 4.2.1.13.8	See 4.2.1.13.13		
3110	ORGANIC PEROXIDE TYPE F, SOLID Dicumyl peroxide [b]	4	See 6.7.2.4.2	See 6.7.2.6.3	See 6.7.2.8.2 4.2.1.13.6 4.2.1.13.7 4.2.1.13.8	See 4.2.1.13.13		

[a] *Provided that steps have been taken to achieve the safety equivalence of 65% tert-Butyl hydroperoxide and 35% water.*

[b] *Maximum quantity per portable tank: 2000 kg.*

T23 **PORTABLE TANK INSTRUCTION (cont'd)** **T23**

This portable tank instruction applies to self-reactive substances of Class 4.1 and organic peroxides of Class 5.2. The general provisions of Section 4.2.1 and the requirements of Section 6.7.2 shall be met. The additional provisions specific to self-reactive substances of Class 4.1 and organic peroxides of Class 5.2 in 4.2.1.13 shall also be met.

UN No.	Substance	Minimum test pressure (bar)	Minimum shell thickness (mm-reference steel)	Bottom opening requi-rements	Pressure-relief requi-rements	Degree of filling	Control tempe-rature	Emergency tempe-rature
3119	ORGANIC PEROXIDE, TYPE F, LIQUID, TEMPERATURE CONTROLLED	4	See 6.7.2.4.2	See 6.7.2.6.3	See 6.7.2.8.2 4.2.1.13.6 4.2.1.13.7 4.2.1.13.8	See 4.2.1.13.13	[c]	[c]
	tert-Butyl peroxyacetate, not more than 32% in diluent type B						+30 °C	+35 °C
	tert-Butyl peroxy-2-ethylhexanoate, not more than 32% in diluent type B						+15 °C	+20 °C
	tert-Butyl peroxypivalate, not more than 27% in diluent type B						+5 °C	+10 °C
	tert-Butyl peroxy-3,5,5-trimethyl-hexanoate, not more than 32% in diluent type B						+35 °C	+40 °C
	Di-(3,5,5-trimethyl-hexanoyl) peroxide, not more than 38% in diluent type A						0 °C	+5 °C
3120	ORGANIC PEROXIDE, TYPE F, SOLID, TEMPERATURE CONTROLLED	4	See 6.7.2.4.2	See 6.7.2.6.3	See 6.7.2.8.2 4.2.1.13.6 4.2.1.13.7 4.2.1.13.8	See 4.2.1.13.13	[c]	[c]
3229	SELF-REACTIVE LIQUID TYPE F	4	See 6.7.2.4.2	See 6.7.2.6.3	See 6.7.2.8.2 4.2.1.13.6 4.2.1.13.7 4.2.1.13.8	See 4.2.1.13.13		

[c] *As approved by the competent authority.*

T23 **PORTABLE TANK INSTRUCTION (cont'd)** **T23**

This portable tank instruction applies to self-reactive substances of Class 4.1 and organic peroxides of Class 5.2. The general provisions of Section 4.2.1 and the requirements of Section 6.7.2 shall be met. The additional provisions specific to self-reactive substances of Class 4.1 and organic peroxides of Class 5.2 in 4.2.1.13 shall also be met.

UN No.	Substance	Minimum test pressure (bar)	Minimum shell thickness (mm-reference steel)	Bottom opening requi-rements	Pressure-relief requi-rements	Degree of filling	Control tempe-rature	Emergency tempe-rature
3230	SELF-REACTIVE SOLID TYPE F	4	See 6.7.2.4.2	See 6.7.2.6.3	See 6.7.2.8.2 4.2.1.13.6 4.2.1.13.7 4.2.1.13.8	See 4.2.1.13.13		
3239	SELF-REACTIVE LIQUID TYPE F, TEMPERATURE CONTROLLED	4	See 6.7.2.4.2	See 6.7.2.6.3	See 6.7.2.8.2 4.2.1.13.6 4.2.1.13.7 4.2.1.13.8	See 4.2.1.13.13	[c]	[c]
3240	SELF-REACTIVE SOLID TYPE F, TEMPERATURE CONTROLLED	4	See 6.7.2.4.2	See 6.7.2.6.3	See 6.7.2.8.2 4.2.1.13.6 4.2.1.13.7 4.2.1.13.8	See 4.2.1.13.13	[c]	[c]

[c] *As approved by the competent authority.*

T50 **PORTABLE TANK INSTRUCTION** **T50**

This portable tank instruction applies to non-refrigerated liquefied gases. The general provisions of Section 4.2.2 and the requirements of Section 6.7.3 shall be met.

UN No.	Non-refrigerated liquefied gases	Max. allowable working pressure (bar) Small; Bare; Sunshield; Insulated	Openings below liquid level	Pressure-relief requirements (see 6.7.3.7)	Maximum filling density (kg/l)
1005	Ammonia, anhydrous	29.0 25.7 22.0 19.7	Allowed	See 6.7.3.7.3	0.53
1009	Bromotrifluoromethane (Refrigerant gas R 13B1)	38.0 34.0 30.0 27.5	Allowed	Normal	1.13
1010	Butadienes, stabilized	7.5 7.0 7.0 7.0	Allowed	Normal	0.55
1011	Butane	7.0 7.0 7.0 7.0	Allowed	Normal	0.51

T50 **PORTABLE TANK INSTRUCTION (cont'd)** **T50**

This portable tank instruction applies to non-refrigerated liquefied gases. The general provisions of Section 4.2.2 and the requirements of Section 6.7.3 shall be met.

UN No.	Non-refrigerated liquefied gases	Max. allowable working pressure (bar) Small; Bare; Sunshield; Insulated	Openings below liquid level	Pressure-relief requirements (see 6.7.3.7)	Maximum filling density (kg/l)
1012	Butylene	8.0 7.0 7.0 7.0	Allowed	Normal	0.53
1017	Chlorine	19.0 17.0 15.0 13.5	Not Allowed	See 6.7.3.7.3	1.25
1018	Chlorodifluoromethane (Refrigerant gas R 22)	26.0 24.0 21.0 19.0	Allowed	Normal	1.03
1020	Chloropentafluoroethane (Refrigerant gas R 115)	23.0 20.0 18.0 16.0	Allowed	Normal	1.06
1021	1-Chloro-1,2,2,2-tetrafluoroethane (Refrigerant gas R 124)	10.3 9.8 7.9 7.0	Allowed	Normal	1.20
1027	Cyclopropane	18.0 16.0 14.5 13.0	Allowed	Normal	0.53
1028	Dichlorodifluoromethane (Refrigerant gas R 12)	16.0 15.0 13.0 11.5	Allowed	Normal	1.15
1029	Dichlorofluoromethane (Refrigerant gas R 21)	7.0 7.0 7.0 7.0	Allowed	Normal	1.23
1030	1,1-Difluoroethane (Refrigerant gas R 152a)	16.0 14.0 12.4 11.0	Allowed	Normal	0.79
1032	Dimethylamine, anhydrous	7.0 7.0 7.0 7.0	Allowed	Normal	0.59
1033	Dimethyl ether	15.5 13.8 12.0 10.6	Allowed	Normal	0.58

T50 **PORTABLE TANK INSTRUCTION (cont'd)** **T50**

This portable tank instruction applies to non-refrigerated liquefied gases. The general provisions of Section 4.2.2 and the requirements of Section 6.7.3 shall be met.

UN No.	Non-refrigerated liquefied gases	Max. allowable working pressure (bar) Small; Bare; Sunshie ld; Insulated	Openings below liquid level	Pressure - relief requirements (see 6.7.3.7)	Maximum filling density (kg/l)
1036	Ethylamine	7.0 7.0 7.0 7.0	Allowed	Normal	0.61
1037	Ethyl chloride	7.0 7.0 7.0 7.0	Allowed	Normal	0.80
1040	Ethylene oxide with nitrogen up to a total pressure of 1MPa (10 bar) at 50 °C	- - - 10.0	Not Allowed	See 6.7.3.7.3	0.78
1041	Ethylene oxide and carbon dioxide mixture with more than 9% but not more than 87% ethylene oxide	See MAWP definition in 6.7.3.1	Allowed	Normal	See 4.2.2.7
1055	Isobutylene	8.1 7.0 7.0 7.0	Allowed	Normal	0.52
1060	Methyllacetylene and propadiene mixture, stabilized	28.0 24.5 22.0 20.0	Allowed	Normal	0.43
1061	Methylamine, anhydrous	10.8 9.6 7.8 7.0	Allowed	Normal	0.58
1062	Methyl bromide	7.0 7.0 7.0 7.0	Not Allowed	See 6.7.3.7.3	1.51
1063	Methyl chloride (Refrigerant gas R 40)	14.5 12.7 11.3 10.0	Allowed	Normal	0.81
1064	Methyl mercaptan	7.0 7.0 7.0 7.0	Not Allowed	See 6.7.3.7.3	0.78
1067	Dinitrogen tetroxide	7.0 7.0 7.0 7.0	Not Allowed	See 6.7.3.7.3	1.30

T50 **PORTABLE TANK INSTRUCTION (cont'd)** **T50**

This portable tank instruction applies to non-refrigerated liquefied gases. The general provisions of Section 4.2.2 and the requirements of Section 6.7.3 shall be met.

UN No.	Non-refrigerated liquefied gases	Max. allowable working pressure (bar) Small; Bare; Sunshield; Insulated	Openings below liquid level	Pressure-relief requirements (see 6.7.3.7)	Maximum filling density (kg/l)
1075	Petroleum gas, liquefied	See MAWP definition in 6.7.3.1	Allowed	Normal	See 4.2.2.7
1077	Propylene	28.0 24.5 22.0 20.0	Allowed	Normal	0.43
1078	Refrigerant gas, n.o.s.	See MAWP definition in 6.7.3.1	Allowed	Normal	See 4.2.2.7
1079	Sulphur dioxide	11.6 10.3 8.5 7.6	Not Allowed	See 6.7.3.7.3	1.23
1082	Trifluorochloroethylene, stabilized (Refrigerant gas R 1113)	17.0 15.0 13.1 11.6	Not Allowed	See 6.7.3.7.3	1.13
1083	Trimethylamine, anhydrous	7.0 7.0 7.0 7.0	Allowed	Normal	0.56
1085	Vinyl bromide, stabilized	7.0 7.0 7.0 7.0	Allowed	Normal	1.37
1086	Vinyl chloride, stabilized	10.6 9.3 8.0 7.0	Allowed	Normal	0.81
1087	Vinyl methyl ether, stabilized	7.0 7.0 7.0 7.0	Allowed	Normal	0.67
1581	Chloropicrin and methyl bromide mixture	7.0 7.0 7.0 7.0	Not Allowed	See 6.7.3.7.3	1.51
1582	Chloropicrin and methyl chloride mixture	19.2 16.9 15.1 13.1	Not Allowed	See 6.7.3.7.3	0.81

T50 **PORTABLE TANK INSTRUCTION (cont'd)** **T50**

This portable tank instruction applies to non-refrigerated liquefied gases. The general provisions of Section 4.2.2 and the requirements of Section 6.7.3 shall be met.

UN No.	Non-refrigerated liquefied gases	Max. allowable working pressure (bar) Small; Bare; Sunshield; Insulated	Openings below liquid level	Pressure-relief requirements (see 6.7.3.7)	Maximum filling density (kg/l)
1858	Hexafluoropropylene (Refrigerant gas R 1216)	19.2 16.9 15.1 13.1	Allowed	Normal	1.11
1912	Methyl chloride and methylene chloride mixture	15.2 13.0 11.6 10.1	Allowed	Normal	0.81
1958	1,2-Dichloro-1,1,2,2-tetrafluoroethane (Refrigerant gas R 114)	7.0 7.0 7.0 7.0	Allowed	Normal	1.30
1965	Hydrocarbon gas, mixture liquefied, n.o.s.	See MAWP definition in 6.7.3.1	Allowed	Normal	See 4.2.2.7
1969	Isobutane	8.5 7.5 7.0 7.0	Allowed	Normal	0.49
1973	Chlorodifluoromethane and chloropentafluoroethane mixture with fixed boiling point, with approximately 49% chlorodifluoromethane (Refrigerant gas R 502)	28.3 25.3 22.8 20.3	Allowed	Normal	1.05
1974	Chlorodifluorobromomethane (Refrigerant gas R 12B1)	7.4 7.0 7.0 7.0	Allowed	Normal	1.61
1976	Octafluorocyclobutane (Refrigerant gas RC 318)	8.8 7.8 7.0 7.0	Allowed	Normal	1.34
1978	Propane	22.5 20.4 18.0 16.5	Allowed	Normal	0.42
1983	1-Chloro-2,2,2-trifluoroethane (Refrigerant gas R 133a)	7.0 7.0 7.0 7.0	Allowed	Normal	1.18
2035	1,1,1-Trifluoroethane (Refrigerant gas R 143a)	31.0 27.5 24.2 21.8	Allowed	Normal	0.76

T50 **PORTABLE TANK INSTRUCTION (cont'd)** **T50**

This portable tank instruction applies to non-refrigerated liquefied gases. The general provisions of Section 4.2.2 and the requirements of Section 6.7.3 shall be met.

UN No.	Non-refrigerated liquefied gases	Max. allowable working pressure (bar) Small; Bare; Sunshield; Insulated	Openings below liquid level	Pressure-relief requirements (see 6.7.3.7)	Maximum filling density (kg/l)
2424	Octafluoropropane (Refrigerant gas R 218)	23.1 20.8 18.6 16.6	Allowed	Normal	1.07
2517	1-Chloro-1,1-difluoroethane (Refrigerant gas R 142b)	8.9 7.8 7.0 7.0	Allowed	Normal	0.99
2602	Dichlorodifluoromethane and difluoroethane azeotropic mixture with approximately 74% dichlorodifluoromethane (Refrigerant gas R 500)	20.0 18.0 16.0 14.5	Allowed	Normal	1.01
3057	Trifluoroacetyl chloride	14.6 12.9 11.3 9.9	Not allowed	6.7.3.7.3	1.17
3070	Ethylene oxide and dichlorodifluoromethane mixture with not more than 12.5% ethylene oxide	14.0 12.0 11.0 9.0	Allowed	6.7.3.7.3	1.09
3153	Perfluoro (methyl vinyl ether)	14.3 13.4 11.2 10.2	Allowed	Normal	1.14
3159	1,1,1,2-Tetrafluoroethane (Refrigerant gas R 134a)	17.7 15.7 13.8 12.1	Allowed	Normal	1.04
3161	Liquefied gas, flammable, n.o.s.	See MAWP definition in 6.7.3.1	Allowed	Normal	See 4.2.2.7
3163	Liquefied gas, n.o.s.	See MAWP definition in 6.7.3.1	Allowed	Normal	See 4.2.2.7
3220	Pentafluoroethane (Refrigerant gas R 125)	34.4 30.8 27.5 24.5	Allowed	Normal	0.95
3252	Difluoromethane (Refrigerant gas R 32)	43.0 39.0 34.4 30.5	Allowed	Normal	0.78

T50 **PORTABLE TANK INSTRUCTION (cont'd)** **T50**

This portable tank instruction applies to non-refrigerated liquefied gases. The general provisions of Section 4.2.2 and the requirements of Section 6.7.3 shall be met.

UN No.	Non-refrigerated liquefied gases	Max. allowable working pressure (bar) Small; Bare; Sunshield; Insulated	Openings below liquid level	Pressure-relief requirements (see 6.7.3.7)	Maximum filling density (kg/l)
3296	Heptafluoropropane (Refrigerant gas R 227)	16.0 14.0 12.5 11.0	Allowed	Normal	1.20
3297	Ethylene oxide and chlorotetrafluoroethane mixture, with not more than 8.8% ethylene oxide	8.1 7.0 7.0 7.0	Allowed	Normal	1.16
3298	Ethylene oxide and pentafluoroethane mixture, with not more than 7.9% ethylene oxide	25.9 23.4 20.9 18.6	Allowed	Normal	1.02
3299	Ethylene oxide and tetrafluoroethane mixture, with not more than 5.6% ethylene oxide	16.7 14.7 12.9 11.2	Allowed	Normal	1.03
3318	Ammonia solution, relative density less than 0.880 at 15 °C in water, with more than 50% ammonia	See MAWP definition in 6.7.3.1	Allowed	See 6.7.3.7.3	See 4.2.2.7
3337	Refrigerant gas R 404A	31.6 28.3 25.3 22.5	Allowed	Normal	0.84
3338	Refrigerant gas R 407A	31.3 28.1 25.1 22.4	Allowed	Normal	0.95
3339	Refrigerant gas R 407B	33.0 29.6 26.5 23.6	Allowed	Normal	0.95
3340	Refrigerant gas R 407C	29.9 26.8 23.9 21.3	Allowed	Normal	0.95

T75 **PORTABLE TANK INSTRUCTION** **T75**

This portable tank instruction applies to refrigerated liquefied gases. The general provisions of Section 4.2.3 and the requirements of Section 6.7.4 shall be met.

4.2.4.3 ***Portable tank special provisions***

Portable tank special provisions are assigned to certain substances to indicate provisions which are in addition to or in lieu of those provided by the portable tank instructions or the requirements in Chapter 6.7. Portable tank special provisions are identified by an alpha numeric code beginning with the letters "TP" (tank provision) and are assigned to specific substances in Column (11) of Table A of Chapter 3.2. The following is a list of the portable tank special provisions:

TP1 The degree of filling prescribed in 4.2.1.9.2 shall not be exceeded.

$$(\text{Degree of filling} = \frac{97}{1 + \alpha\ (tr - tf)})$$

TP2 The degree of filling prescribed in 4.2.1.9.3 shall not be exceeded.

$$(\text{Degree of filling} = \frac{95}{1 + \alpha\ (tr - tf)})$$

TP3 For liquids carried under elevated temperature conditions the degree of filling prescribed in 4.2.1.9.5.1 shall not be exceeded.

$$(\text{Degree of filling} = 95\ \frac{dr}{df})$$

TP4 The degree of filling shall not exceed 90% or, alternatively, any other value approved by the competent authority (see 4.2.1.15.2).

TP5 *(Reserved)*

TP6 To prevent the tank bursting in any event, including fire engulfment, it shall be provided with pressure-relief devices which are adequate in relation to the capacity of the tank and to the nature of the substance carried. The device shall also be compatible with the substance.

TP7 Air shall be eliminated from the vapour space by nitrogen or other means.

TP8 The test pressure may be reduced to 1.5 bar when the flash point of the substances carried is greater than 0 °C.

TP9 A substance under this description shall only be carried in a portable tank under an approval granted by the competent authority.

TP10 A lead lining, not less than 5 mm thick, which shall be tested annually, or another suitable lining material approved by the competent authority is required.

TP12 This substance is highly corrosive to steel.

TP13 Self-contained breathing apparatus shall be provided when this substance is carried.

TP16 The tank shall be fitted with a special device to prevent under-pressure and excess pressure during normal carriage conditions. This device shall be approved by the competent authority.
Pressure-relief requirements are as indicated in 6.7.2.8.3 to prevent crystallization of the product in the pressure-relief valve.

TP17 Only inorganic non-combustible materials shall be used for thermal insulation of the tank.

TP18 Temperature shall be maintained between 18 °C and 40 °C. Portable tanks containing solidified methacrylic acid shall not be reheated during carriage.

TP19 The calculated shell thickness shall be increased by 3 mm. Shell thickness shall be verified ultrasonically at intervals midway between periodic hydraulic tests.

TP20 This substance shall only be carried in insulated tanks under a nitrogen blanket.

TP21 The shell thickness shall be not less than 8 mm. Tanks shall be hydraulically tested and internally inspected at intervals not exceeding 2.5 years.

TP22 Lubricant for joints or other devices shall be oxygen compatible.

TP23 Carriage permitted under special conditions prescribed by the competent authorities.

TP24 The portable tank may be fitted with a device located under maximum filling conditions in the vapour space of the shell to prevent the build up of excess pressure due to the slow decomposition of the substance carried. This device shall also prevent an unacceptable amount of leakage of liquid in the case of overturning or entry of foreign matter into the tank. This device shall be approved by the competent authority or its authorized body.

TP25 Sulphur trioxide 99.95% pure and above may be carried in tanks without an inhibitor provided that it is maintained at a temperature equal to or above 32.5 °C.

TP26 When carried under heated conditions, the heating device shall be fitted outside the shell. For UN 3176 this requirement only applies when the substance reacts dangerously with water.

TP27 A portable tank having a minimum test pressure of 4 bar may be used if it is shown that a test pressure of 4 bar or less is acceptable according to the test pressure definition in 6.7.2.1.

TP28 A portable tank having a minimum test pressure of 2.65 bar may be used if it is shown that a test pressure of 2.65 bar or less is acceptable according to the test pressure definition in 6.7.2.1.

TP29 A portable tank having a minimum test pressure of 1.5 bar may be used if it is shown that a test pressure of 1.5 bar or less is acceptable according to the test pressure definition in 6.7.2.1.

CHAPTER 4.3

USE OF FIXED TANKS (TANK-VEHICLES), DEMOUNTABLE TANKS, TANK-CONTAINERS AND TANK SWAP BODIES WITH SHELLS MADE OF METALLIC MATERIALS, AND BATTERY-VEHICLES AND MULTIPLE-ELEMENT GAS CONTAINERS (MEGCs)

NOTE: *For portable tanks see Chapter 4.2; for fibre-reinforced plastics tanks, see Chapter 4.4; for vacuum operated waste tanks, see Chapter 4.5.*

4.3.1 Scope

4.3.1.1 Provisions which take up the whole width of the page apply both to fixed tanks (tank-vehicles), demountable tanks and battery-vehicles, and to tank-containers, tank swap bodies and MEGCs. Provisions contained in a single column apply only to:

- fixed tanks (tank-vehicles), demountable tanks and battery-vehicles (left-hand column);
- tank-containers, tank swap bodies and MEGCs (right-hand column).

4.3.1.2 These provisions apply to:

fixed tanks (tank-vehicles), demountable tanks and battery-vehicles	tank-containers, tank swap bodies and MEGCs

used for the carriage of gaseous, liquid, powdery or granular substances.

4.3.1.3 Section 4.3.2 lists the provisions applicable to fixed tanks (tank-vehicles), demountable tanks, tank-containers and tank swap bodies, intended for the carriage of substances of all classes, and to battery-vehicles and MEGCs intended for the carriage of gases of Class 2. Sections 4.3.3 and 4.3.4 contain special provisions adding to or amending the provisions of Section 4.3.2.

4.3.1.4 For requirements concerning the construction, equipment, type approval, tests and marking, see Chapter 6.8.

4.3.1.5 For transitional measures concerning the application of this Chapter, see:

1.6.3	1.6.4

4.3.2 Provisions applicable to all classes

4.3.2.1 *Use*

4.3.2.1.1 A substance subject to ADR may be carried in fixed tanks (tank-vehicles), demountable tanks, battery-vehicles, tank-containers, tank swap bodies and MEGCs only when provision is made for a tank code according to 4.3.3.1.1 and 4.3.4.1.1 in Column (12) of Table A in Chapter 3.2.

4.3.2.1.2 The required type of tank, battery-vehicle and MEGC is given in code form in Column (12) of Table A in Chapter 3.2. The identification codes appearing there are made up of letters or numbers in a given order. The explanations for reading the four parts of the code are given in 4.3.3.1.1 (when the substance to be carried belongs to Class 2) and in 4.3.4.1.1 (when the substance to be carried belongs to Classes 3 to 9) [1].

[1] *An exception is made for tanks intended for the carriage of substances of classes 5.2 or 7 (see 4.3.4.1.3).*

4.3.2.1.3 The required type according to 4.3.2.1.2 corresponds to the least stringent construction requirements which are acceptable for the dangerous substance in question unless otherwise prescribed in this Chapter or in Chapter 6.8. It is possible to use tanks corresponding to codes prescribing a higher minimum calculation pressure, or more stringent requirements for filling or discharge openings or for safety valves/devices (see 4.3.3.1.1 for Class 2 and 4.3.4.1.1 for Classes 3 to 9).

4.3.2.1.4 For certain substances, tanks, battery-vehicles or MEGCs are subject to additional provisions which are included as special provisions in Column (13) of Table A in Chapter 3.2.

4.3.2.1.5 Tanks, battery-vehicles and MEGCs shall not be loaded with any dangerous substances other than those for the carriage of which they have been approved according to 6.8.2.3.1 and which, in contact with the materials of the shell, gaskets, equipment and protective linings, are not liable to react dangerously with them (see "dangerous reaction" in 1.2.1), to form dangerous products or appreciably to weaken these materials[2].

4.3.2.1.6 Foodstuffs shall not be carried in tanks used for dangerous substances unless the necessary steps have been taken to prevent any harm to public health.

4.3.2.2 ***Degree of filling***

4.3.2.2.1 The following degrees of filling shall not be exceeded in tanks intended for the carriage of liquids at ambient temperatures:

(a) for flammable substances without additional risks (e.g. toxicity or corrosivity), in tanks with a venting system or with safety valves (even where preceded by a bursting disc):

$$\text{degree of filling} = \frac{100}{1 + a\,(50 - t_F)} \text{ \% of capacity}$$

(b) for toxic or corrosive substances (whether flammable or not) in tanks with a venting system or with safety valves (even where preceded by a bursting disc):

$$\text{degree of filling} = \frac{98}{1 + a\,(50 - t_F)} \text{ \% of capacity}$$

(c) for flammable substances and for slightly toxic or corrosive substances (whether flammable or not) in hermetically closed tanks without a safety device:

$$\text{degree of filling} = \frac{97}{1 + a\,(50 - t_F)} \text{ \% of capacity}$$

(d) for highly toxic, toxic, highly corrosive or corrosive substances (whether flammable or not) in hermetically closed tanks without a safety device:

$$\text{degree of filling} = \frac{95}{1 + a\,(50 - t_F)} \text{ \% of capacity}$$

4.3.2.2.2 In these formulae, α is the mean coefficient of cubical expansion of the liquid between 15 °C and 50 °C, i.e. for a maximum variation in temperature of 35 °C.

---

2 *It may be necessary to consult the manufacturer of the substance and the competent authority for guidance on the compatibility of the substance with the materials of the tank, battery-vehicle or MEGC.*

α is calculated by the formula:

$$a = \frac{D_{15} - d_{50}}{35 d_{50}}$$

where d_{15} and d_{50} are the relative densities of the liquid at 15 °C and 50 °C respectively.
t_F is the mean temperature of the liquid during filling.

4.3.2.2.3 The provisions of 4.3.2.2.1 (a) to (d) above shall not apply to tanks whose contents are, by means of a heating device, maintained at a temperature above 50 °C during carriage. In this case the degree of filling at the outset shall be such, and the temperature so regulated, that the tank is not full to more than 95% of its capacity and that the filling temperature is not exceeded, at any time during carriage.

4.3.2.2.4 Where shells intended for the carriage of liquids[3] are not divided by partitions or surge plates into sections of not more than 7 500 litres capacity, they shall be filled to not less than 80% or not more than 20% of their capacity.

4.3.2.3 ***Operation***

4.3.2.3.1 The thickness of the walls of the shell shall not, throughout its use, fall below the minimum figure prescribed in:

6.8.2.1.17 to 6.8.2.1.21	6.8.2.1.17 to 6.8.1.20

4.3.2.3.2

	During carriage tank-containers/MEGCs shall be loaded on the carrying vehicle in such a way as to be adequately protected by the fittings of the carrying vehicle or of the tank-container/ MEGC itself against lateral and longitudinal impact and against overturning [4]. If the tank-containers/MEGCs, including the service equipment, are so constructed as to withstand impact or overturning they need not be protected in this way.

4.3.2.3.3 During filling and discharge of tanks, battery-vehicles and MEGCs, appropriate measures shall be taken to prevent the release of dangerous quantities of gases and vapours. Tanks, battery-vehicles and MEGCs shall be closed so that the contents cannot spill out uncontrolled. The openings of bottom-discharge tanks shall be closed by means of screw-threaded plugs, blank flanges or other equally effective devices. The leakproofness of the

---

[3] *Under this provision, substances whose kinematic viscosity at 20 °C is below 2 680 mm2/s shall be deemed to be liquids.*

[4] *Examples of protection of shells:*

- *protection against lateral impact may, for example, consist of longitudinal bars protecting the shell on both sides at the level of the median line;*
- *protection against overturning may, for example, consist of reinforcing rings or bars fixed transversally in relation to the frame;*
- *protection against rear impact, may, for example, consist of a bumper or frame.*

closures of the tanks, and of the battery-vehicles and MEGCs shall be checked by the filler after the tank is filled. This applies in particular to the upper part of the dip tube.

4.3.2.3.4 Where several closure systems are fitted in series, that nearest to the substance being carried shall be closed first.

4.3.2.3.5 No dangerous residue of the filling substance shall adhere to the outside of the tank during carriage.

4.3.2.3.6 Substances which may react dangerously with each other shall not be carried in adjoining compartments of tanks.

Substances which may react dangerously with each other may be carried in adjoining compartments of tanks, when these compartments are separated by a partition with a wall thickness equal to or greater than that of the tank itself. They may also be carried separated by an empty space or an empty compartment between loaded compartments.

4.3.2.4 ***Empty tanks, battery-vehicles and MEGCs, uncleaned***

NOTE*: For empty tanks, battery-vehicles and MEGCs, uncleaned, special provisions TU1, TU2, TU4, TU16 and TU35 of 4.3.5 may apply.*

4.3.2.4.1 No dangerous residue of the filling substance shall adhere to the outside of the tank during carriage.

4.3.2.4.2 To be accepted for carriage, empty tanks, battery-vehicles and MEGCs, uncleaned, shall be closed in the same manner and be leakproof to the same degree as if they were full.

4.3.2.4.3 Where empty tanks, battery-vehicles and MEGCs, uncleaned, are not closed in the same manner and are not leakproof to the same degree as if they were full and where the provisions of ADR cannot be complied with, they shall be carried, with due regard to adequate safety, to the nearest suitable place where cleaning or repair can be carried out. Carriage is adequately safe if suitable measures have been taken to ensure equivalent safety commensurate with the provisions of ADR and to prevent the uncontrolled release of the dangerous goods.

4.3.2.4.4 Empty fixed tanks (tank-vehicles), demountable tanks, battery-vehicles, tank-containers, tank swap bodies and MEGCs, uncleaned, may also be carried after the expiry of the periods established in 6.8.2.4.2 and 6.8.2.4.3 for undergoing the inspection.

4.3.3 Special provisions applicable to Class 2

4.3.3.1 *Coding and hierarchy of tanks*

4.3.3.1.1 *Coding of tanks, battery-vehicles and MEGCs*

The four parts of the codes (tank codes) given in Column (12) of Table A in Chapter 3.2 have the following meanings:

Part	Description	Tank Code
1	Types of tank, battery-vehicle or MEGC	C = tank, battery-vehicle or MEGC for compressed gases; P = tank, battery-vehicle or MEGC for liquefied gases or gases dissolved under pressure; R = tank for refrigerated liquefied gases.
2	Calculation pressure	X = value of the minimum relevant test pressure according to the table in 4.3.3.2.5; or 22 = minimum calculation pressure in bar.
3	Openings (see 6.8.2.2 and 6.8.3.2)	B = tank with bottom filling or discharge openings with 3 closures; or battery-vehicle or MEGC with openings below the surface of the liquid or for compressed gases; C = tank with top filling or discharge openings with 3 closures with only cleaning openings below the surface of the liquid; D = tank with top filling or discharge openings with 3 closures; or battery-vehicle or MEGC with no openings below the surface of the liquid.
4	Safety valves/devices	N = tank, battery-vehicle or MEGC with safety valve according to 6.8.3.2.9 or 6.8.3.2.10 which is not hermetically closed; H = hermetically closed tank, battery-vehicle or MEGC (see 1.2.1);

***NOTE 1**: The special provision TU17 indicated in Column (13) of Table A in Chapter 3.2 for certain gases means that the gas may only be carried in a battery-vehicle or MEGC.*

***NOTE 2**: The pressures indicated on the tank itself or on the panel shall be not less than the value of "X" or the minimum calculation pressure*.

4.3.3.1.2 *Hierarchy of tanks*

Tank code	Other tank code(s) permitted for the substances under this code
C*BN	C#BN, C#CN, C#DN, C#BH, C#CH, C#DH
C*BH	C#BH, C#CH, C#DH
C*CN	C#CN, C#DN, C#CH, C#DH
C*CH	C#CH, C#DH
C*DN	C#DN, C#DH
C*DH	C#DH
P*BN	P#BN, P#CN, P#DN, P#BH, P#CH, P#DH
P*BH	P#BH, P#CH, P#DH
P*CN	P#CN, P#DN, P#CH, P#DH
P*CH	P#CH, P#DH
P*DN	P#DN, P#DH
P*DH	P#DH
R*BN	R#BN, R#CN, R#DN
R*CN	R#CN, R#DN
R*DN	R#DN

The figure represented by "#" shall be equal to or greater than the figure represented by "*".

NOTE: *This hierarchy does not take any special provisions into account (see 4.3.5 and 6.8.4) for each entry.*

4.3.3.2 ***Filling conditions and test pressures***

4.3.3.2.1 The test pressure for tanks intended for the carriage of compressed gases having a critical temperature below -50 °C shall be at least one and one half times the filling pressure at 15 °C.

4.3.3.2.2 The test pressure for tanks intended for the carriage of:

- compressed gases having a critical temperature of - 50° C or above;
- liquefied gases having a critical temperature below 70 ° C; and
- gases dissolved under pressure

shall be such that, when the shell is filled to the maximum mass of the contents per litre of capacity, the pressure reached in the shell by the substance at 55° C for tanks with thermal insulation or 65° C for shells without thermal insulation does not exceed the test pressure.

4.3.3.2.3 The test pressure for tanks intended for the carriage of liquefied gases having a critical temperature of 70° C or above will be:

(a) If the tank is equipped with thermal insulation, at least equal to the vapour pressure, reduced by 0.1 MPa (1 bar) of the liquid at 60 ° C, but not less than 1 MPa (10 bar);

(b) If the tank is not equipped with thermal insulation, at least equal to the vapour pressure, reduced by 0.1 MPa (1 bar), of the liquid at 65 °C, but not less than 1 MPa (10 bar).

The maximum permissible mass of contents per litre of capacity is calculated as follows:

Maximum permissible mass of contents per litre of capacity = 0.95 x density of the liquid phase at 50 °C (in kg/l)

Moreover the vapour phase shall not disappear below 60 °C.

If the shells are not more than 1.5 m in diameter, the values of the test pressure and maximum permissible mass of contents per litre of capacity conforming to packing instruction P200 in 4.1.4.1 shall be applicable.

4.3.3.2.4 The test pressure for tanks intended for the carriage of refrigerated liquefied gases shall be not less than 1.3 times the maximum permitted working pressure indicated on the tank but not less than 300 kPa (3 bar) (gauge pressure); for tanks with vacuum insulation the test pressure shall be not less than 1.3 times the maximum permitted working pressure increased by 100 kPa (1 bar).

4.3.3.2.5 *Table of gases and gas mixtures which may be carried in fixed tanks (tank-vehicles), battery-vehicles, demountable tanks, tank-containers and MEGCs indicating the minimum test pressure for tanks and as far as applicable, maximum permissible mass of contents per litre of capacity*

In the case of gases and gas mixtures classified under n.o.s. entries, the values of the test pressure and maximum permissible mass of contents per litre of capacity shall be prescribed by the expert approved by the competent authority.

When shells for compressed or liquefied gases having a critical temperature of -50 °C or above and below 70 °C have been subjected to a test pressure lower than shown in the table, and the tanks are fitted with thermal insulation, a lower maximum load may be prescribed by the expert approved by the competent authority, provided that the pressure reached in the tank by the substance at 55 °C does not exceed the test pressure stamped on the tank.

UN No.	**Name**	**Classification code**	**Minimum test pressure for tanks**				**Maximum permissible mass of contents per litre of capacity**
			With thermal insulation		**Without thermal insulation**		
			MPa	**bar**	**MPa**	**bar**	**kg**
1001	Acetylene, dissolved	4 F	only in battery-vehicles and MEGCs composed of receptacles				
1002	Air, compressed	1 A	see 4.3.3.2.1				
1003	Air, refrigerated liquid	3 O	see 4.3.3.2.4				
1005	Ammonia, anhydrous	2 TC	2.6	26	2.9	29	0.53
1006	Argon, compressed	1 A	see 4.3.3.2.1				

UN No.	Name	Classification code	Minimum test pressure for tanks				Maximum permissible mass of contents per litre of capacity
			With thermal insulation		Without thermal insulation		
			MPa	bar	MPa	bar	kg
1008	Boron trifluoride, compressed	1 TC	22.5 30	225 300	22.5 30	225 300	0.715 0.86
1009	Bromotrifluoromethane (Refrigerant gas R13B1)	2 A	12	120	 4.2 12 25	 42 120 250	1.50 1.13 1.44 1.60
1010	1,3-butadiene, stabilized or 1,2-butadiene, stabilized or mixtures of 1,3-butadiene and hydrocarbons, stabilized	2 F	1 1 1	10 10 10	1 1 1	10 10 10	0.55 0.59 0.50
1011	Butane	2 F	1	10	1	10	0.51
1012	1-butylene or trans-2-butylene or cis-2-butylene or butylenes mixture	2 F	1 1 1 1	10 10 10 10	1 1 1 1	10 10 10 10	0.53 0.54 0.55 0.50
1013	Carbon dioxide	2 A	19 22.5	190 225	 19 25	 190 250	0.73 0.78 0.66 0.75
1014	Carbon dioxide and oxygen mixtures compressed	1 O	see 4.3.3.2.1				
1015	Carbon dioxide and nitrous oxide mixture	2 A	see 4.3.3.2.2 or 4.3.3.2.3				
1016	Carbon monoxide, compressed	1 TF	see 4.3.3.2.1				
1017	Chlorine	2 TC	1.7	17	1.9	19	1.25
1018	Chlorodifluoromethane (Refrigerant gas R22)	2 A	2.4	24	2.6	26	1.03
1020	Chloropentafluoroethane (Refrigerant gas R115)	2 A	2	20	2.3	23	1.08
1021	1-chloro-1,2,2,2- tetrafluoroethane (Refrigerant gas R124)	2 A	1	10	1.1	11	1.2
1022	Chlorotrifluoromethane (Refrigerant gas R13)	2 A	12 22.5	120 225	 10 12 19 25	 100 120 190 250	0.96 1.12 0.83 0.90 1.04 1.10
1023	Coal gas, compressed	1 TF	see 4.3.3.2.1				

UN No.	Name	Classification code	Minimum test pressure for tanks				Maximum permissible mass of contents per litre of capacity
			With thermal insulation		Without thermal insulation		
			MPa	bar	MPa	bar	kg
1026	Cyanogen	2 TF	10	100	10	100	0.70
1027	Cyclopropane	2 F	1.6	1.6	1.8	1.8	0.53
1028	Dichlorodifluoromethane (Refrigerant gas R12)	2 A	1.5	15	1.6	16	1.15
1029	Dichlorofluoromethane (Refrigerant gas R21)	2 A	1	10	1	10	1.23
1030	1,1-difluoroethane (Refrigerant gas R152a)	2 F	1.4	14	1.6	16	0.79
1032	Dimethylamine, anhydrous	2 F	1	10	1	10	0.59
1033	Dimethyl ether	2 F	1.4	14	1.6	16	0.58
1035	Ethane	2 F	12	120	 9.5 12 30	 95 120 300	0.32 0.25 0.29 0.39
1036	Ethylamine	2 F	1	10	1	10	0.61
1037	Ethyl chloride	2 F	1	10	1	10	0.8
1038	Ethylene, refrigerated liquid	3 F	see 4.3.3.2.4				
1039	Ethyl methyl ether	2 F	1	10	1	10	0.64
1040	Ethylene oxide with nitrogen up to a total pressure of 1MPa (10 bar) at 50 °C	2 TF	1.5	15	1.5	15	0.78
1041	Ethylene oxide and carbon dioxide mixture, with more than 9% but not more than 87% ethylene oxide	2 F	2.4	24	2.6	26	0.73
1046	Helium, compressed	1 A	see 4.3.3.2.1				
1048	Hydrogen bromide, anhydrous	2 TC	5	50	5.5	55	1.54
1049	Hydrogen, compressed	1 F	see 4.3.3.2.1				
1050	Hydrogen chloride, anhydrous	2 TC	12	120	 10 12 15 20	 100 120 150 200	0.69 0.30 0.56 0.67 0.74
1053	Hydrogen sulphide	2 TF	4.5	45	5	50	0.67
1055	Isobutylene	2 F	1	10	1	10	0.52

UN No.	Name	Classification code	Minimum test pressure for tanks				Maximum permissible mass of contents per litre of capacity
			With thermal insulation		Without thermal insulation		
			MPa	bar	MPa	bar	kg
1056	Krypton, compressed	1 A	see 4.3.3.2.1				
1058	Liquefied gases, non flammable, charged with nitrogen, carbon dioxide or air	2 A	1.5 x filling pressure see 4.3.3.2.2 or 4.3.3.2.3				
1060	Methylacetylene and propadiene mixture, stabilized:	2 F	see 4.3.3.2.2 or 4.3.3.2.3				
	mixture P1 mixture P2 propadiene with 1% to 4% methylacetylene		2.5 2.2 2.2	25 22 22	2.8 2.3 2.2	28 23 22	0.49 0.47 0.50
1061	Methylamine, anhydrous	2 F	1	10	1.1	11	0.58
1062	Methyl bromide	2 T	1	10	1	10	1.51
1063	Methyl chloride (Refrigerant gas R40)	2 F	1.3	13	1.5	15	0.81
1064	Methyl mercaptan	2 TF	1	10	1	10	0.78
1065	Neon, compressed	1 A	see 4.3.3.2.1				
1066	Nitrogen, compressed	1 A	see 4.3.3.2.1				
1067	Dinitrogen tetroxide (nitrogen dioxide)	2 TOC	only in battery-vehicles and MEGCs composed of receptacles				
1070	Nitrous oxide	2 O	22.5	225	 18 22.5 25	 180 225 250	0.78 0.68 0.74 0.75
1071	Oil gas, compressed	1 TF	see 4.3.3.2.1				
1072	Oxygen, compressed	1 O	see 4.3.3.2.1				
1073	Oxygen, refrigerated liquid	3 O	see 4.3.3.2.4				
1076	Phosgene	2 TC	only in battery-vehicles and MEGCs composed of receptacles				
1077	Propylene	2 F	2.5	25	2.7	27	0.43

UN No.	Name	Classification code	Minimum test pressure for tanks				Maximum permissible mass of contents per litre of capacity
			With thermal insulation		Without thermal insulation		
			MPa	bar	MPa	bar	kg
1078	Refrigerant gases, n.o.s. such as: mixture F1 mixture F2 mixture F3	2 A	 1 1.5 2.4	 10 15 24	 1.1 1.6 2.7	 11 16 27	 1.23 1.15 1.03
	other mixtures		see 4.3.3.2.2 or 4.3.3.2.3				
1079	Sulphur dioxide	2 TC	1	10	1.2	12	1.23
1080	Sulphur hexafluoride	2 A	12	120	 7 14 16	 70 140 160	1.34 1.04 1.33 1.37
1082	Trifluorochloroethylene, stabilized	2 TF	1.5	15	1.7	17	1.13
1083	Trimethylamine, anhydrous	2 F	1	10	1	10	0.56
1085	Vinyl bromide, stabilized	2 F	1	10	1	10	1.37
1086	Vinyl chloride, stabilized	2 F	1	10	1.1	11	0.81
1087	Vinyl methyl ether, stabilized	2 F	1	10	1	10	0.67
1581	Chloropicrin and methyl bromide mixture	2 T	1	10	1	10	1.51
1582	Chloropicrin and methyl chloride mixture	2 T	1.3	13	1.5	15	0.81
1612	Hexaethyl tetraphosphate and compressed gas mixture	1 T	see 4.3.3.2.1				
1749	Chlorine trifluoride	2 TOC	3	30	3	30	1.40
1858	Hexafluoropropylene (Refrigerant gas R 1216)	2A	1.7	17	1.9	19	1.11
1859	Silicon tetrafluoride, compressed	1 TC	20 30	200 300	20 30	200 300	0.74 1.10
1860	Vinyl fluoride, stabilized	2 F	12 22.5	120 225	 25	 250	0.58 0.65 0.64
1912	Methyl chloride and methylene chloride mixture	2 F	1.3	13	1.5	15	0.81
1913	Neon, refrigerated liquid	3 A	see 4.3.3.2.4				
1951	Argon, refrigerated liquid	3 A	see 4.3.3.2.4				

UN No.	Name	Classification code	Minimum test pressure for tanks				Maximum permissible mass of contents per litre of capacity
			With thermal insulation		Without thermal insulation		
			MPa	bar	MPa	bar	kg
1952	Ethylene oxide and carbon dioxide mixture, with not more than 9% ethylene oxide	2 A	19 25	190 250	19 25	190 250	0.66 0.75
1953	Compressed gas, toxic, flammable, n.o.s.[a]	1 TF	see 4.3.3.2.1 or 4.3.3.2.2				
1954	Compressed gas, flammable n.o.s.	1 F	see 4.3.3.2.1 or 4.3.3.2.2				
1955	Compressed gas, toxic, n.o.s.[a]	1 T	see 4.3.3.2.1 or 4.3.3.2.2				
1956	Compressed gas, n.o.s.	1 A	see 4.3.3.2.1 or 4.3.3.2.2				
1957	Deuterium, compressed	1 F	see 4.3.3.2.1				
1958	1,2-dichloro-1,1,2,2-tetrafluoroethane (Refrigerant gas R114)	2 A	1	10	1	10	1.3
1959	1,1-difluoroethylene (Refrigerant gas R1132a)	2 F	12 22.5	120 225	 25	 250	0.66 0.78 0.77
1961	Ethane, refrigerated liquid	3 F	see 4.3.3.2.4				
1962	Ethylene, compressed	1 F	12 22.5	120 225	 22.5 30	 225 300	0.25 0.36 0.34 0.37
1963	Helium, refrigerated liquid	3 A	see 4.3.3.2.4				
1964	Hydrocarbon gas mixture, compressed, n.o.s.	1 F	see 4.3.3.2.1 or 4.3.3.2.2				
1965	Hydrocarbon gas mixture, liquefied, n.o.s. Mixture A Mixture A01 Mixture A02 Mixture A0 Mixture A1 Mixture B1 Mixture B2 Mixture B Mixture C	2 F	 1 1.2 1.2 1.2 1.6 2 2 2 2.5	 10 12 12 12 16 20 20 20 25	 1 1.4 1.4 1.4 1.8 2.3 2.3 2.3 2.7	 10 14 14 14 18 23 23 23 27	 0.50 0.49 0.48 0.47 0.46 0.45 0.44 0.43 0.42
	Other mixtures		see 4.3.3.2.2 or 4.3.3.2.3				
1966	Hydrogen, refrigerated liquid	3 F	see 4.3.3.2.4				
1967	Insecticide gas, toxic, n.o.s.[a]	2 T	see 4.3.3.2.2 or 4.3.3.2.3				

UN No.	Name	Classification code	Minimum test pressure for tanks				Maximum permissible mass of contents per litre of capacity
			With thermal insulation		Without thermal insulation		
			MPa	bar	MPa	bar	kg
1968	Insecticide gas, n.o.s.	2 A	see 4.3.3.2.2 or 4.3.3.2.3				
1969	Isobutane	2 F	1	10	1	10	0.49
1970	Krypton, refrigerated liquid	3 A	see 4.3.3.2.4				
1971	Methane, compressed or natural gas, compressed with high methane content	1 F	see 4.3.3.2.1				
1972	Methane, refrigerated liquid or natural gas, refrigerated liquid with high methane content	3 F	see 4.3.3.2.4				
1973	Chlorodifluoromethane and chloropentafluoroethane mixture with fixed boiling point, with approximately 49% chlorodifluoromethane (Refrigerant gas R502)	2 A	2.5	25	2.8	28	1.05
1974	Chlorodifluorobromomethane (Refrigerant gas R12B1)	2 A	1	10	1	10	1.61
1976	Octafluorocyclobutane (Refrigerant gas RC318)	2 A	1	10	1	10	1.34
1977	Nitrogen, refrigerated liquid	3 A	see 4.3.3.2.4				
1978	Propane	2 F	2.1	21	2.3	23	0.42
1979	Rare gases mixture, compressed	1 A	see 4.3.3.2.1				
1980	Rare gases and oxygen mixture, compressed	1 A	see 4.3.3.2.1				
1981	Rare gases and nitrogen mixture, compressed	1 A	see 4.3.3.2.1				
1982	Tetrafluoromethane , compressed (Refrigerant gas R14, compressed)	1 A	20 30	200 300	20 30	200 300	0.62 0.94
1983	1-chloro-2,2,2-trifluoroethane (Refrigerant gas R133a)	2 A	1	10	1	10	1.18
1984	Trifluoromethane (Refrigerant gas R23)	2 A	19 25	190 250	 19 25	 190 250	0.92 0.99 0.87 0.95
2034	Hydrogen and methane mixture, compressed	1 F	see 4.3.3.2.1				

UN No.	Name	Classification code	Minimum test pressure for tanks				Maximum permissible mass of contents per litre of capacity
			With thermal insulation		Without thermal insulation		
			MPa	bar	MPa	bar	kg
2035	1,1,1-trifluoroethane (Refrigerant gas R143a)	2 F	2.8	28	3.2	32	0.79
2036	Xenon, compressed	1 A	12	120	13	130	1.30 1.24
2044	2,2-dimethylpropane	2 F	1	10	1	10	0.53
2073	Ammonia solutions, relative density less than 0.880 at 15 °C in water, with more than 35% and not more than 40% ammonia with more than 40% and not more than 50% ammonia	4 A	 1 1.2	 10 12	 1 1.2	 10 12	 0.80 0.77
2187	Carbon dioxide, refrigerated liquid	3 A	see 4.3.3.2.4				
2189	Dichlorosilane	2 TFC	1	10	1	10	0.90
2191	Sulfuryl fluoride	2 T	5	50	5	50	1.1
2193	Hexafluoroethane, compressed (Refrigerant gas R116 compressed)	1 A	16 20	160 200	20	200	1.28 1.34 1.10
2197	Hydrogen iodide, anhydrous	2 TC	1.9	19	2.1	21	2.25
2200	Propadiene, stabilized	2 F	1.8	18	2.0	20	0.50
2201	Nitrous oxide, refrigerated liquid	3 O	see 4.3.3.2.4				
2203	Silane, compressed [b]	1 F	22.5 25	225 250	22.5 25	225 250	0.32 0.41
2204	Carbonyl sulphide	2 TF	2.7	27	3.0	30	0.84
2417	Carbonyl fluoride, compressed	1 TC	20 30	200 300	20 30	200 300	0.47 0.70
2419	Bromotrifluoroethylene	2 F	1	10	1	10	1.19
2420	Hexafluoroacetone	2 TC	1.6	16	1.8	18	1.08
2422	Octafluorobut-2-ene (Refrigerant gas R1318)	2 A	1	10	1	10	1.34
2424	Octafluoropropane (Refrigerant gas R218)	2 A	2.1	21	2.3	23	1.07
2451	Nitrogen trifluoride, compressed	1 O	20 30	200 300	20 30	200 300	0.50 0.75

UN No.	Name	Classification code	Minimum test pressure for tanks				Maximum permissible mass of contents per litre of capacity
			With thermal insulation		Without thermal insulation		
			MPa	bar	MPa	bar	kg
2452	Ethylacetylene, stabilized	2 F	1	10	1	10	0.57
2453	Ethyl fluoride (Refrigerant gas R161)	2 F	2.1	21	2.5	25	0.57
2454	Methyl fluoride (Refrigerant gas R41)	2 F	30	300	30	300	0.36
2517	1-chloro-1,1-difluoroethane (Refrigerant gas R142b)	2 F	1	10	1	10	0.99
2591	Xenon, refrigerated liquid	3 A	see 4.3.3.2.4				
2599	Chlorotrifluoromethane and trifluoromethane, azeotropic mixture with approximately 60% chlorotrifluoromethane (Refrigerant gas R503)	2 A	3.1 4.2 10	31 42 100	3.1 4.2 10	31 42 100	0.11 0.21 0.76 0.20 0.66
2600	Carbon monoxide and hydrogen mixture, compressed	1 TF	see 4.3.3.2.1				
2601	Cyclobutane	2 F	1	10	1	10	0.63
2602	Dichlorodifluoromethane and difluoro-1,1 ethane, azeotropic mixture with approximately 74% dichlorodifluoromethane (Refrigerant gas R500)	2 A	1.8	18	2	20	1.01
2901	Bromine chloride	2 TOC	1	10	1	10	1.50
3057	Trifluoroacetyl chloride	2 TC	1.3	13	1.5	15	1.17
3070	Ethylene oxide and dichlorodifluoromethane mixture with not more than 12.5% ethylene oxide	2 A	1.5	15	1.6	16	1.09
3083	Perchloryl fluoride	2 TO	2.7	27	3.0	30	1.21
3136	Trifluoromethane, refigerated liquid	3 A	See 4.3.3.2.4				
3138	Ethylene, acetylene propylene in mixture, refrigerated liquid, containing at least 71.5% ethylene with not more than 22.5% acetylene and not more than 6% propylene	3 F	see 4.3.3.2.4				
3153	Perfluoro(methyl vinyl ether)	2 F	1.4	14	1.5	15	1.14

UN No.	Name	Classification code	Minimum test pressure for tanks				Maximum permissible mass of contents per litre of capacity
			With thermal insulation		Without thermal insulation		
			MPa	bar	MPa	bar	kg
3154	Perfluoro(ethyl vinyl ether)	2 F	1	10	1	10	0.98
3156	Compressed gas, oxidizing, n.o.s.	1 O	see 4.3.3.2.1 or 4.3.3.2.2				
3157	Liquefied gas, oxidizing, n.o.s.	2 O	see 4.3.3.2.2 or 4.3.3.2.3				
3158	Gas, refrigerated liquid, n.o.s.	3 A	see 4.3.3.2.4				
3159	1,1,1,2-tetrafluoroethane (Refrigerant gas R134a)	2 A	1.6	16	1.8	18	1.04
3160	Liquefied gas, toxic, flammable, n.o.s. [a]	2 TF	see 4.3.3.2.2 or 4.3.3.2.3				
3161	Liquefied gas, flammable, n.o.s.	2 F	see 4.3.3.2.2 or 4.3.3.2.3				
3162	Liquefied gas, toxic, n.o.s. [a]	2 T	see 4.3.3.2.2 or 4.3.3.2.3				
3163	Liquefied gas, n.o.s.	2 A	see 4.3.3.2.2 or 4.3.3.2.3				
3220	Pentafluoroethane (Refrigerant gas R125)	2 A	4.1	41	4.9	49	0.95
3252	Difluoromethane (Refrigerant gas R32)	2 F	3.9	39	4.3	43	0.78
3296	Heptafluoropropane (Refrigerant gas R227)	2 A	1.4	14	1.6	16	1.20
3297	Ethylene oxide and chlorotetrafluoroethane mixture, with not more than 8.8% ethylene oxide	2 A	1	10	1	10	1.16
3298	Ethylene oxide and pentafluoroethane mixture, with not more than 7.9% ethylene oxide	2 A	2.4	24	2.6	26	1.02
3299	Ethylene oxide and tetrafluoroethane mixture, with not more than 5.6% ethylene oxide	2 A	1.5	15	1.7	17	1.03
3300	Ethylene oxide and carbon dioxide mixture, with more than 87% ethylene oxide	2 TF	2.8	28	2.8	28	0.73
3303	Compressed gas, toxic, oxidizing, n.o.s. [a]	1 TO	see 4.3.3.2.1 or 4.3.3.2.2				

UN No.	Name	Classification code	Minimum test pressure for tanks				Maximum permissible mass of contents per litre of capacity
			With thermal insulation		Without thermal insulation		
			MPa	bar	MPa	bar	kg
3304	Compressed gas, toxic, corrosive, n.o.s. [a]	1 TC	see 4.3.3.2.1 or 4.3.3.2.2				
3305	Compressed gas, toxic, flammable, corrosive, n.o.s. [a]	1 TFC	see 4.3.3.2.1 or 4.3.3.2.2				
3306	Compressed gas, toxic, oxidizing, corrosive, n.o.s. [a]	1 TOC	see 4.3.3.2.1 or 4.3.3.2.2				
3307	Liquefied gas, toxic, oxidizing, n.o.s. [a]	2 TO	see 4.3.3.2.2 or 4.3.3.2.3				
3308	Liquefied gas, toxic, corrosive, n.o.s. [a]	2 TC	see 4.3.3.2.2 or 4.3.3.2.3				
3309	Liquefied gas, toxic, flammable, corrosive, n.o.s. [a]	2 TFC	see 4.3.3.2.2 or 4.3.3.2.3				
3310	Liquefied gas, toxic, oxidizing, corrosive, n.o.s. [a]	2 TOC	see 4.3.3.2.2 or 4.3.3.2.3				
3311	Gas, refrigerated liquid, oxidizing, n.o.s.	3 O	see 4.3.3.2.4				
3312	Gas, refrigerated liquid, flammable, n.o.s.	3 F	see 4.3.3.2.4				
3318	Ammonia solutions, relative density less than 0.880 at 15 °C in water, with more than 50% ammonia	4 TC	see 4.3.3.2.2				
3337	Refrigerant gas R404A	2 A	2.9	29	3.2	32	0.84
3338	Refrigerant gas R407A	2 A	2.8	28	3.2	32	0.95
3339	Refrigerant gas R407B	2 A	3.0	30	3.3	33	0.95
3340	Refrigerant gas R407C	2 A	2.7	27	3.0	30	0.95
3354	Insecticide gas, flammable, n.o.s.	2 F	see 4.3.3.2.2 or 4.3.3.2.3				
3355	Insecticide gas, toxic, flammable, n.o.s. [a]	2 TF	see 4.3.3.2.2 or 4.3.3.2.3				

a *Allowed if LC_{50} equal to or greater than 200 ppm*

b *Considered as pyrophoric*

4.3.3.3 ***Operation***

4.3.3.3.1 When tanks, battery-vehicles or MEGCs are approved for different gases, the change of use shall include emptying, purging and evacuation operations to the extent necessary for safe operation.

4.3.3.3.2 When tanks, battery-vehicles or MEGCs are handed over for carriage, only the particulars specified in 6.8.3.5.6 applicable to the gas loaded or just discharged shall be visible; all particulars concerning other gases shall be covered up.

4.3.3.3.3 All the elements of a battery-vehicle or MEGC shall contain only one and the same gas.

4.3.3.4 (*Reserved)*

4.3.4 Special provisions applicable to Classes 3 to 9

4.3.4.1 ***Coding, rationalized approach and hierarchy of tanks***

4.3.4.1.1 *Coding of tanks*

The four parts of the codes (tank codes) given in Column (12) of Table A in Chapter 3.2 have the following meanings:

Part	Description	Tank code
1	Types of tank	L = tank for substances in the liquid state (liquids or solids handed over for carriage in the molten state); S = tank for substances in the solid state (powdery or granular).
2	Calculation pressure	G = minimum calculation pressure according to the general requirements of 6.8.2.1.14; or 1.5; 2.65; 4; 10; 15 or 21= minimum calculation pressure in bar (see 6.8.2.1.14).
3	Openings (see 6.8.2.2.2)	A = tank with bottom-filling and discharge openings with 2 closures; B = tank with bottom-filling and discharge openings with 3 closures; C = tank with top-filling and discharge openings with only cleaning openings below the surface of the liquid; D = tank with top-filling and discharge openings with no openings below the surface of the liquid.

Part	Description	Tank code
4	Safety valves/devices	V = tank with a venting system, according to 6.8.2.2.6, but no flame trap; or non-explosion-pressure proof tank; F = tank with a venting system, according to 6.8.2.2.6, fitted with a flame trap; or explosion-pressure proof tank; N = tank with a safety valve according to 6.8.2.2.7 or 6.8.2.2.8 and not hermetically closed; these tanks may be fitted with vacuum valves; H = hermetically closed tank (see 1.2.1).

4.3.4.1.2 *Rationalized approach for assignment of ADR tank codes to groups of substances and hierarchy of tanks.*

NOTE: *Certain substances and groups of substances are not included in the rationalized approach, see 4.3.4.1.3*

Rationalized approach				Hierarchy of tanks
Tank code	**Group of permitted substances**			**Other tank codes permitted for substances under this code**
	Class	**Classification code**	**Packing group**	
LIQUIDS LGAV	3 9	F2 M9	III III	LGAH; LGBV; LGBF; LGBH; L1.5AH; L1.5BN; L1.5BH; L4BN; L4BH; L4DH; L10BH; L10CH; L10DH; L15CH; L21DH
LGBV	4.1 5.1 9 and groups of permitted substances for tank code LGAV	F2 O1 M6 M11	none III III III	LGBF; LGBH; L1.5BN; L1.5BH; L4BV; L4BN; L4BH; L4DH; L10BH; L10CH; L10DH; L15CH; L21DH
LGBF	3 3 and groups of permitted substances for tank codes LGAV and LGBV	F1 F1	II vapour pressure at 50 °C < 1.1 bar III	LGBH; L1.5BN; L1.5BH; L4BN; L4BH; L4DH; L10BH; L10CH; L10DH; L15CH; L21DH
L1.5BN	3 and groups of permitted substances for tank codes LGAV, LGBV and LGBF	F1	I, II 1.1 bar < vapour pressure at 50 °C < 1.75 bar	L1.5BH; L4BN; L4BH; L4DH; L10BH; L10CH;L10DH; L15CH; L21DH.
L4BV	5.1	O1	-	-
L4BN	3 3 5.1 8	F1 FC O1 C1 C3 C4 C5 C7 C8	I Vapour pressure at 50 °C>1.75 bar III I, II II, III II, III II, III II, III II, III II, III	L4BH; L4DH; L10BH; L10CH; L10DH; L15CH; L21DH.

Rationalized approach				Hierarchy of tanks
Tank code	**Group of permitted substances**			**Other tank codes permitted for substances under this code**
	Class	**Classification code**	**Packing group**	
		C9	II, III	
		C10	II, III	
		CF1	II	
		CF2	II	
		CS1	II	
		CS2	II	
		CW1	II	
		CW2	II	
		CO1	II	
		CO2	II	
		CT1	II, III	
		CT2	II, III	
		CFT	II	
		M11	III	
	and groups of permitted substances for tank codes LGAV, LGBV, LGBF and L1.5BN			
L4BH	3	FT1	II, III	L4DH; L10BH; L10CH; L10DH; L15CH; L21DH.
		FT2	II	
		FC	II	
		FTC	II	
	6.1	T1	II, III	
		T2	II, III	
		T3	II, III	
		T4	II, III	
		T6	II, III	
		T7	II, III	
		TF1	II	
		TF2	II, III	
		TF3	II	
		TS	II	
		TW1	II	
L4BH				
	6.1	TO1	II	
		TC1	II	
		TC2	II	
		TC3	II	
		TFC	II	
	6.2	Risk group 2		
		I3	II	
	9	M2	II	
	and groups of permitted substances for tank codes LGAV, LGBV, LGBF, L1.5BN and L4BN			
L4DH	4.2	S1	II, III	L10DH; L21DH
		S3	II, III	
		ST1	II, III	
		ST3	II, III	
		SC1	II, III	
		SC3	II, III	
	4.3	W1	II, III	
		WF1	II, III	
		WT1	II, III	
		WC1	II, III	
	8	CT1	II, III	
	and groups of permitted substances for tank codes LGAV, LGBV, LGBF, L1.5BN, L4BN and L4BH			
L10BH	8	C1	I	L10CH; L10DH; L15CH and L21DH
		C3	I	
		C4	I	

Rationalized approach				Hierarchy of tanks
Tank code	**Group of permitted substances**			**Other tank codes permitted for substances under this code**
	Class	**Classification code**	**Packing group**	
		C5	I	
		C7	I	
		C8	I	
		C9	I	
		C10	I	
		CF1	I	
		? F2	I	
		CS1	I	
		? W1	I	
		CO1	I	
		CO2	I	
		CT1	I	
		CT2	I	
		COT	I	
	and groups of permitted substances for tank codes LGAV, LGBV, LGBF, L1.5BN, L4BN, and L4BH			
L10CH	3	FT1	I	L10DH; L15CH; L21DH
		FT2	I	
		FC	I	
		FTC	I	
	6.1	T1	I	
		T2	I	
		T3	I	
		T4	I	
		T6	I	
		T7	I	
		TF1	I	
		TF2	I	
		TF3	I	
L10CH				
	6.1	TS	I	
		TW1	I	
		TO1	I	
		TC1	I	
		TC2	I	
		TC3	I	
		TC4	I	
		TFC	I	
	and groups of permitted substances for tank codes LGAV, LGBV, LGBF, L1.5BN, L4BN, L4BH, and L10BH			
L10DH	4.3	W1	I	L21DH
		WF1	I	
		WT1	I	
		WC1	I	
		WFC	I	
	5.1	OTC	I	
	8	CT1	I	
	and groups of permitted substances for tank codes LGAV, LGBV, LGBF, L1.5BN, L4BN, L4BH, L4DH, L10BH and L10CH			
L15CH	3	FT1	I	L21DH
	6.1	TF1	I	
	and groups of permitted substances for tank codes LGAV, LGBV, LGBF, L1.5BN, L4BN, L4BH, L10BH and L10CH			
L21DH	4.2	S1	I	
		S3	I	
		SW	I	

Rationalized approach				Hierarchy of tanks
Tank code	**Group of permitted substances**			**Other tank codes permitted for substances under this code**
	Class	**Classification code**	**Packing group**	
		ST3	I	
	and groups of permitted substances for tank codes LGAV, LGBV, LGBF, L1.5BN, L4BN, L4BH, L4DH, L10BH, L10CH, L10DH and L15CH			
SOLIDS SGAV	4.1	F1	III	SGAN; SGAH; S4AH; S10AN; S10AH.
		F3	III	
	4.2	S2	III	
	5.1	O2	II, III	
	8	C2	II, III	
		C4	III	
		C6	III	
		C8	III	
		C10	II, III	
		? T2	III	
	9	M7	III	
		M11	II, III	
SGAN	4.1	F1	II	SGAH; S4AH; S10AN; S10AH.
		F3	II	
		FT1	II, III	
		FT2	II, III	
		FC1	II, III	
		FC2	II, III	
	4.2	S2	II, III	
		S4	II, III	
		ST2	II, III	
		ST4	II, III	
SGAN				
	4.2	SC2	II, III	
		SC4	II, III	
	4.3	W2	II, III	
		WS	II, III	
		WT2	II, III	
		WC2	II, III	
	5.1	O2	II, III	
		OT2	II, III	
		OC2	II, III	
	8	C2	II	
		? 4	II	
		? 6	II	
		? 8	II	
		?10	II	
		CF2	II	
		CS2	II	
		CW2	II	
		CO2	II	
		CT2	II	
	9	M3	III	
	and groups of permitted substances for tank codes SGAV			
SGAH	6.1	T2	II, III	S4AH; S10AH
		T3	II, III	
		T5	II, III	
		T7	II, III	
		T9	II	
		TF3	II	
		TS	II	
		TW2	II	
		TO2	II	
		TC2	II	
		TC4	II	
	9	M1	II, III	

Rationalized approach				Hierarchy of tanks
Tank code	**Group of permitted substances**			**Other tank codes permitted for substances under this code**
	Class	**Classification code**	**Packing group**	
	and groups of permitted substances for tanks codes SGAV and SGAN			
S4AH	6.2	I3	II	S10AH
	9	M2	II	
	and groups of permitted substances for tanks codes SGAV, SGAN and SGAH			
S10AN	8	C2	I	S10AH
		C4	I	
		C6	I	
		C8	I	
		C10	I	
		CF2	I	
		CS2	I	
		CW2	I	
		CO2	I	
		CT2	I	
	and groups of permitted substances for tank codes SGAV and SGAN			
S10AH	6.1	T2	I	
		T3	I	
		T5	I	
		T7	I	
		TS	I	
		TW2	I	
		TO2	I	
		TC2	I	
		TC4	I	
	and groups of permitted substances for tank codes SGAV, SGAN, SGAH and S10AN			

***NOTE**: This hierarchy does not take account of any special provisions for each entry (see 4.3.5 and 6.8.4)*

4.3.4.1.3 The following substances and groups of substances, where a "(+)" appears in Column (12) of Table A in Chapter 3.2, are subject to special provisions. In that case the alternative use of the tanks for other substances and groups of substances is not permitted and the hierarchy of 4.3.4.1.2 is not applicable (see also 6.8.4). The requirements for these tanks are given by the following tank codes supplemented by the relevant special provisions indicated in Column (13) of Table A in Chapter 3.2

(a) Class 4.1:

UN No. 2448 sulphur, molten: code LGBV;

(b) Class 4.2:

UN No. 1381 phosphorus, white or yellow, dry, or under water or in solution and UN No. 2447 phosphorus, white or yellow molten: code L10DH;

(c) Class 4.3:

UN No. 1389 alkali metal amalgam, UN No. 1391 alkali metal dispersion or alkaline earth metal dispersion, UN No. 1392 alkaline earth metal amalgam, UN No. 1415 lithium, UN No. 1420 potassium metal alloys, UN No. 1421 alkali metal alloy, liquid, n.o.s, UN No. 1422 potassium sodium alloys, UN No. 1428 sodium and UN No. 2257 potassium: code L10BN;

UN No. 1407 caesium and UN No. 1423 rubidium: code L10CH;

(d) Class 5.1:

UN No. 1873 perchloric acid 50-72%: code L4DN;

UN No. 2015 hydrogen peroxide, aqueous solution, stabilized with more than 70% hydrogen peroxide: code L4DV;

UN No. 2015 hydrogen peroxide, aqueous solution, stabilized with 60-70% hydrogen peroxide: code L4BV;

UN No. 2014 hydrogen peroxide, aqueous solution with 20-60% hydrogen peroxide, and UN No. 3149 hydrogen peroxide and peroxyacetic acid mixture, stabilized: code L4BV;

(e) Class 5.2:

UN No. 3109 organic peroxide type F, liquid and UN No. 3119 organic peroxide, type F, liquid temperature controlled: code L4BN;

UN No. 3110 organic peroxide, type F, solid and UN No. 3120 organic peroxide, type F, solid, temperature controlled: code S4AN;

(f) Class 6.1:

UN No. 1613 hydrogen cyanide, aqueous solution and UN No. 3294 hydrogen cyanide solution in alcohol: code L15DH;

(g) Class 7:

All substances: special tanks;

Minimum requirements for liquids: code L2,65CN; for solids: code S2,65AN

Notwithstanding the general requirements of this paragraph, tanks used for radioactive material may also be used for the carriage of other goods provided the requirements of 5.1.3.2 are complied with.

(h) Class 8:

UN No. 1052 hydrogen fluoride, anhydrous and UN No. 1790 hydrofluoric acid, solution, with more than 85% hydrofluoric acid: code L21DH;

UN No. 1744 bromine or bromine solution: code L21DH;

UN No. 1791 hypochlorite solution and UN No. 1908 chlorite solution: code L4BV.

4.3.4.2 ***General provisions***

4.3.4.2.1 Where hot substances are loaded, the temperature of the outer surface of the tank or of the thermal insulation shall not exceed 70 °C during carriage.

4.3.4.2.2 The connecting pipes between independent but interconnected tanks of a transport unit shall be empty during carriage. Flexible filling and discharge pipes which are not permanently connected to the shells shall be empty during carriage.

4.3.4.2.3 *(Reserved)*

4.3.5 Special provisions

When they are shown under an entry in Column (13) of Table of A in Chapter 3.2, the following special provisions apply:

TU1 The tanks shall not be handed over for carriage until the substance has solidified completely and been covered by an inert gas. Uncleaned empty tanks which have contained these substances shall be filled with an inert gas.

TU2 The substance shall be covered by an inert gas. Uncleaned empty tanks which have contained these substances shall be filled with an inert gas.

TU3 The inside of the shell and all parts liable to come into contact with the substance shall be kept clean. No lubricant capable of combining dangerously with the substance shall be used for pumps, valves or other devices.

TU4 During carriage, these substances shall be under a layer of inert gas, the gauge pressure of which shall not be less than 50 kPa (0.5 bar).

Uncleaned empty tanks which have contained these substances shall when handed over for carriage be filled with an inert gas at a gauge pressure of at least 50 kPa (0.5 bar).

TU5 *(Reserved)*

TU6 Not authorized for carriage in tanks, battery-vehicles and MEGCs when having a LC_{50} lower than 200 ppm.

TU7 The materials used to ensure leakproofness of the joints or for the maintenance of the closures shall be compatible with the contents.

TU8 An aluminium-alloy tank shall not be used for carriage unless the tank is reserved solely for such carriage and the acetaldehyde is free from acid.

TU9 UN No.1203 petrol (gasoline) with a vapour pressure at 50 °C of more than 110 kPa (1.1 bar) but not above 150 kPa (1.5 bar) may also be carried in tanks designed according to 6.8.2.1.14 (a) and having equipment conforming to 6.8.2.2.6.

TU10 *(Reserved)*

TU11 During filling, the temperature of this substance shall not exceed 60 °C. A maximum filling temperature of 80° C is allowed provided that smoulder spots are prevented during filling and the tanks are hermetically closed. After filling, the tanks shall be pressurized (e.g. with compressed air) to check tightness. It shall be ensured that no depressurization takes place during carriage. Before discharge, it shall be checked if pressure in the tanks is still above atmospheric. If this is not the case, an inert gas shall be introduced into the tanks prior to discharge.

TU12 In the event of a change of use, shells and equipment shall be thoroughly cleansed of all residues before and after the carriage of this substance.

TU13 Tanks shall be free from impurities at the time of filling. Service equipment such as valves and external piping shall be emptied after filling or discharging.

TU14 The closures of the tanks shall be protected with locked caps during carriage.

TU15 Tanks shall not be used for the carriage of foodstuffs, articles of consumption or animal feeds.

TU16 Uncleaned empty tanks, shall, when handed over for carriage, either:

- be filled with nitrogen; or

- be filled with water to not less than 96% and not more than 98% of their capacity; between 1 October and 31 March, this water shall contain sufficient anti-freeze agent to make it impossible for the water to freeze during carriage; the anti-freeze agent shall be free from corrosive action and not liable to react with phosphorus.

TU17 Only to be carried in battery-vehicles or MEGCs the elements of which are composed of receptacles.

TU18 The degree of filling shall remain below the level at which, if the contents were raised to a temperature at which the vapour pressure equalled the opening pressure of the safety valve, the volume of the liquid would reach 95% of the tank's capacity at that temperature. The provision in 4.3.2.3.4 shall not apply.

TU19 Tanks may be filled to 98% at the filling temperature and pressure. The provision in 4.3.2.3.4 shall not apply.

TU20 *(Reserved)*

TU21 The substance shall, if water is used as a protective agent, be covered with a depth of not less than 12 cm of water at the time of filling; the degree of filling at a temperature of 60 °C shall not exceed 98%. If nitrogen is used as a protective agent, the degree of filling at a temperature of 60 °C shall not exceed 96%. The remaining space shall be filled with nitrogen in such a way that, even after cooling, the pressure at no time falls below atmospheric pressure. The tank shall be closed in such a way that no leakage of gas occurs.

TU22 Tanks shall be filled to not more than 90% of their capacity; a space of 5% shall remain empty when the liquid is at an average temperature of 50 °C.

TU23 The degree of filling shall not exceed 0.93 kg per litre of capacity, if filling is by mass. If filling is by volume, the degree of filling shall not exceed 85%.

TU24 The degree of filling shall not exceed 0.95 kg per litre of capacity, if filling is by mass. If filling is by volume, the degree of filling shall not exceed 85%.

TU25 The degree of filling shall not exceed 1.14 kg per litre of capacity, if filling is by mass. If filling is by volume, the degree of filling shall not exceed 85%.

TU26 The degree of filling shall not exceed 85%.

TU27 Tanks shall not be filled to more than 98% of their capacity.

TU28 Tanks shall be filled to not more than 95% of their capacity at a reference temperature of 15 °C.

TU29 Tanks shall be filled to not more than 97% of their capacity and the maximum temperature after filling shall not exceed 140 °C.

TU30 Tanks shall be filled as set out in the test report for the type approval of the tank but shall be filled to not more than 90% of their capacity.

TU31 Tanks shall not be filled to more than 1 kg per litre of capacity.

TU32 Tanks shall not be filled to more than 88% of their capacity.

TU33 Tanks shall be filled to not less than 88% and not more than 92% of their capacity or to 2.86 kg per litre of capacity.

TU34 Tanks shall not be filled to more than 0.84 kg per litre of capacity.

TU35 Empty fixed tanks (tank-vehicles), empty demountable tanks and empty tank-containers, uncleaned, which have contained these substances are not subject to the requirements of ADR if adequate measures have been taken to nullify any hazard.

TU36 The degree of filling according to 4.3.2.2, at the reference temperature of 15 °C, shall not exceed 93% of the capacity.

CHAPTER 4.4

USE OF FIBRE-REINFORCED PLASTICS (FRP) TANKS

NOTE: *For portable tanks, see Chapter 4.2; for fixed tanks (tank-vehicles), demountable tanks, tank-containers and tank swap bodies, with shells made of metallic materials, and battery-vehicles and multiple elements gas containers (MEGCs), see Chapter 4.3; for vacuum operated waste containers, see Chapter 4.5.*

4.4.1 General

The carriage of dangerous substances in fibre-reinforced plastics (FRP) tanks is permitted only when the following conditions are met:

(a) The substance is classified in Class 3, 5.1, 6.1, 6.2, 8 or 9;

(b) The maximum vapour pressure (absolute pressure) at 50 °C of the substance does not exceed 110 kPa (1.1 bar);

(c) The carriage of the substance in metallic tanks is authorized according to 4.3.2.1.1;

(d) The calculation pressure specified for that substance in part 2 of the tank code given in Column (12) of Table A in Chapter 3.2 does not exceed 4 bar (see also 4.3.4.1.1) and,

(e) The tank complies with the provisions of Chapter 6.9 applicable for the carriage of the substance.

4.4.2 Operation

4.4.2.1 The provisions of 4.3.2.1.5 to 4.3.2.2.4, 4.3.2.3.3 to 4.3.2.3.6, 4.3.2.4.1, 4.3.2.4.2 and 4.3.4.2 shall apply.

4.4.2.2 The temperature of the substance carried shall not exceed, at the time of filling, the maximum service temperature indicated on the tank plate referred to in 6.9.6.

4.4.2.3 When applicable to carriage in metallic tanks, the special provisions (TU) of 4.3.5 shall also apply, as indicated in Column (13) of Table A in Chapter 3.2.

CHAPTER 4.5

USE OF VACUUM OPERATED WASTE TANKS

NOTE: *For portable tanks, see Chapter 4.2; for fixed tanks (tank-vehicles), demountable tanks, tank-containers and tank swap bodies, with shells made of metallic materials, and battery-vehicles and multiple elements gas containers (MEGCs), see Chapter 4.3; for fibre reinforced plastics tanks, see Chapter 4.4.*

4.5.1 Use

4.5.1.1 Substances in Classes 3, 4.1, 5.1, 6.1, 6.2, 8 and 9 may be carried in vacuum-operated waste tanks conforming to Chapter 6.10 if their carriage in fixed or demountable tanks is permitted according to Chapter 4.3.

4.5.2 Operation

4.5.2.1 The provisions of Chapter 4.3 except those of 4.3.2.2.4 and 4.3.2.3.3 apply to the carriage in vacuum operated waste tanks and are supplemented by the provisions of 4.5.2.2 to 4.5.2.4 below.

4.5.2.2 For carriage of liquids classified as flammable, vacuum-operated waste tanks shall be filled through fillings which discharge into the tank at a low level. Provisions shall be made to minimize the production of spray.

4.5.2.3 When discharging flammable liquids with a flash-point below 23° C by using air pressure, the maximum allowed pressure is 100 kPa (1 bar).

4.5.2.4 The use of tanks fitted with an internal piston operating as a compartment wall is allowed only when the substances on either side of the wall (piston) do not react dangerously with each other (see 4.3.2.3.6).

PART 5

Consignment procedures

-

CHAPTER 5.1

GENERAL PROVISIONS

5.1.1 Application and general provisions

This Part sets forth the provisions for dangerous goods consignments relative to marking, labelling, and documentation, and, where appropriate, authorization of consignments and advance notifications.

5.1.2 Use of overpacks

5.1.2.1 An overpack shall be marked and labelled, as required for packages by Chapter 5.2, for each item of dangerous goods contained in the overpack, unless markings and labels representative of all dangerous goods contained in the overpack are visible. If a specific label is required for different packages, it only needs to be applied once.

5.1.2.2 Each package of dangerous goods contained in an overpack shall comply with all applicable provisions of ADR. The intended function of each package shall not be impaired by the overpack.

5.1.2.3 The prohibitions on mixed loading also apply to these overpacks.

5.1.3 Empty uncleaned packagings (including IBCs and large packagings), tanks, vehicles and containers for carriage in bulk

5.1.3.1 Empty uncleaned packagings (including IBCs and large packagings), tanks (including tank-vehicles, battery-vehicles, demountable tanks, portable tanks, tank-containers, MEGCs), vehic les and containers for carriage in bulk having contained dangerous goods of the different classes other than Class 7, shall be marked and labelled as if they were full.

***NOTE**: For documentation, see Chapter 5.4*.

5.1.3.2 Tanks and IBCs used for the carria ge of radioactive material shall not be used for the storage or carriage of other goods unless decontaminated below the level of 0.4 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters and 0.04 Bq/cm^2 for all other alpha emitters.

5.1.4 Mixed packing

When two or more dangerous goods are packed within the same outer packaging, the package shall be labelled and marked as required for each substance or article. If the same label is required for different goods, it only needs to be applied once.

5.1.5 General provisions for Class 7

5.1.5.1 *Requirements before shipments*

5.1.5.1.1 *Requirements before the first shipment of a package*

Before the first shipment of any package, the following requirements shall be fulfilled:

(a) If the design pressure of the containment system exceeds 35 kPa (gauge), it shall be ensured that the containment system of each package conforms to the approved design requirements relating to the capability of that system to maintain its integrity under that pressure;

(b) For each Type B(U), Type B(M) and Type C package and for each package containing fissile material, it shall be ensured that the effectiveness of its shielding and containment and, where necessary, the heat transfer characteristics and the effectiveness of the confinement system, are within the limits applicable to or specified for the approved design;

(c) For packages containing fissile material, where, in order to comply with the requirements of 6.4.11.1, neutron poisons are specifically included as components of the package, checks shall be performed to confirm the presence and distribution of those neutron poisons.

5.1.5.1.2 *Requirements before each shipment of a package*

Before each shipment of any package, the following requirements shall be fulfilled:

(a) For any package it shall be ensured that all the requirements specified in the relevant provisions of ADR have been satisfied;

(b) It shall be ensured that lifting attachments which do not meet the requirements of 6.4.2.2 have been removed or otherwise rendered incapable of being used for lifting the package, in accordance with 6.4.2.3;

(c) For each Type B(U), Type B(M) and Type C package and for each package containing fissile material, it shall be ensured that all the requirements specified in the approval certificates have been satisfied;

(d) Each Type B(U), Type B(M) and Type C package shall be held until equilibrium conditions have been approached closely enough to demonstrate compliance with the requirements for temperature and pressure unless an exemption from these requirements has received unilateral approval;

(e) For each Type B(U), Type B(M) and Type C package, it shall be ensured by inspection and/or appropriate tests that all closures, valves, and other openings of the containment system through which the radioactive contents might escape are properly closed and, where appropriate, sealed in the manner for which the demonstrations of compliance with the requirements of 6.4.8.7 were made;

(f) For each special form radioactive material, it shall be ensured that all the requirements specified in the special form approval certificate and the relevant provisions of ADR have been satisfied;

(g) For packages containing fissile material the measurement specified in 6.4.11.4(b) and the tests to demonstrate closure of each package as specified in 6.4.11.7 shall be performed where applicable;

(h) For each low dispersible radioactive material, it shall be ensured that all the requirements specified in the approval certificate and the relevant provisions of ADR have been satisfied.

5.1.5.2 ***Approval of shipments and notification***

5.1.5.2.1 *General*

In addition to the approval for package designs described in Chapter 6.4, multilateral shipment approval is also required in certain circumstances (5.1.5.2.2 and 5.1.5.2.3). In some circumstances it is also necessary to notify competent authorities of a shipment (5.1.5.2.4).

5.1.5.2.2 *Shipment approvals*

Multilateral approval shall be required for:

(a) the shipment of Type B(M) packages not conforming with the requirements of 6.4.7.5 or designed to allow controlled intermittent venting;

(b) the shipment of Type B(M) packages containing radioactive material with an activity greater than 3000 A_1 or 3000 A_2, as appropriate, or 1000 TBq, whichever is the lower;

(c) the shipment of packages containing fissile materials if the sum of the criticality safety indexes of the packages exceeds 50;

except that a competent authority may authorize carriage into or through its country without shipment approval, by a specific provision in its design approval (see 5.1.5.3.1).

5.1.5.2.3 *Shipment approval by special arrangement*

Provisions may be approved by a competent authority under which a consignment, which does not satisfy all of the applicable requirements of ADR may be carried under special arrangement (see 1.7.4).

5.1.5.2.4 *Notifications*

Notification to competent authorities is required as follows:

(a) Before the first shipment of any package requiring competent authority approval, the consignor shall ensure that copies of each applicable competent authority certificate applying to that package design have been submitted to the competent authority of each country through or into which the consignment is to be carried. The consignor is not required to await an acknowledgement from the competent authority, nor is the competent authority required to make such acknowledgement of receipt of the certificate;

(b) For each of the following types of shipments:

(i) Type C packages containing radioactive material with an activity greater than 3000 A_1 or 3000 A_2, as appropriate, or 1000 TBq, whichever is the lower;

(ii) Type B(U) packages containing radioactive material with an activity greater than 3000 A_1 or 3000 A_2, as appropriate, or 1000 TBq, whichever is the lower;

(iii) Type B(M) packages;

(iv) Shipment under special arrangement;

The consignor shall notify the competent authority of each country through or into which the consignment is to be carried. This notification shall be in the hands of each

competent authority prior to the commencement of the shipment, and preferably at least 7 days in advance;

(c) The consignor is not required to send a separate notification if the required information has been included in the application for shipment approval;

(d) The consignment notification shall include:

(i) sufficient information to enable the identification of the package or packages including all applicable certificate numbers and identification marks;

(ii) information on the date of shipment, the expected date of arrival and proposed routeing;

(iii) the name(s) of the radioactive material(s) or nuclide(s);

(iv) descriptions of the physical and chemical forms of the radioactive material, or whether it is special form radioactive material or low dispersible radioactive material; and

(v) the maximum activity of the radioactive contents during carriage expressed in becquerels (Bq) with an appropriate SI prefix (see 1.2.2.1). For fissile material, the mass of fissile material in grams (g), or multiples thereof, may be used in place of activity.

5.1.5.3 ***Certificates issued by the competent authority***

5.1.5.3.1 Certificates issued by the competent authority are required for the following:

(a) Designs for:

(i) special form radioactive material;

(ii) low dispersible radioactive material;

(iii) packages containing 0.1 kg or more of uranium hexafluoride;

(iv) all packages containing fissile material unless excepted by 6.4.11.2;

(v) Type B(U) packages and Type B(M) packages;

(vi) Type C packages;

(b) Special arrangements;

(c) Certain shipments (see 5.1.5.2.2).

The certificates shall confirm that the applicable requirements are met, and for design approvals shall attribute to the design an identification mark.

The package design and shipment approval certificates may be combined into a single certificate.

Certificates and applications for these certificates shall be in accordance with the requirements in 6.4.23.

5.1.5.3.2 The consignor shall be in possession of a copy of each applicable certificate. The consignor shall also have a copy of any instructions with regard to the proper closing of the package and any preparation for shipment before making any shipment under the terms of the certificates.

5.1.5.3.3 For package designs where a competent authority issued certificate is not required, the consignor shall, on request, make available for inspection by the competent authority, documentary evidence of the compliance of the package design with all the applicable requirements.

5.1.5.4. ***Summary of approval and prior notification requirements***

NOTE 1*: Before first shipment of any package requiring competent authority approval of the design, the consignor shall ensure that a copy of the approval certificate for that design has been submitted to the competent authority of each country en route (see 5.1.5.2.4 (a)).*

NOTE 2*: Notification required if contents exceed 3 x 10^3 A_1, or 3 x 10^3 A_2, or 1000 TBq; (see 5.1.5.2.4 (b)).*

NOTE 3*: Multilateral approval of shipment required if contents exceed 3 x 10^3 A_1, or 3 x 10^3 A_2, or 1000 TBq, or if controlled intermittent venting is allowed (see 5.1.5.2).*

NOTE 4*: See approval and prior notification provisions for the applicable package for carrying this material.*

Subject	**UN Number**	**Competent Authority approval required**		**Consignor required to notify the competent authorities of the country of origin and of the countries en route [a] before each shipment**	**Reference**
		Country of origin	**Countries en route [a]**		
Calculation of unlisted A_1 and A_2 values	-	Yes	Yes	No	---
Excepted packages - package design - shipment	2908, 2909, 2910, 2911	 No No	 No No	 No No	---
LSA material [b] and SCO [b] Industrial packages types 1, 2 or 3, non fissile and fissile excepted - package design - shipment	2912, 2913, 3321, 3322	 No No	 No No	 No No	---
Type A packages [b], non fissile and fissile excepted - package design - shipment	2915, 3332	 No No	 No No	 No No	--
Subject	**UN Number**	**Competent Authority approval required**		**Consignor required to notify the competent authorities of the country of origin and of the countries en route [a] before each shipment**	**Reference**
		Country of origin	**Countries en route [a]**		
Type B(U) packages [b], non fissile and fissile excepted - package design - shipment	2916	 Yes No	 No No	 See Note 1 See Note 2	5.1.5.2.4 (b), 5.1.5.3.1 (a)

Type B(M) packages [b], non fissile and fissile excepted - package design - shipment	2917	 Yes See Note 3	 Yes See Note 3	 No Yes	5.1.5.2.4 (b), 5.1.5.3.1 (a), 5.1.5.2.2.
Type C packages [b], non fissile and fissile excepted - package design - shipment	3323	 Yes No	 No No	 See Note 1 See Note 2	5.1.5.2.4 (b), 5.1.5.3.1 (a)
Packages for fissile material - package design - shipment : - sum of criticality safety indexes not more than 50 - sum of criticality safety indexes greater than 50	2977, 3324, 3325, 3326, 3327, 3328, 3329, 3330, 3331, 3333	 Yes [c] No [d] Yes	 Yes [c] No [d] Yes	 No See Note 2 See Note 2	5.1.5.3.1 (a), 5.1.5.2.2, 6.4.22.4
Special form radioactive material - design - shipment	 - See Note 4	 Yes See Note 4	 No See Note 4	 No See Note 4	1.6.5.4, 5.1.5.3.1 (a)
Low dispersable radioactive material - design - shipment	 - See Note 4	 Yes See Note 4	 No See Note 4	 No See Note 4	5.1.5.3.1 (a),6.4.22.3
Packages containing 0.1 kg or more of uranium hexafluoride - design - shipment	 - See Note 4	 Yes See Note 4	 No See Note 4	 No See Note 4	5.1.5.3.1 (a),6.4.22.3
Special Arrangement - shipment	2919, 3331	 Yes	 Yes	 Yes	5.1.5.3.1 (b),5.1.5.2.4 (b)
Approved packages designs subjected to transitional measures	-	See 1.6.5	See 1.6.5	See Note 1	1.6.5.2, 1.6.5.3, 5.1.5.2.4 (b), 5.1.5.3.1 (a),5.1.5.2.2.

[a] *Countries from, through or into which the consignment is carried.*

[b] *If the radioactive contents are fissile material which is not excepted from the provisions for packages containing fissile material, then the provisions for fissile material packages apply (see 6.4.11).*

[c] *Designs of packages for fissile material may also require approval in respect of one of the other items in the table.*

[d] *Shipments may, however, require approval in respect of one of the other items in the table.*

CHAPTER 5.2
MARKING AND LABELLING

5.2.1 Marking of packages

***NOTE**: For markings related to the construction, testing and approval of packagings, large packagings, gas receptacles and IBCs, see Part 6.*

5.2.1.1 Unless provided otherwise in ADR, the UN number corresponding to the dangerous goods contained, preceded by the letters "UN" shall be clearly and durably marked on each package. In the case of unpackaged articles the marking shall be displayed on the article, on its cradle or on its handling, storage or launching device.

5.2.1.2 All package markings required by this Chapter:

(a) shall be readily visible and legible;

(b) shall be able to withstand open weather exposure without a substantial reduction in effectiveness.

5.2.1.3 Salvage packagings shall additionally be marked with the word "**SALVAGE**".

5.2.1.4 Intermediate bulk containers of more than 450 litres capacity shall be marked on two opposite sides.

5.2.1.5 ***Additional provisions for goods of Class 1***

For goods of Class 1, packages shall, in addition, bear the proper shipping name as determined in accordance with 3.1.2. The marking, which shall be clearly legible and indelible, shall be in an official language of the country of origin and also, if that language is not English, French or German, in English, French or German unless any agreements concluded between the countries concerned in the transport operation provide otherwise.

5.2.1.6 ***Additional provisions for goods of Class 2***

Refillable receptacles shall bear the following particulars in clearly legible and durable characters:

(a) the UN number and the proper shipping name of the gas or mixture of gases, as determined in accordance with 3.1.2.

In the case of gases classified under an N.O.S. entry, only the technical name [1] of the gas has to be indicated in addition to the UN number.
In the case of mixtures, not more than the two constituents which most predominantly contribute to the hazards have to be indicated;

---

[1] *Instead of the technical name the use of one of the following names is permitted:*

- *For UN No. 1078 refrigerant gas, N.O.S.: mixture F1, mixture F2, mixture F3;*
- *For UN No. 1060 methylacetylene and propadiene mixtures, stabilized: mixture P1, mixture P2;*
- *For UN No. 1965 hydrocarbon gas mixture, liquefied, N.O.S.: mixture A or butane, mixture A01 or butane, mixture A02 or butane, mixture A0 or butane, mixture A1, mixture B1, mixture B2, mixture B, mixture C or propane.*

(b) for compressed gases filled by mass and for liquefied gases, either the maximum filling mass and the tare of the receptacle with fittings and accessories as fitted at the time of filling, or the gross mass;

(c) the date (year) of the next periodic inspection.

These marks can either be engraved or indicated on a durable information disk or label attached on the receptacle or indicated by an adherent and clearly visible marking such as by printing or by any equivalent process.

NOTE 1: *See also 6.2.1.7.1.*

NOTE 2: *For non refillable receptacles, see 6.2.1.7.2.*

5.2.1.7 ***Special marking provisions for goods of Class 7***

5.2.1.7.1 Each package shall be legibly and durably marked on the outside of the packaging with an identification of either the consignor or consignee, or both.

5.2.1.7.2 For each package, other than excepted packages, the UN number preceded by the letters "UN" and the proper shipping name shall be legibly and durably marked on the outside of the packaging. In the case of excepted packages only the UN number, preceded by the letters "UN", is required.

5.2.1.7.3 Each package of gross mass exceeding 50 kg shall have its permissible gross mass legibly and durably marked on the outside of the packaging.

5.2.1.7.4 Each package which conforms to:

(a) an Industrial package Type 1, an Industrial package Type 2 or an Industrial package Type 3 design shall be legibly and durably marked on the outside of the packaging with "TYPE IP-1", "TYPE IP-2" or "TYPE IP-3" as appropriate;

(b) a Type A package design shall be legibly and durably marked on the outside of the packaging with "TYPE A";

(c) an Industrial package Type 2, an Industrial package Type 3 or a Type A package design shall be legibly and durably marked on the outside of the packaging with the international vehicle registration code (VRI Code) [2] of the country of origin of design and the name of the manufacturers, or other identification of the packaging specified by the competent authority.

5.2.1.7.5 Each package which conforms to a design approved by the competent authority shall be legibly and durably marked on the outside of the packaging with:

(a) the identification mark allocated to that design by the competent authority;

(b) a serial number to uniquely identify each packaging which conforms to that design;

(c) in the case of a Type B(U) or Type B(M) package design, with "TYPE B(U)" or "TYPE B(M)"; and

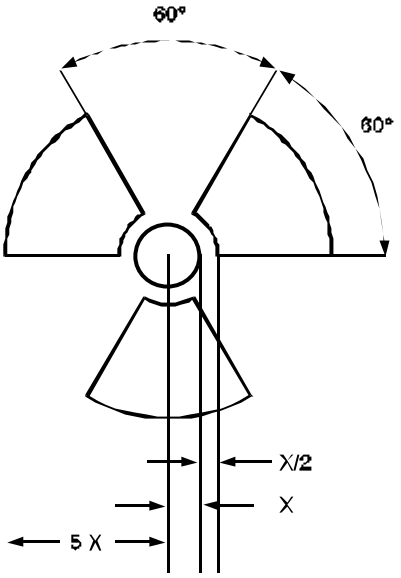
(d) in the case of a Type C package design, with "TYPE C".

---

[2] *Distinguishing sign for motor vehicles in international traffic prescribed in the Vienna Convention on Road Traffic (1968).*

5.2.1.7.6 Each package which conforms to a Type B(U), Type B(M) or Type C package design shall have the outside of the outermost receptacle which is resistant to the effects of fire and water plainly marked by embossing, stamping or other means resistant to the effects of fire and water with the trefoil symbol shown in the figure below.

Basic trefoil symbol with proportions
based on a central circle of radius X.
The minimum allowable size of X
shall be 4 mm.



5.2.1.7.7 Where LSA-I or SCO-I material is contained in receptacles or wrapping materials and is carried under exclusive use as permitted by 4.1.9.2.3, the outer surface of these receptacles or wrapping materials may bear the marking 'RADIOACTIVE LSA-I' or 'RADIOACTIVE SCO-I', as appropriate.

5.2.2 Labelling of packages

5.2.2.1 ***Labelling provisions***

5.2.2.1.1 For each article or substance listed in Table A of Chapter 3.2, the labels shown in Column (5) shall be affixed unless otherwise provided for by a special provision in Column (6).

5.2.2.1.2 Indelible danger markings corresponding exactly to the prescribed models may be used instead of labels.

5.2.2.1.3 to
5.2.2.1.5 *(Reserved)*

5.2.2.1.6 Each label shall:

(a) be affixed to the same surface of the package, if the dimensions of the package allow; for packages of Class1 and 7, near the mark indicating the proper shipping name;

(b) be so placed on the package that it is not covered or obscured by any part or attachment to the packaging or any other label or marking; and

(c) be displayed next to each other when more than one label is required.

Where a package is of such an irregular shape or small size that a label cannot be satisfactorily affixed, the label may be attached to the package by a securely affixed tag or other suitable means.

5.2.2.1.7 Intermediate bulk containers of more than 450 litres capacity shall be labelled on two opposite sides.

5.2.2.1.8 *(Reserved)*

5.2.2.1.9 *Special provisions for the labelling of self-reactive substances and organic peroxides*

(a) The label conforming to model No. 4.1 also implies that the product may be flammable and hence no label conforming to model No. 3 is required. In addition, a label conforming to model No. 1 shall be applied for self-reactive substances Type B, unless the competent authority has permitted this label to be dispensed with for a specific packaging because test data have proven that the self-reactive substance in such a packaging does not exhibit explosive behaviour.

(b) The label conforming to model No. 5.2 also implies that the product may be flammable and hence no label conforming to model No. 3 is required. In addition, the following labels shall be applied:

(i) A label conforming to model No. 1 for organic peroxides type B, unless the competent authority has permitted this label to be dispensed with for a specific packaging because test data have proven that the organic peroxide in such a packaging does not exhibit explosive behaviour;

(ii) A label conforming to model No. 8 is required when Packing Group I or II criteria of Class 8 are met.

For self-reactive substances and organic peroxides mentioned by name, the labels to be affixed are indicated in the list found in 2.2.41.4 and 2.2.52.4 respectively.

5.2.2.1.10 *Special provisions for the labelling of infectious substances packages*

In addition to the label conforming to model No. 6.2, infectious substances packages shall bear any other label required by the nature of the contents.

5.2.2.1.11 *Special provisions for the labelling of radioactive material*

5.2.2.1.11.1 Except as provided for large containers and tanks in accordance with 5.3.1.1.3, each package, overpack and container containing radioactive material shall bear at least two labels which conform to the models Nos.7A, 7B, and 7C as appropriate according to the category (see 2.2.7.8.4) of that package, overpack or container. Labels shall be affixed to two opposite sides on the outside of the package or on the outside of all four sides of the container. Each overpack containing radioactive material shall bear at least two labels on opposite sides of the outside of the overpack. In addition, each package, overpack and container containing fissile material, other than fissile material excepted under 6.4.11.2 shall bear labels which conform to model No.7E; such labels, where applicable shall be affixed adjacent to the labels for radioactive material. Labels shall not cover the markings specified in 5.2.1. Any labels which do not relate to the contents shall be removed or covered.

5.2.2.1.11.2 Each label conforming to models Nos.7A, 7B, and 7C shall be completed with the following information.

(a) *Contents*:

(i) except for LSA-I material, the name(s) of the radionuclide(s) as taken from Table 2.2.7.7.2.1, using the symbols prescribed therein. For mixtures of radionuclides, the most restrictive nuclides shall be listed to the extent the space on the line permits. The group of LSA or SCO shall be shown following the name(s) of the radionuclide(s). The terms "LSA-II","LSA-III", "SCO-I" and "SCO-II" shall be used for this purpose;

(ii) for LSA-I material, only the term "LSA-I" is necessary; the name of the radionuclide is not necessary;

(b) *Activity*: The maximum activity of the radioactive contents during carriage expressed in becquerels (Bq) with the appropriate SI prefix (see 1.2.2.1). For fissile material, the mass of fissile material in grams (g), or multiples thereof, may be used in place of activity;

(c) For overpacks and containers the "contents" and "activity" entries on the label shall bear the information required in (a) and (b) above, respectively, totalled together for the entire contents of the overpack or container except that on labels for overpacks or containers containing mixed loads of packages containing different radionuclides, such entries may read "See Transport Documents";

(d) *Transport index*: see 2.2.7.6.1.1 and 2.2.7.6.1.2 (no transport index entry is required for category I-WHITE).

5.2.2.1.11.3 Each label conforming to the model No. 7E shall be completed with the criticality safety index (CSI) as stated in the certificate of approval for special arrangement or the certificate of approval for the package design issued by the competent authority.

5.2.2.1.11.4 For overpacks and containers, the criticality safety index (CSI) on the label shall bear the information required in 5.2.2.1.11.3 totalled together for the fissile contents of the overpack or container.

5.2.2.1.12 *Additional labelling*

With the exception of Classes 1 and 7, label conforming to model No. 11 illustrated in 5.2.2.2.2 shall be displayed on two opposite sides of a package on the following packages:

- packages containing liquids in receptacles, the closures of which are not visible from the outside;

- packages containing vented receptacles or vented receptacles without outer packaging; and

- packages containing refrigerated liquefied gases.

5.2.2.2 *Provisions for labels*

5.2.2.2.1 Labels shall satisfy the provisions below and conform, in terms of colour, symbols and general format, to the models shown in 5.2.2.2.2.

5.2.2.2.1.1 Labels, except label conforming to model No. 11, shall be in the form of a square set at an angle of 45° (diamond-shaped) with minimum dimensions of 100 mm by 100 mm. They have a line of the same colour as the symbol, 5 mm inside the edge and running parallel with it. Label conforming to model No. 11 shall be rectangular, of standard format A5 (148x210

mm). If the size of the package so requires, the dimensions of the labels may be reduced, provided that they remain clearly visible.

5.2.2.2.1.2 Gas cylinders for Class 2 may, on account of their shape, orientation and securing mechanisms for carriage, bear labels representative of those specified in this section, which have been reduced in size, according to the dimensions outlined in ISO 7225:1994, *"Gas cylinders - Precautionary labels"*, for display on the non-cylindrical part (shoulder) of such cylinders.

5.2.2.2.1.3 Labels, except label conforming to model No.11, are divided into halves. With the exception of Divisions 1.4, 1.5 and 1.6, the upper half of the label is reserved for the pictorial symbol and the lower half for texts and the class number and the compatibility group letter as appropriate.

***NOTE**: For the labels of Classes 1, 2, 3, 5.1, 5.2, 7, 8 and 9, the respective class number shall be shown in the bottom corner. For the labels of Classes 4.1, 4.2 and 4.3 and of Classes 6.1 and 6.2 only figures 4 and 6 respectively shall be shown in the bottom corner (see 5.2.2.2.2).*

5.2.2.2.1.4 Except for Divisions 1.4, 1.5 and 1.6, labels for Class 1 show in the lower half the division number and compatibility group letter for the substance or article. Labels for Divisions 1.4, 1.5 and 1.6 show in the upper half the division number and in the lower half the compatibility group letter.

5.2.2.2.1.5 On labels other than those for material of Class 7, the optional insertion of any text (other than the class number) in the space below the symbol shall be confined to particulars indicating the nature of the risk and precautions to be taken in handling.

5.2.2.2.1.6 The symbols, text and numbers shall be clearly legible and indelible and shall be shown in black on all labels except for:

(a) the Class 8 label, where the text (if any) and class number shall appear in white; and

(b) labels with entirely green, red or blue backgrounds where they may be shown in white.

5.2.2.2.1.7 All labels shall be able to withstand open weather exposure without a substantial reduction in effectiveness.

5.2.2.2.2 *Specimen labels*

CLASS 1 HAZARD
Explosive substances or articles

(No.1)
Divisions 1.1, 1.2 and 1.3
Symbol (exploding bomb): black; Background: orange; Figure '1' in bottom corner

(No.1.4)
Division 1.4

(No.1.5)
Division 1.5

(No.1.6)
Division1.6

Background: orange; Figures: black; Numerals shall be about 30 mm in height
and be about 5 mm thick (for a label measuring 100 mm x 100 mm); Figure '1' in bottom corner

** Place for division - to be left blank if explosive is the subsidiary risk
* Place for compatibility group - to be left blank if explosive is the subsidiary risk

CLASS 2 HAZARD
Gases

(No.2.1)
Flammable gases
Symbol (flame): black or white;
Background: red; Figure '2' in bottom corner

(No.2.2)
Non flammable, non-toxic gases
Symbol (gas cylinder): black or white;
Background: green; Figure '2' in bottom corner

(No.2.3)
Toxic gases
Symbol (skull and crossbones): black;
Background: white; Figure '2' in bottom corner

CLASS 3 HAZARD
Flammable liquids

(No.3)
Symbol (flame): black or white;
Background: red; Figure '3' in bottom corner

CLASS 4.1 HAZARD
Flammable solids, self-reactive substances and desensitized explosives

(No.4.1)
Symbol (flame): black;
Background: white with seven vertical red stripes;
Figure '4' in bottom corner

CLASS 4.2 HAZARD
Substances liable to spontaneous combustion

(No.4.2)
Symbol (flame): black;
Background: upper half white, lower half red;
Figure '4' in bottom corner

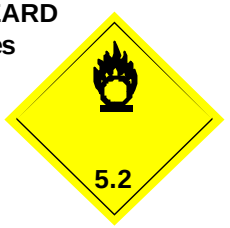
CLASS 4.3 HAZARD
Substances which, in contact with water, emit flammable gases

(No.4.3)
Symbol (flame): black or white;
Background: blue;
Figure '4' in bottom corner

CLASS 5.1 HAZARD
Oxidizing substances

(No. 5.1)

CLASS 5.2 HAZARD
Organic peroxides



(No. 5.2)

Symbol (flame over circle): black; Background: yellow;
Figures '5.1' in bottom corner
Figures '5.2' in bottom corner

CLASS 6.1 HAZARD
Toxic substances

(No. 6.1)
Symbol (skull and crossbones): black;
Background: white; Figure '6' in bottom corner

CLASS 6.2 HAZARD
Infectious substances

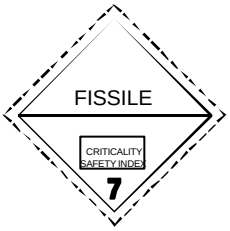
(No.6.2)
The lower half of the label may bear the inscriptions: 'INFECTIOUS SUBSTANCE' and 'IN THE CASE OF DAMAGE OR LEAKAGE IMMEDIATELY NOTIFY PUBLIC HEALTH AUTHORITY';
Symbol (three crescents superimposed on a circle) and incriptions: black;
Background: white; Figure '6' in bottom corner

CLASS 7 HAZARD
Radioactive material

(No. 7A)
Category I - White
Symbol (trefoil): black;
Background: white;
Text (mandatory): black in lower half of label:
'RADIOACTIVE'
'CONTENTS ...'
'ACTIVITY…'
One red vertical bar shall
follow the word 'RADIOACTIVE';
Figure '7' in bottom corner.

(No. 7B)
Category II - Yellow
Symbol (trefoil): black;
Background: upper half yellow with white border, lower half white;
Text (mandatory): black in lower half of label:
'RADIOACTIVE'
'CONTENTS...'
'ACTIVITY…'
In a black outlined box: 'TRANSPORT INDEX';
Two red vertical bars shall
follow the word 'RADIOACTIVE';
Figure '7' in bottom corner.

(No. 7C)
Category III - Yellow
Three red vertical bars shall
follow the word 'RADIOACTIVE';
Figure '7' in bottom corner.



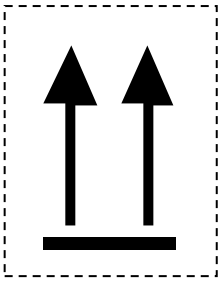
(No. 7E)
Class 7 fissile material
Background: white;
Text (mandatory): black in upper half of label: 'FISSILE';
In a black outlined box in the lower half of the label:
'CRITICALITY SAFETY INDEX'
Figure '7' in bottom corner.

CLASS 8 HAZARD
Corrosive substances

(No. 8)
Symbol (liquids, spilling from two glass test tubes
and attacking a hand and a metal): black;
Background: upper half white;
lower half black with white border;
Figure '8' in bottom corner

CLASS 9 HAZARD
Miscellaneous dangerous substances and articles

(No. 9)
Symbol (seven vertical stripes in upper half): black;
Background: white;
Figure '9' underlined in bottom corner



(No. 11)
Two black arrows on white
or suitable contrasting background

CHAPTER 5.3

PLACARDING AND MARKING OF CONTAINERS, MEGCs, TANK-CONTAINERS, PORTABLE TANKS AND VEHICLES

NOTE : *For marking and placarding of containers, MEGCs, tank-containers and portable tanks for carriage in a transport chain including a maritime journey, see also 1.1.4.2. If the provisions of 1.1.4.2 (c) are applied, only 5.3.1.3 and 5.3.2.1.1 of this Chapter are applicable*.

5.3.1 Placarding

5.3.1.1 *General provisions*

5.3.1.1.1 As and when required in this section, placards shall be affixed to the exterior surface of containers, MEGCs, tank-containers, portable tanks and vehicles. Placards shall correspond to the labels required in Column (5) and, where appropriate, Column (6) of Table A of Chapter 3.2 for the dangerous goods contained in the container, MEGC, tank-container, portable tank or vehicle and shall conform to the specifications given in 5.3.1.7.

5.3.1.1.2 For Class 1, compatibility groups shall not be indicated on placards if the transport unit or container is carrying substances or articles belonging to two or more compatibility groups. Transport units or containers carrying substances or articles of different divisions shall bear only placards conforming to the model of the most dangerous division in the order:

1.1 (most dangerous), 1.5, 1.2, 1.3, 1.6, 1.4 (least dangerous).

When 1.5 D substances are carried with substances or articles of Division 1.2, the transport unit or container shall be placarded as Division 1.1.

5.3.1.1.3. For Class 7, the primary risk placard shall conform to model No. 7D as specified in 5.3.1.7.2. This placard is not required for vehicles or containers carrying excepted packages and for small containers.

Where both Class 7 labels and placards would be required to be affixed to vehicles, containers, MEGCs, tank-containers or portable tanks, an enlarged label corresponding to the label required may be displayed instead of placard No.7D to serve both purposes.

5.3.1.1.4 Containers, MEGCs, tank-containers, portable tanks or vehicles containing goods of more than one class need not bear a subsidiary risk placard if the hazard represented by that placard is already indicated by a primary or subsidiary risk placard.

5.3.1.1.5 Placards which do not relate to the dangerous goods being carried, or residues thereof, shall be removed or covered.

5.3.1.2 *Placarding of containers, MEGCs, tank-containers and portable tanks*

NOTE*: This sub-section does not apply to swap-bodies, except tank swap bodies or swap-bodies carried in combined road/rail transport.*

The placards shall be affixed to both sides and at each end of the container, MEGC, tank-container or portable tank.

5.3.1.3 ***Placarding of vehicles carrying containers, MEGCs, tank-containers or portable tanks***

NOTE: *This sub-section does not apply to the placarding of vehicles carrying swap-bodies other than tank swap-bodies or than swap-bodies carried in combined road/rail transport; for such vehicles, see 5.3.1.5.*

If the placards affixed to the containers, MEGCs, tank-containers or portable tanks are not visible from outside the carrying vehicles, the same placards shall also be affixed to both sides and at the rear of the vehicle. Otherwise, no placard need be affixed on the carrying vehicle.

5.3.1.4 ***Placarding of vehicles for carriage in bulk, tank-vehicles, battery vehicles and vehicles with demountable tanks***

Placards shall be affixed to both sides and at the rear of the vehicle.

NOTE: *When, in the course of an ADR journey or at the end of an ADR journey, a tank semi-trailer is separated from its tractor to be loaded on board a ship or an inland navigation vessel, placards shall also be displayed at the front of the semi-trailer.*

5.3.1.5 ***Placarding of vehicles carrying packages only***

NOTE: *This sub-section applies also to vehicles carrying swap-bodies loaded with packages, except for combined road/rail transport; for combined road/rail transport, see 5.3.1.2 and 5.3.1.3.*

5.3.1.5.1 For vehicles carrying packages containing substances or articles of Class 1, placards shall be affixed to both sides and at the rear of the vehicle.

5.3.1.5.2 For vehicles carrying radioactive material of Class 7 in packagings or IBCs (other than excepted packages), placards shall be affixed to both sides and at the rear of the vehicle.

NOTE: *If, during an ADR journey, a vehicle carrying packages containing dangerous goods of classes other than Classes 1 and 7 is loaded on board a ship for sea transport or if the ADR journey precedes a voyage by sea, placards shall be affixed to both sides and at the rear of the vehicle. Placards may remain affixed to both sides and at the rear of the vehicle after a sea voyage.*

5.3.1.6 ***Placarding of empty tank-vehicles, battery-vehicles, MEGCs, tank-containers, portable tanks and empty vehicles and containers for carriage in bulk***

5.3.1.6.1 Empty tank-vehicles, vehicles with demountable tanks, battery-vehicles, MEGCs, tank-containers and portable tanks uncleaned and not degassed, and empty vehicles and containers for carriage in bulk, uncleaned, shall continue to display the placards required for the previous load.

5.3.1.7 ***Specifications for placards***

5.3.1.7.1 Except as provided in 5.3.1.7.2 for the Class 7 placard, a placard shall:

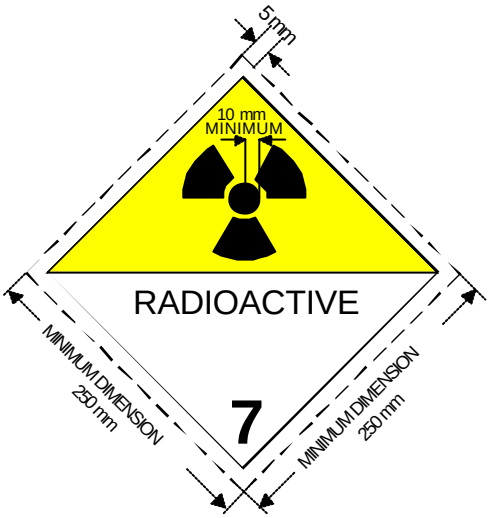
(a) Be not less than 250 mm by 250 mm, with a line of the same colour as the symbol running 12.5mm inside the edge and parallel with it;

(b) Correspond to the label required for the dangerous goods in question with respect to colour and symbol (see 5.2.2.2); and

(c) Display the numbers (and for goods of Class 1, the compatibility group letter) prescribed for the dangerous goods in question in 5.2.2.2 for the corresponding label, in digits not less than 25 mm high.

5.3.1.7.2 The Class 7 placard shall be not less than 250 mm by 250 mm with a black line running 5 mm inside the edge and parallel with it and is otherwise as shown below (Model No. 7D). The number "7" shall not be less than 25 mm high. The background colour of the upper half of the placard shall be yellow and of the lower half white, the colour of the trefoil and the printing shall be black. The use of the word "RADIOACTIVE" in the bottom half is optional to allow the use of this placard to display the appropriate UN number for the consignment.

Placard for radioactive material of Class 7



(No.7D)
Symbol (trefoil): black; Background: upper half yellow with
white border, lower half white;
The lower half shall show the word "RADIOACTIVE" or alternatively, when required, the appropriate UN Number (see 5.3.2.1.2)
and the figure "7" in the bottom corner.

5.3.1.7.3 For tanks with a capacity of not more than 3 m^3 and for small containers, placards may be replaced by labels conforming to 5.2.2.2.

5.3.1.7.4 For Classes 1 and 7, if the size and construction of the vehicle are such that the available surface area is insufficient to affix the prescribed placards, their dimensions may be reduced to 100 mm on each side.

5.3.2 Orange-coloured plate marking

5.3.2.1 ***General orange-coloured plate marking provisions***

5.3.2.1.1 Transport units carrying dangerous goods shall display two rectangular reflectorized orange-coloured plates conforming to 5.3.2.2.1, set in a vertical plane. They shall be affixed one at the front and the other at the rear of the transport unit, both perpendicular to the longitudinal axis of the transport unit. They shall be clearly visible.

5.3.2.1.2 When a hazard identification number is indicated in Column (20) of table A of Chapter 3.2, tank-vehicles or transport units having one or more tanks carrying dangerous goods shall in addition display on the sides of each tank or tank compartment, clearly visible and parallel to the longitudinal axis of the vehicle, orange-coloured plates identical with those prescribed in 5.3.2.1.1. These orange-coloured plates shall bear the hazard identification number and the UN number prescribed respectively in Columns (20) and (1) of table A of Chapter 3.2 for each of the substances carried in the tank or in a compartment of the tank.

5.3.2.1.3 For tank-vehicles or transport units having one or more tanks carrying substances with UN Nos. 1202, 1203 or 1223, or aviation fuel classed under UN Nos. 1268 or 1863, but no other dangerous substance, the orange-coloured plates prescribed in 5.3.2.1.2 need not be affixed if the plates affixed to the front and rear in accordance with 5.3.2.1.1 bear the hazard identification number and the UN number prescribed for the most hazardous substance carried, i.e. the substance with the lowest flash-point.

5.3.2.1.4 When a hazard identification number is indicated in Column (20) of Table A of Chapter 3.2, transport units and containers carrying dangerous solid substances in bulk shall in addition display on the sides of each transport unit or container, clearly visible and parallel to the longitudinal axis of the vehicle, orange-coloured plates identical with those prescribed in 5.3.2.1.1. These orange-coloured plates shall bear the hazard identification number and the UN number prescribed respectively in Columns (20) and (1) of table A of Chapter 3.2 for each of the substances carried in bulk in the transport unit or in the container.

5.3.2.1.5 For containers carrying dangerous solid substances in bulk and for tanks-containers, MEGCs and portable tanks, the plates prescribed in 5.3.2.1.2 and 5.3.2.1.4 may be replaced by a self-adhesive sheet, by paint or by any other equivalent process, provided the material used for this purpose is weather-resistant and ensures durable marking. In this case, the provisions of the last sentence of 5.3.2.2.2, concerning resistance to fire, shall not apply.

5.3.2.1.6 For transport units carrying only one substance, the orange-coloured plates prescribed in 5.3.2.1.2 and 5.3.2.1.4 shall not be necessary provided that those displayed at the front and rear in accordance with 5.3.2.1.1 bear the hazard identification number and the UN number prescribed respectively in Columns (20) and (1) of Table A of Chapter 3.2.

5.3.2.1.7 The above requirements are also applicable to empty fixed or demountable tanks, tank-containers, MEGCs, portable tanks and battery-vehicles, uncleaned and not degassed and empty vehicles and empty containers for carriage in bulk, uncleaned.

5.3.2.1.8 Orange-coloured plates which do not relate to dangerous goods carried, or residues thereof, shall be removed or covered. If plates are covered, the covering shall be total and remain effective after 15 minute' engulfment in fire.

5.3.2.2 ***Specifications for the orange-coloured plates***

5.3.2.2.1 The reflectorized orange-coloured plates shall be of 40 cm base and not less than 30 cm high; they shall have a black border not more than 15 mm wide. If the size and construction of the vehicle are such that the available surface area is insufficient to affix these orange-coloured plates, their dimensions may be reduced to 300 mm for the base, 120 mm for the height and 10 mm for the black border.

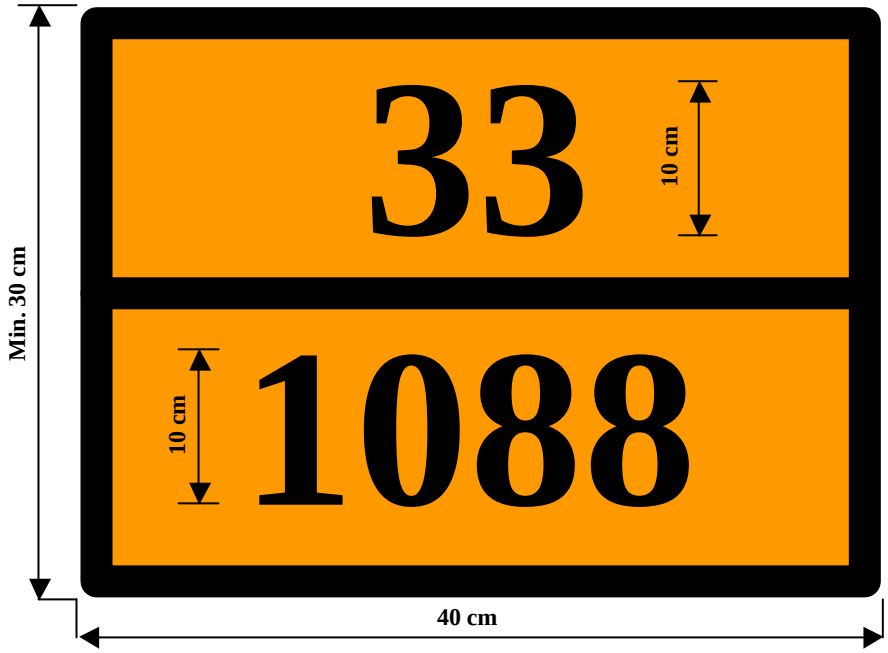
NOTE: *The colour of the orange plates in conditions of normal use should have chromaticity co-ordinates lying within the area on the chromaticity diagram formed by joining the following co-ordinates*

Chromaticity co-ordinates of points at the corners of the area on the chromaticity diagram				
x	0.52	0.52	0.578	0.618
y	0.38	0.40	0.422	0.38

Luminance factor of reflectorized colour: ß > 0.12.
Reference centre E, standard illuminant C, normal incidence 45°, viewed at 0°.
Co-efficient of reflex luminous intensity at an angle of illumination of 5°, viewed at 0.2°: not less than 20 candelas per lux per m^2.

5.3.2.2.2 The hazard identification number and the UN number shall consist of black digits 100 mm high and of 15 mm stroke thickness. The hazard-identification number shall be inscribed in the upper part of the plate and the UN number in the lower part; they shall be separated by a horizontal black line, 15 mm in stroke width, extending from side to side of the plate at mid-height (see 5.3.2.2.3).The hazard identification number and the UN number shall be indelible and shall remain legible after 15 minute' engulfment in fire.

5.3.2.2.3 *Example of orange-coloured plate with hazard identification number and UN number*



Hazard Identification number (2 or 3 figures preceded where appropriate by the letter X, see 5.3.2.3)

UN number (4 figures)

Background orange.
Border, horizontal line and figures black,15 mm thickness.

5.3.2.3 ***Meaning of hazard identification numbers***

5.3.2.3.1 The hazard identification number consists of two or three figures. In general, the figures indicate the following hazards:

2 Emission of gas due to pressure or to chemical reaction
3 Flammability of liquids (vapours) and gases or self-heating liquid
4 Flammability of solids or self-heating solid
5 Oxidizing (fire-intensifying) effect
6 Toxicity or risk of infection
7 Radioactivity
8 Corrosivity
9 Risk of spontaneous violent reaction

***NOTE**: The risk of spontaneous violent reaction within the meaning of figure 9 include the possibility following from the nature of a substance of a risk of explosion, disintegration and polymerization reaction following the release of considerable heat or flammable and/or toxic gases.*

Doubling of a figure indicates an intensification of that particular hazard.

Where the hazard associated with a substance can be adequately indicated by a single figure, this is followed by zero.

The following combinations of figures, however, have a special meaning: 22, 323, 333, 362, 382, 423, 44, 446, 462, 482, 539, 606, 623, 642, 823, 842, 90 and 99, see 5.3.2.3.2 below.

If a hazard identification number is prefixed by the letter "X", this indicates that the substance will react dangerously with water. For such substances, water may only be used by approval of experts.

5.3.2.3.2 The hazard identification numbers listed in Column (20) of table A of Chapter3.2 have the following meanings:

20	asphyxiant gas or gas with no subsidiary risk
22	refrigerated liquefied gas, asphyxiant
223	refrigerated liquefied gas, flammable
225	refrigerated liquefied gas, oxidizing (fire-intensifying)
23	flammable gas
239	flammable gas, which can spontaneously lead to violent reaction
25	oxidizing (fire-intensifying) gas
26	toxic gas
263	toxic gas, flammable
265	toxic gas, oxidizing (fire-intensifying)
268	toxic gas, corrosive
30	flammable liquid (flash-point between 23 °C and 61 °C, inclusive) or flammable liquid or solid in the molten state with a flash-point above 61 °C, heated to a temperature equal to or above its flash-point, or self-heating liquid
323	flammable liquid which reacts with water, emitting flammable gases
X323	flammable liquid which reacts dangerously with water, emitting flammable gases [1]
33	highly flammable liquid (flash-point below 23 °C)
333	pyrophoric liquid
X333	pyrophoric liquid which reacts dangerously with water [1]
336	highly flammable liquid, toxic
338	highly flammable liquid, corrosive
X338	highly flammable liquid, corrosive, which reacts dangerously with water [1]
339	highly flammable liquid which can spontaneously lead to violent reaction
36	flammable liquid (flash-point between 23 °C and 61 °C, inclusive), slightly toxic, or self-heating liquid, toxic
362	flammable liquid, toxic, which reacts with water, emitting flammable gases
X362	flammable liquid toxic, which reacts dangerously with water, emitting flammable gases [1]
368	flammable liquid, toxic, corrosive
38	flammable liquid (flash-point between 23 °C and 61 °C, inclusive), slightly corrosive or self-heating liquid, corrosive

[1] W*ater not to be used except by approval of experts.*

382	flammable liquid, corrosive, which reacts with water, emitting flammable gases
X382	flammable liquid, corrosive, which reacts dangerously with water, emitting flammable gases [1]
39	flammable liquid, which can spontaneously lead to violent reaction
40	flammable solid, or self-reactive substance, or self-heating substance
423	solid which reacts with water, emitting flammable gases
X423	flammable solid which reacts dangerously with water, emitting flammable gases [1]
43	spontaneously flammable (pyrophoric) solid
44	flammable solid, in the molten state at an elevated temperature
446	flammable solid, toxic, in the molten state, at an elevated temperature
46	flammable or self-heating solid, toxic
462	toxic solid which reacts with water, emitting flammable gases
X462	solid which reacts dangerously with water, emitting toxic gases [1]
48	flammable or self-heating solid, corrosive
482	corrosive solid which reacts with water, emitting flammable gases
X482	solid which reacts dangerously with water, emitting corrosive gases [1]
50	oxidizing (fire-intensifying) substance
539	flammable organic peroxide
55	strongly oxidizing (fire-intensifying) substance
556	strongly oxidizing (fire-intensifying) substance, toxic
558	strongly oxidizing (fire-intensifying) substance, corrosive
559	strongly oxidizing (fire-intensifying) substance, which can spontaneously lead to violent reaction
56	oxidizing substance (fire-intensifying), toxic
568	oxidizing substance (fire-intensifying), toxic, corrosive
58	oxidizing substance (fire-intensifying), corrosive
59	oxidizing substance (fire-intensifying) which can spontaneously lead to violent reaction
60	toxic or slightly toxic substance
606	infectious substance
623	toxic liquid, which reacts with water, emitting flammable gases
63	toxic substance, flammable (flash-point between 23 °C and 61 °C, inclusive)
638	toxic substance, flammable (flash-point between 23 °C and 61 °C, inclusive), corrosive
639	toxic substance, flammable (flash-point not above 61 °C) which can spontaneously lead to violent reaction
64	toxic solid, flammable or self-heating
642	toxic solid, which reacts with water, emitting flammable gases
65	toxic substance, oxidizing (fire-intensifying)
66	highly toxic substance
663	highly toxic substance, flammable (flash-point not above 61 °C)
664	highly toxic solid, flammable or self-heating
665	highly toxic substance, oxidizing (fire-intensifying)
668	highly toxic substance, corrosive
669	highly toxic substance which can spontaneously lead to violent reaction
68	toxic substance, corrosive
69	toxic or slightly toxic substance, which can spontaneously lead to violent reaction

[1] W*ater not to be used except by approval of experts.*

70	radioactive material
72	radioactive gas
723	radioactive gas, flammable
73	radioactive liquid, flammable (flash-point not above 61 °C)
74	radioactive solid, flammable
75	radioactive material, oxidizing (fire-intensifying)
76	radioactive material, toxic
78	radioactive material, corrosive
80	corrosive or slightly corrosive substance
X80	corrosive or slightly corrosive substance, which reacts dangerously with water [1]
823	corrosive liquid which reacts with water, emitting flammable gases
83	corrosive or slightly corrosive substance, flammable (flash-point between 23 °C and 61 °C, inclusive)
X83	corrosive or slightly corrosive substance, flammable, (flash-point between 23 °C and 61 °C, inclusive), which reacts dangerously with water [1]
839	corrosive or slightly corrosive substance, flammable (flash-point between 23 °C and 61 °C inclusive) which can spontaneously lead to violent reaction
X839	corrosive or slightly corrosive substance, flammable (flash-point between 23 °C and 61 °C inclusive), which can spontaneously lead to violent reaction and which reacts dangerously with water [1]
84	corrosive solid, flammable or self-heating
842	corrosive solid which reacts with water, emitting flammable gases
85	corrosive or slightly corrosive substance, oxidizing (fire-intensifying)
856	corrosive or slightly corrosive substance, oxidizing (fire-intensifying) and toxic
86	corrosive or slightly corrosive substance, toxic
88	highly corrosive substance
X88	highly corrosive substance, which reacts dangerously with water [1]
883	highly corrosive substance, flammable (flash-point between 23 °C and 61 °C inclusive)
884	highly corrosive solid, flammable or self-heating
885	highly corrosive substance, oxidizing (fire-intensifying)
886	highly corrosive substance, toxic
X886	highly corrosive substance, toxic, which reacts dangerously with water [1]
89	corrosive or slightly corrosive substance, which can spontaneously lead to violent reaction
90	environmentally hazardous substance; miscellaneous dangerous substances
99	miscellaneous dangerous substance carried at an elevated temperature.

[1] *Water not to be used except by approval of experts.*

5.3.3 Mark for elevated temperature substances

Tank-vehicles, tank-containers, portable tanks, special vehicles or containers or especially equipped vehicles or containers for which a mark for elevated temperature substances is required according to special provision 580 in Column (6) of Table A of Chapter 3.2 shall bear on both sides and at the rear for vehicles, and on both sides and at each end for containers, tank-containers and portable tanks, a triangular shaped mark with sides of at least 250 mm, to be shown in red, as reproduced below.

CHAPTER 5.4

DOCUMENTATION

5.4.0 Any carriage of goods governed by ADR shall be accompanied by the documentation prescribed in this Chapter, as appropriate, unless exempted under 1.1.3.1 to 1.1.3.5.

NOTE 1*: For the list of documentation to be carried on board transport units, see 8.1.2.*

NOTE 2: *The use of electronic data processing (EDP) or electronic data interchange (EDI) techniques as an aid to or instead of paper documentation is permitted, provided that the procedures used for the capture, storage and processing of electronics data meet the legal requirements as regards the evidential value and availability of data during transport in a manner at least equivalent to that of paper documentation.*

5.4.1 Dangerous goods transport document and related information

5.4.1.1 *General information required in the transport document*

5.4.1.1.1 The transport document(s) shall contain the following information for each dangerous substance, material or article offered for carriage:

(a) the UN number;

(b) the proper shipping name supplemented, when applicable (see 3.1.2.6), with the technical, chemical or biological name, as determined in accordance with 3.1.2;

(c) the class of the goods, or for substances and articles of Class1 the division, followed immediately by the compatibility group letter;

(d) where assigned, the packing group for the substance or article;

(e) the initials ADR or RID;

(f) the number and a description of the packages;

(g) the total quantity of dangerous goods covered by the description (as a volume or as a gross mass, or as a net mass as appropriate);

NOTE*: In the case of application of 1.1.3.6 the total quantity of dangerous goods carried per transport unit shall be expressed as a value calculated in accordance with the provisions of 1.1.3.6.*

(h) the name and address of the consignor;

(i) the name and address of the consignee(s);

(j) a declaration as required by the terms of any special agreement.

The location and order in which the elements of information required appear in the transport document is left optional, except that (a), (b), (c), (d) and (e) shall appear in that sequence, e.g. : "**1098 ALLYL ALCOHOL, 6.1, I, ADR**"

5.4.1.1.2 The information required on a transport document shall be legible.

5.4.1.1.3 *Special provisions for wastes*

If waste containing dangerous goods (other than radioactive wastes) is being carried, the UN number and the proper shipping name shall be preceeded by the word "**WASTE**", unless this term is part of the proper shipping name, e.g.:

"WASTE, 1230 METHANOL, 3, II, ADR", or
"WASTE, 1993 FLAMMABLE LIQUID, N.O.S., (toluene and ethyl alcohol), 3, II, ADR"

5.4.1.1.4 *Special provisions for dangerous goods packed in limited quantities*

No information is required in the transport document, if any, for carriage of dangerous goods packed in limited quantities according to Chapter 3.4.

5.4.1.1.5 *Special provisions for salvage packagings*

When dangerous goods are carried in a salvage packaging, the words **"SALVAGE PACKAGE"** shall be added after the description of the goods in the transport document.

5.4.1.1.6 *Special provisions for empty uncleaned packagings, vehicles, containers, tanks, battery-vehicles and MEGCs*

For empty means of containment, uncleaned, the description in the transport document shall be '**EMPTY PACKAGING**", "**EMPTY RECEPTACLE**", "**EMPTY IBC**", "**EMPTY VEHICLE**", "**EMPTY TANK-VEHICLE**", "**EMPTY DEMOUNTABLE TANK**", "**EMPTY PORTABLE TANK**", "**EMPTY TANK-CONTAINER**", "**EMPTY CONTAINER**", '**EMPTY BATTERY-VEHICLE**", '**EMPTY MEGC**", as appropriate, followed by the class number and the letters "ADR or RID". See example as follows: "**EMPTY PACKAGING, 3, ADR**"

In the case of empty gas receptacles with a capacity of more than 1 000 litres, empty tank-vehicles, battery-vehicles, demountable tanks, portable tanks, tank-containers, MEGCs, vehicles and containers for carriage in bulk, uncleaned, this description shall be followed by the words '**last load**" together with the UN number and proper shipping name of the goods last loaded. See example as follows:

"EMPTY TANK-VEHICLE, 2, ADR, LAST LOAD: 1017 CHLORINE"

If empty tanks, battery-vehicles and MEGCs, uncleaned, are carried to the nearest place where cleaning or repair can be carried out in accordance with the provisions of 4.3.2.4.3 or 7.5.8.1, the following additional entry shall be made in the transport document: **"Carriage in accordance with 4.3.2.4.3"** or **"Carriage in accordance with 7.5.8.1"**

5.4.1.1.7 *Special provisions for carriage in a transport chain including maritime or air carriage*

For carriage in accordance with 1.1.4.2, a statement shall be included in the transport document, as follows: **"Carriage in accordance with 1.1.4.2 "**.

5.4.1.1.8 *Special provisions for use of portable tanks approved for maritime carriage*

For carriage in accordance with 1.1.4.3, a statement shall be included in the transport document, as follows: **"Carriage in accordance with 1.1.4.3 "**.

5.4.1.1.9 *(Reserved)*

5.4.1.1.10 *Special provisions for exemptions related to quantities carried per transport unit*

5.4.1.1.10.1 In the case of exemptions provided for in 1.1.3.6, the transport document shall bear the following inscription: "**Load not exceeding the exemption limits prescribed in 1.1.3.6**."

5.4.1.1.10.2 Where consignments from more than one consignor are carried in the same transport unit, the transport documents accompanying these consignments need not bear the inscription mentioned in 5.4.1.1.10.1.

5.4.1.1.11 *Special provisions for the carriage of IBCs after the date of expiry of the last periodic test inspection*.

For carriage in accordance with 4.1.2.2, a statement to this effect shall be included in the transport document, as follows: "Carriage in accordance with 4.1.2.2"

5.4.1.1.12 (Reserved)

5.4.1.1.13 *Special provisions for carriage in multi-compartment tank-vehicles or transport units with more than one tank.*

When by derogation from 5.3.2.1.2 a multi-compartment tank-vehicle or a transport unit with more than one tank is marked in accordance with 5.3.2.1.3 the substances contained in each tank or in each compartment of a tank shall be specified in the transport document.

5.4.1.2 *Additional or special information required for certain classes*

5.4.1.2.1 *Special provisions for Class 1*

(a) The transport document shall indicate, in addition to the requirements in 5.4.1.1.1 (g):

- the total net mass, in kg, of explosive contents[1] for each substance or article covered by a description;
- the total net mass, in kg, of explosive contents[1] for all substances and articles covered by the transport document.

(b) For mixed packing of two different goods, the description of the goods in the transport document shall include the UN numbers and names printed in capitals in Columns (1) and (2) of Table A of Chapter 3.2 of both substances or articles. If more than two different goods are contained in the same package in conformity with the mixed packing provisions given in 4.1.10 special provisions MP1, MP2 and MP20 to MP24, the transport document shall indicate under the description of the goods the UN numbers of all the substances and articles contained in the package, in the form, "Goods of UN Nos...";

(c) For the carriage of substances and articles assigned to an n.o.s. entry or the entry "0190 SAMPLES, EXPLOSIVE" or packed conforming to packing instruction P101 of 4.1.4.1, a copy of the competent authority approval with the conditions of carriage shall be attached to the transport document. It shall be in an official language of the forwarding country and also, if that language is not English, French or German, in English, French or German unless agreements, if any, concluded between the countries concerned in the transport operation provide otherwise;

(d) If packages containing substances and articles of compatibility groups B and D are loaded together in the same vehicle in accordance with the requirements of 7.5.2.2, the approval certificate of the protective container/separate compartment in accordance with 7.5.2.2, note [a] under the table, shall be attached to the transport document;

[1] *For articles, "explosive contents" means the explosive substance contained in the article.*

(e) When explosive substances or articles are carried in packagings conforming to packing instruction P101, the transport document shall bear the inscription "**Packaging approved by the competent authority of ...**" (see 4.1.4.1, packing instruction P101).

NOTE: *The commercial or technical name of the goods may be entered additionally to the proper shipping name in the transport document.*

5.4.1.2.2 *Additional provisions for Class 2*

(a) For the carriage of mixtures (see 2.2.2.1.1) in tanks (demountable tanks, fixed tanks, portable tanks, tank-containers or elements of battery-vehicles or of MEGCs), the composition of the mixture as a percentage of the volume or as a percentage of the mass shall be given. Constituents below 1% need not be indicated (see also 3.1.2.6.1.2);

(b) For the carriage of cylinders, tubes, pressure drums, cryogenic receptacles and bundles of cylinders under the conditions of 4.1.6.6, the following entry shall be included in the transport document: **"Carriage in accordance with 4.1.6.6"**.

5.4.1.2.3 *Additional provisions for self-reactive substances of Class 4.1 and organic peroxides of Class 5.2*

5.4.1.2.3.1 For self-reactive substances of Class 4.1 and for organic peroxides of Class 5.2 that require temperature control during carriage, the control and emergency temperatures shall be indicated in the transport document, as follows: **"Control temperature: ... °C Emergency temperature: ... °C"**.

5.4.1.2.3.2 When for certain self-reactive substances of Class 4.1 and certain organic peroxides of Class 5.2 the competent authority has permitted the label conforming to model No.1 to be dispensed with for a specific packaging (see 5.2.2.1.9), a statement to this effect shall be included in the transport document, as follows: **"The label conforming to model No.1 is not required"**.

5.4.1.2.3.3 When organic peroxides and self-reactive substances are carried under conditions where approval is required (for organic peroxides see 2.2.52.1.8, 4.1.7.2.2 and special provision TA2 of 6.8.4; for self-reactive substances see 2.2.41.1.13 and 4.1.7.2.2, a statement to his effect shall be included in the transport document, e.g. **"Carriage in accordance with 2.2.52.1.8"**.

A copy of the approval of the competent authority with the conditions of carriage shall be attached to the transport document.

5.4.1.2.3.4 When a sample of an organic peroxide (see 2.2.52.1.9) or a self-reactive substance (see 2.2.41.1.15) is carried, a statement to this effect shall be included in the transport document, e.g. **"Carriage in accordance with 2.2.52.1.9"**.

5.4.1.2.3.5 When self-reactive substances type G (see Manual of Tests and Criteria, Part II, paragraph 20.4.2 (g)) are carried, the following statement may be given in the transport document: **"Not a self-reactive substance of Class 4.1"**.

When organic peroxides type G (see Manual of Tests and Criteria, Part II, paragraph 20.4.3 (g)) are carried, the following statement may be given in the transport document: **"Not a substance of Class 5.2"**.

5.4.1.2.4 *Additional provisions for Class 6.2*

(a) If the infectious substance is a genetically modified substance, the words "genetically modified micro-organisms" shall be added in the transport document;

(b) For diagnostic specimens which are offered for carriage under the conditions of 2.2.62.1.8, the proper shipping name shall be: **"Diagnostic specimen, containing ..."** (the infectious substance determining the classification to be entered);

(c) For the carriage of easily perishable substances, appropriate information shall be provided, e.g. **"Cool at +2/+4 °C"** or **"Carry in frozen state"** or **"Do not freeze"**.

5.4.1.2.5 *Special provisions for Class 7*

5.4.1.2.5.1 The consignor shall include in the transport documents with each consignment the following information, as applicable in the order given:

(a) The UN number assigned to the material preceded by the letters "UN";

(b) The proper shipping name;

(c) The Class number "7";

(d) The name or symbol of each radionuclide or, for mixtures of radionuclides, an appropriate general description or a list of the most restrictive nuclides;

(e) A description of the physical and chemical form of the material, or a notation that the material is special form radioactive material or low dispersible radioactive material. A generic chemical description is acceptable for chemical form;

(f) The maximum activity of the radioactive contents during carriage expressed in becquerels (Bq) with an appropriate SI prefix (see 1.2.2.1). For fissile material, the mass of fissile material in grams (g), or appropriate multiples thereof, may be used in place of activity;

(g) The category of the package, i.e. I-WHITE, II-YELLOW, III-YELLOW;

(h) The transport index (categories II-YELLOW and III-YELLOW only);

(i) For consignments including fissile material other than consignments excepted under 6.4.11.2, the criticality safety index;

(j) The identification mark for each competent authority approval certificate (special form radioactive material, low dispersible radioactive material, special arrangement, package design, or shipment) applicable to the consignment;

(k) For consignments of packages in an overpack or container, a detailed statement of the contents of each package within the overpack or container and, where appropriate, of each overpack or container in the consignment. If packages are to be removed from the overpack or container at a point of intermediate unloading, appropriate transport documents shall be made available;

(l) Where a consignment is required to be shipped under exclusive use, the statement **"EXCLUSIVE USE SHIPMENT"**; and

(m) For LSA-II and LSA-III substances, SCO-I and SCO-II, the total activity of the consignment as a multiple of A_2.

5.4.1.2.5.2 The consignor shall provide in the transport documents a statement regarding actions, if any, that are required to be taken by the carrier. The statement shall be in the languages deemed necessary by the carrier or the authorities concerned, and shall include at least the following information:

(a) Supplementary requirements for loading, stowage, carriage, handling and unloading of the package, overpack or container including any special stowage provisions for the safe dissipation of heat (see special provision CV33 (3.2) of 7.5.11), or a statement that no such requirements are necessary;

(b) Restrictions on the mode of carriage or vehicle and any necessary routeing instructions;

(c) Emergency arrangements appropriate to the consignment.

5.4.1.2.5.3 The applicable competent authority certificates need not necessarily accompany the consignment. The consignor shall make them available to the carrier(s) before loading and unloading.

5.4.1.3 *(Reserved)*

5.4.1.4 ***Format and language***

5.4.1.4.1 The document containing the information in 5.4.1.1 and 5.4.1.2 may be that already required by other regulations in force for carriage by another mode of carriage. In case of multiple consignees, the name and address of the consignees and the quantities delivered enabling the nature and quantities carried to be evaluated at any time, may be entered in other documents which are to be used or in any other documents made mandatory according to other specific regulations and which shall be on board the vehicle.

The particulars to be entered in the document shall be drafted in an official language of the forwarding country, and also, if that language is not English, French, or German, in English, French or German, unless international road carriage tariffs, if any, or agreements concluded between the countries concerned in the transport operation, provide otherwise.

5.4.1.4.2 If by reason of the size of the load, a consignment cannot be loaded in its entirety on a single transport unit, at least as many separate documents, or copies of the single document, shall be made out as transport units loaded. Furthermore, in all cases, separate transport documents shall be made out for consignments or parts of consignments which may not be loaded together on the same vehicle by reason of the prohibitions set forth in 7.5.2.

The information relative to the hazards of the goods to be carried (as indicated in 5.4.1.1) may be incorporated in, or combined with, an existing transport or cargo handling document. The layout of the information in the document (or the order of transmission of the corresponding data by electronic date processing (EDP) or electronic date interchange (EDI) techniques) shall be as provided in 5.4.1.1.1.

When an existing transport document or cargo handling document cannot be used for the purposes of dangerous goods documentation for multimodal transport, the use of documents corresponding to the example shown in 5.4.4 is considered advisable [2].

[2] *If used, the relevant recommendations of the UN/ECE Working Party on Facilitation of International Trade Procedures may be consulted, in particular Recommendation No.1 (United Nations Lay-out*

5.4.1.5 ***Non-dangerous goods***

When goods mentioned by name in Table A of Chapter 3.2, are not subject to ADR because they are considered as non-dangerous according to Part 2, the consignor may enter in the transport document a statement to that effect, e.g.: "**Not goods of Class....**"

NOTE*: This provision may be used in particular when the consignor considers that, due to the chemical nature of the goods (e.g solutions and mixtures) carried or to the fact that such goods are deemed dangerous for other regulatory purposes the consignment might be subject to control during the journey.*

Key for Trade Documents) (ECE/TRADE/137, edition 96.1), Recommendation No.11 (Documentary Aspects of the International Transport of Dangerous Goods) ECE/TRADE/204,edition 96.1) and Recommendation No.22 (Lay-out Key for standard Consignment Instructions) (ECE/TRADE/168, edition 96.1). Refer to the Trade Data Elements Directory, Volume III, Trade Facilitation Recommendations (ECE/TRADE/200) (United Nations publication Sales No.E.96.II.E.13).

5.4.2 Container packing certificate

If the carriage of dangerous goods in a large container precedes a voyage by sea, a container packing certificate conforming to section 5.4.2 of the IMDG Code [3] shall be provided with the transport document [4].

---

[3] *Guidelines for use in practice and in training for loading goods in transport units have also been drawn up by the International Maritime Organization (IMO), the International Labour Organization (ILO) and the United Nations Economic Commission for Europe (UN/ECE) and have been published by IMO ("IMO/ILO/UN-ECE Guidelines for Packing of Cargo Transport Units (CTUs)").*

[4] *Section 5.4.2 of the IMDG Code requires the following:*

*"**5.4.2 Container/vehicle packing certificate***

5.4.2.1 When packages containing dangerous goods are packed onto or into any unit, such as, freight container, flat, trailer or other vehicle intended for transport by sea, those responsible for the packing of the unit shall provide a "container/vehicle packing certificate" specifying the container/vehicle/unit identification number(s) and certifying that the operation has been carried out in accordance with the following conditions:

.1 The cargo transport unit was clean, dry and apparently fit to receive the goods;

.2 If the consignments include goods of Class 1, other than Division 1.4, the cargo transport unit is structurally serviceable in conformity with 7.4.10 (of the IMDG Code).

.3 Goods, which should be segregated, have not been packed together onto or in the cargo transport unit (unless approved by the competent authority concerned in accordance with 7.2.2.3 (of the IMDG Code);

.4 All packages have been externally inspected for damage, leakage or sifting, and only sound packages have been loaded;

.5 Drums have been stowed in an upright position, unless otherwise authorized by the competent authority;

.6 All packages have been properly packed onto or in the cargo transport unit and secured;

.7 When dangerous goods are transported in bulk packagings, the cargo has been evenly distributed;

.8 The cargo transport unit and the packages therein are properly marked, labelled, and placarded;

.9 When solid carbon dioxide (CO2-dry ice) is used for cooling purposes, the cargo transport unit is externally marked or labelled in a conspicuous place, such as, at the door end, with the words: DANGEROUS CO2 GAS (DRY ICE) INSIDE. VENTILATE THOROUGHLY BEFORE ENTERING",

.10 The dangerous goods transport document required in 5.4.1 (of the IMDG Code) has been received for each dangerous goods consignment packed onto or in the cargo transport unit.

5.4.2.2 The functions of the dangerous goods transport document required in 5.4.1 (of the IMDG Code) and of the container/vehicle packing certificate required in 5.4.2.1 (of the IMDG Code) may be incorporated into a single document; if not, these documents shall be attached one to the other. If these functions are incorporated into a single document, such as, a dangerous goods declaration, a shipping note, etc., the inclusion of a signed declaration phrase such as "It is declared that the packing of the goods into the unit has been carried out in accordance with the provisions of 5.4.2.1" will suffice. The person signing this declaration shall be identified on the document.

Note: The container/vehicle packing certificate is not required for tanks."

The functions of the transport document required under 5.4.1 and of the container packing certificate as provided above may be incorporated into a single document; if not, these documents shall be attached one to the other. If these functions are incorporated into a single document, the inclusion in the transport document of a statement that the loading of the container has been carried out in accordance with the applicable modal regulations together with the identification of the person responsible for the container packing certificate shall be sufficient.

NOTE: *The container packing certificate is not required for portable tanks, tank-containers and MEGCs.*

5.4.3 Instructions in writing

5.4.3.1 As a precaution against any accident or emergency that may occur or arise during carriage, the driver shall be given instructions in writing, specifying concisely for each dangerous substance or article carried or for each group of goods presenting the same dangers to which the substance(s) or article(s) carried belong(s):

(a) the name of the substance or article or group of goods, the Class and the UN number or for a group of goods the UN numbers of the goods for which these instructions are intended or are applicable;

(b) the nature of the danger inherent in these goods as well as the measures to be taken by the driver and the personal protection equipment to be used by the driver;

(c) the general actions to be taken, e.g. to warn the road users and passers-by and call the police/fire brigade;

(d) the additional actions to be taken to deal with minor leakages or spillages to prevent their escalation, if this can be achieved without personal risk;

(e) the special actions to be taken for certain goods, if applicable;

(f) the necessary equipment for general and, if applicable, additional and/or special actions.

5.4.3.2 These instructions shall be provided by the consignor and shall be handed out to the driver at the latest when the dangerous goods are loaded on the vehicle. Information on the content of the instructions shall be supplied to the carrier at the latest when the carriage order is given, so as to enable him to take the necessary steps to ensure that the employees concerned are aware of these instructions and are capable of carrying them out properly and to ensure that the necessary equipment is on board the vehicle.

5.4.3.3 The consignor shall be responsible for the content of these instructions. They shall be provided in a language the driver(s) taking over the dangerous goods is (are) able to read and to understand, and in all languages of the countries of origin, transit and destination. In the case of countries with more than one official language, the competent authority shall specify the official language or languages applicable throughout the territory or in each region or part of the territory.

5.4.3.4 These instructions shall be kept readily identifiable in the driver's cab.

5.4.3.5 Instructions in writing according to this section which are not applicable to the goods which are on board of the vehicle, shall be kept separate from pertinent documents in such a way as to prevent confusion.

5.4.3.6 The carrier shall ensure that the drivers concerned understand and are capable of carrying out these instructions properly.

5.4.3.7 In case of mixed loads of packaged goods including dangerous goods which belong to different groups of goods presenting the same dangers, the instructions in writing may be restricted to one instruction per Class of dangerous goods carried on board of the vehicle. In such case no name of goods, or UN number has to be mentioned in the instructions.

5.4.3.8 These instructions shall be drafted according to the following format:

LOAD

- Mention of the proper shipping name of the substance or article, or the name of the group of goods presenting the same dangers, the Class and the UN number or for a group of goods the UN numbers of the goods for which these instructions are intended or are applicable.

- Description shall be restricted to e.g. the physical state with indication of any colour and mention of any odour, to aid identification of leakages or spillages.

NATURE OF DANGER

Short enumeration of dangers:

- Main danger;

- Additional dangers including possible delayed effects and dangers for the environnent;

- Behaviour under fire or heating (decomposition, explosion, development of toxic fumes, etc.);

- If applicable, it shall be mentioned here that the goods carried react dangerously with water.

PERSONAL PROTECTION

Mention of the personal protection intended for the driver in accordance with the requirements of 8.1.5.

GENERAL ACTIONS TO BE TAKEN BY DRIVER

Mention of the following instructions:

- Stop the engine;

- No naked lights. No smoking;

- Mark roads and warn other road users or passers-by;

- Inform the public about the hazard and give advice to keep upwind;

- Notify police and fire brigade as soon as possible.

ADDITIONAL AND/OR SPECIAL ACTIONS TO BE TAKEN BY THE DRIVER

Appropriate instructions shall be included here as well as the list of equipment necessary for the driver to perform the additional and/or special actions according to the class(es) of the goods being carried (e.g. shovel, collecting container, etc.).

It is considered that drivers of vehicles should be instructed and trained to take additional actions with minor leakages or spillages to prevent their escalation, provided that this can be achieved without personal risk.

It is considered that any special action recommended by the consignor requires a special training of the driver. If applicable, appropriate instructions shall be included here as well as the list of equipment needed for these special actions.

FIRE

Information for the driver in case of fire:

Drivers should be instructed during training to deal with minor vehicle fires. They shall not attempt to deal with any fire involving the load.

FIRST AID

Information for the driver in case of contact with the carried good(s).

ADDITIONAL INFORMATION

*** * * * ***

5.4.4. Example of a multimodal dangerous goods form

Example of a form which may be used as a combined dangerous goods declaration and container packing certificate for multimodal carriage of dangerous goods.

-

MULTIMODAL DANGEROUS GOODS FORM

FOR DANGEROUS GOODS; You must specify: proper shipping name, hazard class, UN no, packing group (where assigned) and any other element of information required under applicable national and international regulations

BLACK HATCHINGS BLACK HATCHINGS BLACK HATCHINGS BLACK HATCHINGS BLACK HATCHINGS BLACK HATCHINGS BLACK HATCHINGS BLACK

1. Shipper / Consignor / Sender	2. Transport document number	
	3. Page 1 of Pages	4. Shipper's reference
		5. Freight Forwarder's reference
6. Consignee	7. Carrier (to be completed by the carrier)	
	SHIPPER'S DECLARATION I hereby declare that the contents of this consignment are fully and accurately described below by the proper shipping name, and are classified, packaged, marked and labeled/placarded and are in all respects in proper condition for transport according to the applicable international and national governmental regulations.	
8. This shipment is within the limitations prescribed for: (Delete non-applicable) PASSENGER AND CARGO AIRCRAFT / CARGO AIRCRAFT ONLY	9. Additional handling information	
10. Vessel / flight number and date / 11. Port / place of loading		
12. Port / place of discharge / 13. Destination		

14. Shipping marks	* Number and kind of packages; description of goods	Gross mass (kg)	Net mass	Cube (m^3)

15. Container identification No./ Vehicle registration No.	16. Seal number(s)	17. Container/vehicle size & type	18. Tare (kg)	19. Total gross mass (including tare) (kg)

CONTAINER/VEHICLE PACKING CERTIFICATE

I hereby declare that the goods described above have been packed/loaded into the container/vehicle identified above in accordance with the applicable provisions**

MUST BE COMPLETED AND SIGNED

CONTAINER/VEHICLE LOADS BY PERSON RESPONSIBLE FOR PACKING/LOADING

21. RECEIVING ORGANISATION RECEIPT
Received the above number of packages/containers/trailers in apparent good order and condition unless stated hereon: RECEIVING ORGANISATION REMARKS:

20. Name of company	Haulier's name	22. Name of company (OF SHIPPER PREPARING THIS NOTE)
Name / Status of declarant	Vehicle reg. no.	Name / Status of declarant
Place and date	Signature and date	Place and date
Signature of declarant	DRIVER'S SIGNATURE	Signature of declarant

*** See 5.4.2*

MULTIMODAL DANGEROUS GOODS FORM

Continuation Sheet

1. Shipper / Consignor /Sender	2. Transport document number	
	3. Page 1 of Pages	4. Shipper's reference
		5. Freight Forwarder's reference

14. Shipping marks	* Number and kind of packages; description of goods	Gross mass (kg)	Net mass	Cube (m^3)

I/We declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport according to applicable national and international regulations.

BLACK HATCHINGS BLACK HATCHINGS BLACK HATCHINGS BLACK HATCHINGS BLACK HATCHINGS BLACK HATCHINGS BLACK HATCHINGS BLACK HATCHINGS BLACK HATCHINGS BLACK H ATCHINGS BLACK HATCHINGS BLACK HATCHINGS BLACK

CHAPTER 5.5

SPECIAL PROVISIONS

5.5.1 Special provisions for the consignment of infectious substances in risk groups 3 and 4

5.5.1.1 Unless an infectious substance cannot be consigned by any other means, live vertebrate or invertebrate animals shall not be used to consign such a substance. Such animals shall be packed, marked, indicated, and carried in accordance with the relevant regulations governing the carriage of animals [1].

5.5.1.2 The transport of infectious substances requires co-ordinated action by the consignor, the carrier and the consignee to ensure safety and arrival on time and in proper condition. To this end, the following measures shall be taken:

(a) *Advance arrangements between consignor, carrier and consignee*. Dispatch of infectious substances shall not take place before advance arrangements have been made between consignor, carrier and consignee or before the consignee has confirmed with his competent authorities that the substances can legally be imported and that no delay will be incurred in the delivery of the consignment to its destination;

(b) *Preparation of dispatch documents*. In order to secure transmission without hindrance it is necessary to prepare all dispatch documents, including the transport document (see Chapter 5.4), in strict accordance with rules governing the acceptance of the goods to be dispatched;

(c) *Routeing*. Transport shall be by the quickest possible routeing. If transshipment is necessary, precautions shall be taken to ensure special care, expeditious handling and monitoring of the substances in transit;

(d) *Timely notification of all transport data by consignor to consignee.* The consignor shall notify the consignee in advance of transport details, such as: means of transport, transport document number and date and hour of expected arrival at the point of destination, so that the consignment can be collected promptly. The most rapid means of communication shall be used for this notification.

5.5.1.3 Dead animals which are known or reasonably believed to contain an infectious substance shall be packed, marked, labelled and carried in accordance with the conditions [2] specified by the competent authority of the country of origin [3].

---

1 *Regulations governing the carriage of live animals are contained in, e.g. Directive 91/628/EEC of 19 November 1991 on the protection of animals during transport (Official Journal of the European Communities No. L 340 of 11.12.1991, p.17) and in the Recommendations of the Council of Europe (Ministerial Committee) on the carriage of certain animal species.*

2 *Such regulations are contained e.g. in the Council of the European Communities Directive 90/667/EEC of 27.11.1990, laying down the veterinary rules for the disposal and processing of animal waste, for its placing on the market and for the prevention of pathogens in feedstuffs of animal or fish origin and amending Directive 90/425/EEC (Official Journal of the European Communities, No. L 363 of 27.12.1990 p. 0051-0060).*

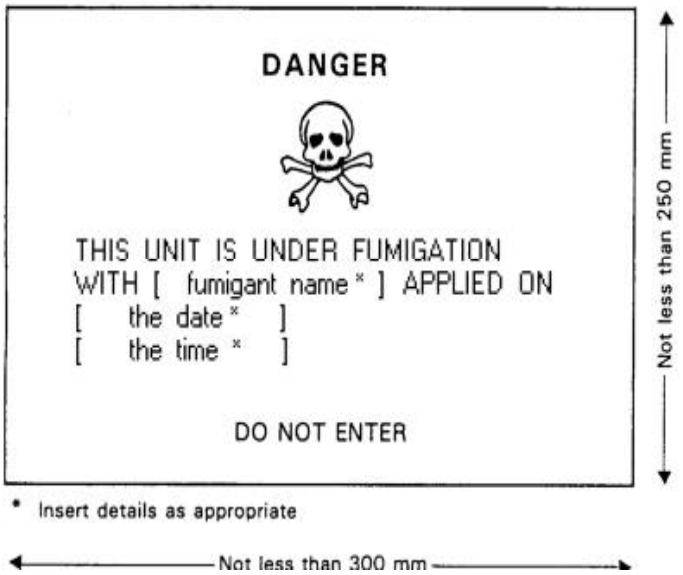
3 *If the country of origin is not a contracting party to ADR, the competent authority of the first country contracting party to ADR reached by the consignment.*

5.5.2 Special provisions for fumigated containers and vehicles

5.5.2.1 Transport documents associated with containers and vehicles that have been fumigated shall show the date of fumigation and the type and amount of the fumigant used. These particulars shall be drafted in an official language of the forwarding country and also, if the language is not English, French or German, in English, French or German, unless agreements, if any, concluded between the countries concerned in the transport operation provide otherwise. In addition, instructions for disposal of any residual fumigant including fumigation devices (if used) shall be provided.

5.5.2.2 A warning sign as specified in the figure below shall be placed on each fumigated container or vehicle in a location where it will be easily seen by persons attempting to enter the interior of container or vehicle. The particulars concerning the warning sign shall be drafted in a language considered appropriate by the consignor.

Fumigation warning sign



PART 6

Requirements for the construction and testing of packagings, intermediate bulk containers (IBCs), large packagings and tanks

CHAPTER 6.1

REQUIREMENTS FOR THE CONSTRUCTION AND TESTING OF PACKAGINGS

6.1.1 General

6.1.1.1 The requirements of this Chapter do not apply to:

(a) Packages containing radioactive material of Class 7, unless otherwise provided (see 4.1.9);

(b) Packages containing infectious substances of Class 6.2, unless otherwise provided (see Chapter 6.3, Note and packing instruction P621 of 4.1.4.1);

(c) Receptacles containing gases of Class 2;

(d) Packages whose net mass exceeds 400 kg;

(e) Packagings with a capacity exceeding 450 litres.

6.1.1.2 The requirements for packagings in 6.1.4 are based on packagings currently used. In order to take into account progress in science and technology, there is no objection to the use of packagings having specifications different from those in 6.1.4, provided that they are equally effective, acceptable to the competent authority and able successfully to withstand the tests described in 6.1.1.3 and 6.1.5. Methods of testing other than those described in this Chapter are acceptable, provided they are equivalent, and are recognized by the competent authority.

6.1.1.3 Every packaging intended to contain liquids shall successfully undergo a suitable leakproofness test, and be capable of meeting the appropriate test level indicated in 6.1.5.4.3:

(a) before it is first used for carriage;

(b) after remanufacturing or reconditioning, before it is re-used for carriage;

For this test, packagings need not have their own closures fitted.

The inner receptacle of composite packagings may be tested without the outer packaging provided the test results are not affected.

This test is not necessary for:

- inner packagings of combination packagings;

- inner receptacles of composite packagings (glass, porcelain or stoneware), marked with the symbol "RID/ADR" according to 6.1.3.1 (a) (ii);

- light gauge metal packagings, marked with the symbol "RID/ADR" according to 6.1.3.1 (a) (ii).

6.1.1.4 Packagings shall be manufactured and tested under a quality assurance programme which satisfies the competent authority in order to ensure that each manufactured packaging meets the requirements of this Chapter.

6.1.2 Code for designating types of packagings

6.1.2.1 The code consists of:

(a) an Arabic numeral indicating the kind of packaging, e.g. drum, jerrican, etc., followed by;

(b) a capital letter(s) in Latin characters indicating the nature of the material, e.g. steel, wood, etc., followed where necessary by;

(c) an Arabic numeral indicating the category of packaging within the kind to which the packaging belongs.

6.1.2.2 In the case of composite packagings, two capital letters in Latin characters are used in sequence in the second position of the code. The first indicates the material of the inner receptacle and the second that of the outer packaging.

6.1.2.3 In the case of combination packagings and infectious substances packagings marked in accordance with 6.3.1.1, only the code number for the outer packaging is used.

6.1.2.4 The letters "T", "V" or "W" may follow the packaging code. The letter "T" signifies a salvage packaging conforming to the requirements of 6.1.5.1.11. The letter "V" signifies a special packaging conforming to the requirements of 6.1.5.1.7. The letter "W" signifies that the packaging, although of the same type indicated by the code, is manufactured to a specification different to that in 6.1.4 and is considered equivalent under the requirements of 6.1.1.2.

6.1.2.5 The following numerals shall be used for the kinds of packaging:

1. Drum
2. Wooden barrel
3. Jerrican
4. Box
5. Bag
6. Composite packaging
7. (reserved)
0. Light gauge metal packagings

6.1.2.6 The following capital letters shall be used for the types of material:

A. Steel (all types and surface treatments)
B. Aluminium
C. Natural wood
D. Plywood
F. Reconstituted wood
G. Fibreboard
H. Plastics material
L. Textile
M. Paper, multiwall
N. Metal (other than steel or aluminium)
P. Glass, porcelain or stoneware

6.1.2.7 The following table indicates the codes to be used for designating types of packagings depending on the kind of packagings, the material used for their construction and their category; it also refers to the sub-sections to be consulted for the appropriate requirements:

Kind	Material	Category	Code	Sub-section
1. Drums	A. Steel	non-removable head	1A1	6.1.4.1
		removable head	1A2	
	B. Aluminium	non-removable head	1B1	6.1.4.2
		removable head	1B2	
	D. Plywood		1D	6.1.4.5
	G. Fibre		1G	6.1.4.7
	H. Plastics	non-removable head	1H1	6.1.4.8
		removable head	1H2	
	N. Metal, other than steel or aluminium	non-removable head	1N1	6.1.4.3
		removable head	1N2	
2. Barrels	C. Wooden	bung type	2C1	6.1.4.6
		removable head	2C2	
3. Jerricans	A. Steel	non-removable head	3A1	6.1.4.4
		removable head	3A2	
	B. Aluminium	non-removable head	3B1	6.1.4.4
		removable head	3B2	
	H. Plastics	non-removable head	3H1	6.1.4.8
		removable head	3H2	
4. Boxes	A. Steel		4A	6.1.4.14
	B. Aluminium		4B	6.1.4.14
	C. Natural wood	ordinary	4C1	6.1.4.9
		with sift-proof walls	4C2	
	D. Plywood		4D	6.1.4.10
	F. Reconstituted wood		4F	6.1.4.11
	G. Fibreboard		4G	6.1.4.12
	H. Plastics	expanded	4H1	6.1.4.13
		solid	4H2	
5. Bags	H. Woven plastics	without inner liner or coating	5H1	6.1.4.16
		sift-proof	5H2	
		water resistant	5H3	
	H. Plastics film		5H4	6.1.4.17
	L. Textile	without inner liner or coating	5L1	6.1.4.15
		sift-proof	5L2	
		water resistant	5L3	
	M. Paper	multiwall	5M1	6.1.4.18
		multiwall, water resistant	5M2	

Kind	Material	Category	Code	Sub-section
6. Composite packagings	H. Plastics receptacle	with outer steel drum	6HA1	6.1.4.19
		with outer steel crate or box	6HA2	6.1.4.19
		with outer aluminium drum	6HB1	6.1.4.19
		with outer aluminium crate or box	6HB2	6.1.4.19
		with outer wooden box	6HC	6.1.4.19
		with outer plywood drum	6HD1	6.1.4.19
		with outer plywood box	6HD2	6.1.4.19
		with outer fibre drum	6HG1	6.1.4.19
		with outer fibreboard box	6HG2	6.1.4.19
		with outer plastics drum	6HH1	6.1.4.19
		with outer solid plastics box	6HH2	6.1.4.19
	P. Glass, porcelain or stoneware receptacle	with outer steel drum	6PA1	6.1.4.20
		with outer steel crate or box	6PA2	6.1.4.20
		with outer aluminium drum	6PB1	6.1.4.20
		with outer aluminium crate or box	6PB2	6.1.4.20
		with outer wooden box	6PC	6.1.4.20
		with outer plywood drum	6PD1	6.1.4.20
		with outer wickerwork hamper	6PD2	6.1.4.20
		with outer fibre drum	6PG1	6.1.4.20
		with outer fibreboard box	6PG2	6.1.4.20
		with outer expanded plastics packaging	6PH1	6.1.4.20
		with outer solid plastics packaging	6PH2	6.1.4.20
0. Light gauge metal packagings	A. Steel	non-removable head	0A1	6.1.4.22
		removable head	0A2	

6.1.3 Marking

NOTE 1: *The marking indicates that the packaging which bears it corresponds to a successfully tested design type and that it complies with the requirements of this Chapter which are related to the manufacture, but not to the use, of the packaging. In itself, therefore, the mark does not necessarily confirm that the packaging may be used for any substance: generally the type of packaging (e.g. steel drum), its maximum capacity and/or mass, and any special requirements are specified for each substance in Table A of Chapter 3.2.*

NOTE 2: *The marking is intended to be of assistance to packaging manufacturers, reconditioners, packaging users, carriers and regulatory authorities. In relation to the use of a new packaging, the original marking is a means for its manufacturer(s) to identify the type and to indicate those performance test regulations that have been met.*

NOTE 3: *The marking does not always provide full details of the test levels, etc., and these may need to be taken further into account, e.g. by reference to a test certificate, to test reports or to a register of successfully tested packagings. For example, a packaging having an X or Y marking may be used for substances to which a packing group having a lesser degree of danger has been assigned with the relevant maximum permissible value of the relative density [1] determined by taking into account the factor 1.5 or 2.25 indicated in the packaging test requirements in 6.1.5 as appropriate, i.e. Group I packaging tested for products of relative density 1.2 could be used as a Group II packaging for products of relative density 1.8 or a Group III packaging for products of relative density 2.7, provided of course that all the performance criteria can still be met with the higher relative density product.*

6.1.3.1 Each packaging intended for use according to the ADR shall bear markings which are durable, legible and placed in a location and of such a size relative to the packaging as to be readily visible. For packages with a gross mass of more than 30 kg, the markings or a duplicate thereof shall appear on the top or on a side of the packaging. Letters, numerals and symbols shall be at least 12 mm high, except for packagings of 30 litres or 30 kg capacity or less, when they shall be at least 6 mm in height and for packagings of 5 litres or 5 kg or less when they shall be of an appropriate size.

The marking shall show:

(a) (i) The United Nations packaging symbol

This shall not be used for any purpose other than certifying that a packaging complies with the relevant requirements in this Chapter. For embossed metal packagings the capital letters "UN" may be applied instead of the symbol; or

(ii) The symbol "RID/ADR" for packagings approved for rail transport as well as road transport.

For composite packagings (glass, porcelain or stoneware) and light gauge metal packagings, conforming to simplified conditions (see 6.1.1.3, 6.1.5.3.1 (e), 6.1.5.3.4 (c), 6.1.5.4, 6.1.5.5.1 and 6.1.5.6);

(b) The code designating the type of packaging according to 6.1.2;

---

[1] *Relative density (d) is considered to be synonymous with Specific Gravity (SG) and is used throughout this text.*

(c) A code in two parts:

(i) a letter designating the packing group(s) for which the design type has been successfully tested:

X for packing groups I, II and III;
Y for packing groups II and III;
Z for packing group III only;

(ii) the relative density, rounded off to the first decimal, for which the design type has been tested for packagings without inner packagings intended to contain liquids; this may be omitted when the relative density does not exceed 1.2. For packagings intended to contain solids or inner packagings, the maximum gross mass in kilograms.

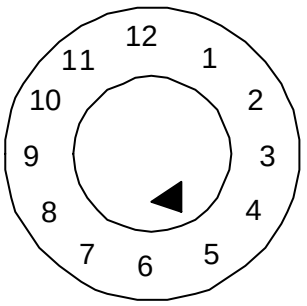
For light-gauge metal packagings, marked with the symbol "RID/ADR" according to 6.1.3.1 (a) (ii) intended to contain liquids having a viscosity at 23 °C exceeding 200 mm^2/s, the maximum gross mass in kg;

(d) Either the letter "S" denoting that the packaging is intended for the carriage of solids or inner packagings or, for packagings (other than combination packagings) intended to contain liquids, the hydraulic test pressure which the packaging was shown to withstand in kPa rounded down to the nearest 10 kPa.

For light-gauge metal packagings, marked with the symbol "RID/ADR, according to 6.1.3.1(a) (ii) intended to contain liquids having a viscosity at 23 °C exceeding 200 mm^2/s, the letter "S";

***NOTE**: The requirements of subparagraph (d) do not apply to packagings intended for the carriage of substances classified under UN Nos. 2814 or 2900 of Class 6.2.*

(e) The last two digits of the year during which the packaging was manufactured. Packagings of types lH and 3H shall also be appropriately marked with the month of manufacture; this may be marked on the packaging in a different place from the remainder of the marking. An appropriate method is:



(f) The State authorizing the allocation of the mark, indicated by the distinguishing sign for motor vehicles in international traffic [2];

(g) The name of the manufacturer or other identification of the packaging specified by the competent authority.

---

[2] *Distinguishing sign for motor vehicles in international traffic prescribed in Vienna Convention on Road Traffic (1968).*

6.1.3.2 Every reusable packaging liable to undergo a reconditioning process which might obliterate the packaging markings shall bear the marks indicated in 6.1.3.1 (a) to (e) in a permanent form. Marks are permanent if they are able to withstand the reconditioning process (e.g. embossed). For packagings other than metal drums of a capacity greater than 100 litres, these permanent marks may replace the corresponding durable markings prescribed in 6.1.3.1.

6.1.3.2.1 In addition to the durable markings prescribed in 6.1.3.1, every new metal drum of a capacity greater than 100 litres shall bear the marks described in 6.1.3.1 (a) to (e) on the bottom, with an indication of the nominal thickness of at least the metal used in the body (in mm, to 0.1 mm), in permanent form (e.g. embossed). When the nominal thickness of either head of a metal drum is thinner than that of the body, the nominal thickness of the top head, body, and bottom head shall be marked on the bottom in permanent form (e.g. embossed), for example "1.0-1.2-1.0" or "0.9-1.0-1.0". Nominal thickness of metal shall be determined according to the appropriate ISO standard, for example ISO 3574:1999 for steel. The marks indicated in 6.1.3.1 (f) and (g) shall not be applied in a permanent form except as provided in 6.1.3.2.3.

6.1.3.2.2 For remanufactured metal drums, if there is no change to the packaging type and no replacement or removal of integral structural components, the required markings need not be permanent. Every other remanufactured metal drum shall bear the markings in 6.1.3.1 (a) to (e) in a permanent form (e.g. embossed) on the top head or side.

6.1.3.2.3 Metal drums made from materials (e.g. stainless steel) designed to be reused repeatedly may bear the markings indicated in 6.1.3.1 (f) and (g) in a permanent form (e.g. embossed).

6.1.3.2.4 The marking in accordance with 6.1.3.1 is valid for only one design type or series of design types. Different surface treatments may fall within the same design type.

A "series of design types" means packagings of the same structural design, wall thickness, material and cross-section, which differ only in their lesser design heights from the design type approved.

The closures of receptacles shall be identifiable as those referred to in the test report.

6.1.3.3 Marking shall be applied in the sequence of the subparagraphs in 6.1.3.l; for examples, see 6.1.3.7. Any additional markings authorized by a competent authority shall still enable the parts of the mark to be correctly identified with reference to 6.1.3.l.

6.1.3.4 After reconditioning a packaging, the reconditioner shall apply to it a durable marking showing, in the following sequence:

(h) The State in which the reconditioning was carried out, indicated by the distinguishing sign for motor vehicles in international traffic [2];

(i) The name or authorized symbol of the reconditioner;

(j) The year of reconditioning; the letter "R"; and, for every packaging successfully passing the leakproofness test in 6.1.1.3, the additional letter "L".

6.1.3.5 When, after reconditioning, the markings required by 6.1.3.1 (a) to (d) no longer appear on the top head or the side of a metal drum, the reconditioner also shall apply them in a durable form followed by 6.1.3.4 (h), (i) and (j). These markings shall not identify a greater performance capability than that for which the original design type had been tested and marked.

---

[2] *Distinguishing sign for motor vehicles in international traffic prescribed in Vienna Convention on Road Traffic (1968).*

6.1.3.6 Packagings manufactured with recycled plastics material as defined in 1.2.1 shall be marked "REC". This mark shall be placed near the mark prescribed in 6.1.3.1.

6.1.3.7 ***Examples of markings for NEW packagings***

 4G/Y145/S/83 NL/VL823	as in 6.1.3.1 (a) (i), (b), (c), (d) and (e) as in 6.1.3.1 (f) and (g)	For a new fibreboard box
 1A1/Y1.4/150/83 NL/VL824	as in 6.1.3.1 (a) (i), (b), (c), (d) and (e) as in 6.1.3.1 (f) and (g)	For a new steel drum to contain liquids
 1A2/Y150/S/83 NL/VL825	as in 6.1.3.1 (a) (i), (b), (c), (d) and (e) as in 6.1.3.1 (f) and (g)	For a new steel drum to contain solids, or inner packagings
 4HW/Y136/S/83 NL/VL826	as in 6.1.3.1 (a) (i), (b), (c), (d) and (e) as in 6.1.3.1 (f) and (g)	For a new plastics box of equivalent specification
 lA2/Y/100/91 USA/MM5	as in 6.1.3.1 (a) (i), (b), (c), (d) and (e) as in 6.1.3.1 (f) and (g)	For a remanufactured steel drum to contain liquids
RID/ADR/0A1/100/83 NL/VL123	as in 6.1.3.1 (a) (ii), (b), (c), (d) and (e) as in 6.1.3.1 (f) and (g)	For a new light gauge metal packaging, non-removable head
RID/ADR/0A2/Y20/S/83 NL/VL124	as in 6.1.3.1 (a) (ii), (b), (c), (d) and (e) as in 6.1.3.1 (f) and (g)	For a new light gauge metal packaging, removable head, intended to contain solids, or liquids with a viscosity at 23 °C exceeding 200 mm^2/s.

6.1.3.8 ***Examples of markings for RECONDITIONED packagings***

 1A1/Y1.4/150/83 NL/RB/85 RL	as in 6.1.3.1 (a) (i), (b), (c), (d) and (e) as in 6.1.3.4 (h), (i) and (j)
 1A2/Y150/S/83 USA/RB/85 R	as in 6.1.3.1 (a) (i), (b), (c), (d) and (e) as in 6.1.3.4 (h), (i) and (j)

6.1.3.9 ***Example of marking for SALVAGE packagings***

 1A2T/Y300/S/94 USA/abc	as in 6.1.3.1 (a) (i), (b), (c), (d) and (e) as in 6.1.3.1 (f) and (g)

NOTE: *The markings, for which examples are given in 6.1.3.7, 6.1.3.8 and 6.1.3.9 may be applied in a single line or in multiple lines provided the correct sequence is respected.*

6.1.3.10 ***Certification***

By affixing marking in accordance with 6.1.3.1, it is certified that mass-produced packagings correspond to the approved design type and that the requirements referred to in the approval have been met.

6.1.4 Requirements for packagings

6.1.4.1 ***Steel drums***

1A1 non-removable head
1A2 removable head

6.1.4.1.1 Body and heads shall be constructed of steel sheet of a suitable type and of adequate thickness in relation to the capacity of the drum and to its intended use.

6.1.4.1.2 Body seams shall be welded on drums intended to contain more than 40 litres of liquid. Body seams shall be mechanically seamed or welded on drums intended to contain solids or 40 litres or less of liquids.

6.1.4.1.3 Chimes shall be mechanically seamed or welded. Separate reinforcing rings may be applied.

6.1.4.1.4 The body of a drum of a capacity greater than 60 litres shall, in general, have at least two expanded rolling hoops or, alternatively, at least two separate rolling hoops. If there are separate rolling hoops they shall be fitted tightly on the body and so secured that they cannot shift. Rolling hoops shall not be spot welded.

6.1.4.1.5 Openings for filling, emptying and venting in the bodies or heads of non-removable head (1A1) drums shall not exceed 7 cm in diameter. Drums with larger openings are considered to be of the removable head type (1A2). Closures for openings in the bodies and heads of drums shall be so designed and applied that they will remain secure and leakproof under normal conditions of carriage. Closure flanges may be mechanically seamed or welded in place. Gaskets or other sealing elements shall be used with closures, unless the closure is inherently leakproof.

6.1.4.1.6 Closure devices for removable head (1A2) drums shall be so designed and applied that they will remain secure and drums will remain leakproof under normal conditions of carriage. Gaskets or other sealing elements shall be used with all removable heads.

6.1.4.1.7 If materials used for body, heads, closures and fittings are not in themselves compatible with the contents to be carried, suitable internal protective coatings or treatments shall be applied. These coatings or treatments shall retain their protective properties under normal conditions of carriage.

6.1.4.1.8 Maximum capacity of drum: 450 litres.

6.1.4.1.9 Maximum net mass: 400 kg.

6.1.4.2 ***Aluminium drums***

1B1 non-removable head
1B2 removable head

6.1.4.2.1 Body and heads shall be constructed of aluminium at least 99% pure or of an aluminium base alloy. Material shall be of a suitable type and of adequate thickness in relation to the capacity of the drum and to its intended use.

6.1.4.2.2 All seams shall be welded. Chime seams, if any, shall be reinforced by the application of separate reinforcing rings.

6.1.4.2.3 The body of a drum of a capacity greater than 60 litres shall, in general, have at least two expanded rolling hoops or, alternatively, at least two separate rolling hoops. If there are separate rolling hoops they shall be fitted tightly on the body and so secured that they cannot shift. Rolling hoops shall not be spot welded.

6.1.4.2.4 Openings for filling, emptying and venting in the bodies or heads of non-removable head (1B1) drums shall not exceed 7 cm in diameter. Drums with larger openings are considered to be of the removable head type (1B2). Closures for openings in the bodies and heads of drums shall be so designed and applied that they will remain secure and leakproof under normal conditions of carriage. Closure flanges shall be welded in place so that the weld provides a leakproof seam. Gaskets or other sealing elements shall be used with closures, unless the closure is inherently leakproof.

6.1.4.2.5 Closure devices for removable head (1B2) drums shall be so designed and applied that they will remain secure and drums will remain leakproof under normal conditions of carriage. Gaskets or other sealing elements shall be used with all removable heads.

6.1.4.2.6 Maximum capacity of drum: 450 litres.

6.1.4.2.7 Maximum net mass: 400 kg.

6.1.4.3 ***Drums of metal other than aluminium or steel***

1N1 non-removable head
1N2 removable head

6.1.4.3.1 The body and heads shall be constructed of a metal or of a metal alloy other than steel or aluminium. Material shall be of a suitable type and of adequate thickness in relation to the capacity of the drum and to its intended use.

6.1.4.3.2 Chime seams, if any, shall be reinforced by the application of separate reinforcing rings. All seams, if any, shall be joined (welded, solded, etc.) in accordance with the technical state of the art for the used metal or metal alloy.

6.1.4.3.3 The body of a drum of a capacity greater than 60 litres shall, in general, have at least two expanded rolling hoops or, alternatively, at least two separate rolling hoops. If there are separate rolling hoops they shall be fitted tightly on the body and so secured that they cannot shift. Rolling hoops shall not be spot welded.

6.1.4.3.4 Openings for filling, emptying and venting in the bodies or heads of non-removable head (1N1) drums shall not exceed 7 cm in diameter. Drums with larger openings are considered to be of the removable head type (1N2). Closures for openings in the bodies and heads of drums shall be so designed and applied that they will remain secure and leakproof under normal conditions of carriage. Closure flanges shall be joined in place (welded, solded, etc.) in accordance with the technical state of the art for the used metal or metal alloy so that the seam join is leakproof. Gaskets or other sealing elements shall be used with closures, unless the closure is inherently leakproof.

6.1.4.3.5 Closure devices for removable head (1N2) drums shall be so designed and applied that they will remain secure and drums will remain leakproof under normal conditions of carriage. Gaskets or other sealing elements shall be used with all removable heads.

6.1.4.3.6 Maximum capacity of drum: 450 litres.

6.1.4.3.7 Maximum net mass: 400 kg.

6.1.4.4 ***Steel or aluminium jerricans***

3A1 steel, non-removable head
3A2 steel, removable head

3B1 aluminium, non-removable head
3B2 aluminium, removable head

6.1.4.4.1 Body and heads shall be constructed of steel sheet, of aluminium at least 99% pure or of an aluminium base alloy. Material shall be of a suitable type and of adequate thickness in relation to the capacity of the jerrican and to its intended use.

6.1.4.4.2 Chimes of steel jerricans shall be mechanically seamed or welded. Body seams of steel jerricans intended to contain more than 40 litres of liquid shall be welded. Body seams of steel jerricans intended to contain 40 litres or less shall be mechanically seamed or welded. For aluminium jerricans, all seams shall be welded. Chime seams, if any, shall be reinforced by the application of a separate reinforcing ring.

6.1.4.4.3 Openings in non-removable head jerricans (3A1 and 3B1) shall not exceed 7 cm in diameter. Jerricans with larger openings are considered to be of the removable head type (3A2 and 3B2). Closures shall be so designed that they will remain secure and leakproof under normal conditions of carriage. Gaskets or other sealing elements shall be used with closures, unless the closure is inherently leakproof.

6.1.4.4.4 If materials used for body, heads, closures and fittings are not in themselves compatible with the contents to be carried, suitable internal protective coatings or treatments shall be applied. These coatings or treatments shall retain their protective properties under normal conditions of carriage.

6.1.4.4.5 Maximum capacity of jerrican: 60 litres.

6.1.4.4.6 Maximum net mass: 120 kg.

6.1.4.5 ***Plywood drums***

1D

6.1.4.5.1 The wood used shall be well seasoned, commercially dry and free from any defect likely to lessen the effectiveness of the drum for the purpose intended. If a material other than plywood is used for the manufacture of the heads, it shall be of a quality equivalent to the plywood.

6.1.4.5.2 At least two-ply plywood shall be used for the body and at least three-ply plywood for the heads; the plies shall be firmly glued together by a water resistant adhesive with their grain crosswise.

6.1.4.5.3 The body and heads of the drum and their joins shall be of a design appropriate to the capacity of the drum and to its intended use.

6.1.4.5.4 In order to prevent sifting of the contents, lids shall be lined with kraft paper or some other equivalent material which shall be securely fastened to the lid and extend to the outside along its full circumference.

6.1.4.5.5 Maximum capacity of drum: 250 litres.

6.1.4.5.6 Maximum net mass: 400 kg.

6.1.4.6 ***Wooden barrels***

2C1 bung type
2C2 removable head

6.1.4.6.1 The wood used shall be of good quality, straight grained, well seasoned and free from knots, bark, rotten wood, sapwood or other defects likely to lessen the effectiveness of the barrel for the purpose intended.

6.1.4.6.2 The body and heads shall be of a design appropriate to the capacity of the barrel and to its intended use.

6.1.4.6.3 Staves and heads shall be sawn or cleft with the grain so that no annual ring extends over more than half the thickness of a stave or head.

6.1.4.6.4 Barrel hoops shall be of steel or iron of good quality. The hoops of removable head (2C2) barrels may be of a suitable hardwood.

6.1.4.6.5 Wooden barrels 2C1: the diameter of the bunghole shall not exceed half the width of the stave in which it is placed.

6.1.4.6.6 Wooden barrels 2C2: heads shall fit tightly into the crozes.

6.1.4.6.7 Maximum capacity of barrel: 250 litres.

6.1.4.6.8 Maximum net mass: 400 kg.

6.1.4.7 ***Fibre drums***

1G

6.1.4.7.1 The body of the drum shall consist of multiple plies of heavy paper or fibreboard (without corrugations) firmly glued or laminated together and may include one or more protective layers of bitumen, waxed kraft paper, metal foil, plastics material, etc.

6.1.4.7.2 Heads shall be of natural wood, fibreboard, metal, plywood, plastics or other suitable material and may include one or more protective layers of bitumen, waxed kraft paper, metal foil, plastics material, etc.

6.1.4.7.3 The body and heads of the drum and their joins shall be of a design appropriate to the capacity of the drum and to its intended use.

6.1.4.7.4 The assembled packaging shall be sufficiently water resistant so as not to delaminate under normal conditions of carriage.

6.1.4.7.5 Maximum capacity of drum: 450 litres.

6.1.4.7.6 Maximum net mass: 400 kg.

6.1.4.8 ***Plastics drums and jerricans***

1H1 drums, non-removable head
1H2 drums, removable head
3H1 jerricans, non-removable head
3H2 jerricans, removable head

6.1.4.8.1 The packaging shall be manufactured from suitable plastics material and be of adequate strength in relation to its capacity and intended use. Except for recycled plastics material as defined in 1.2.1, no used material other than production residues or regrind from the same manufacturing process may be used. The packaging shall be adequately resistant to ageing

and to degradation caused either by the substance contained or by ultra-violet radiation. Any permeation of the substance contained in the package, or recycled plastics material used to produce new packaging, shall not constitute a danger under normal conditions of carriage.

6.1.4.8.2 If protection against ultra-violet radiation is required, it shall be provided by the addition of carbon black or other suitable pigments or inhibitors. These additives shall be compatible with the contents and remain effective throughout the life of the packaging. Where use is made of carbon black, pigments or inhibitors other than those used in the manufacture of the tested design type, retesting may be waived if the carbon black content does not exceed 2% by mass or if the pigment content does not exceed 3% by mass; the content of inhibitors of ultra-violet radiation is not limited.

6.1.4.8.3 Additives serving purposes other than protection against ultra-violet radiation may be included in the composition of the plastics material provided that they do not adversely affect the chemical and physical properties of the material of the packaging. In such circumstances, retesting may be waived.

6.1.4.8.4 The wall thickness at every point of the packaging shall be appropriate to its capacity and intended use, taking into account the stresses to which each point is liable to be exposed.

6.1.4.8.5 Openings for filling, emptying and venting in the bodies or heads of non-removable head drums (1H1) and jerricans (3H1) shall not exceed 7 cm in diameter. Drums and jerricans with larger openings are considered to be of the removable head type (1H2 and 3H2). Closures for openings in the bodies or heads of drums and jerricans shall be so designed and applied that they will remain secure and leakproof under normal conditions of carriage. Gaskets or other sealing elements shall be used with closures unless the closure is inherently leakproof.

6.1.4.8.6 Closure devices for removable head drums and jerricans (1H2 and 3H2) shall be so designed and applied that they will remain secure and leakproof under normal conditions of carriage. Gaskets shall be used with all removable heads unless the drum or jerrican design is such that, where the removable head is properly secured, the drum or jerrican is inherently leakproof.

6.1.4.8.7 The maximum permissible permeability for flammable liquids shall be 0.008 g/l.h at 23 °C (see 6.1.5.8).

6.1.4.8.8 Where recycled plastics material is used for production of new packaging, the specific properties of the recycled material shall be assured and documented regularly as part of a quality assurance programme recognised by the competent authority. The quality assurance programme shall include a record of proper pre-sorting and verification that each batch of recycled plastics material has the proper melt flow rate, density, and tensile yield strength, consistent with that of the design type manufactured from such recycled material. This necessarily includes knowledge about the packaging material from which the recycled plastics have been derived, as well as the awareness of the prior contents of those packagings if those prior contents might reduce the capability of new packaging produced using that material. In addition, the packaging manufacturer's quality assurance programme under 6.1.1.4 shall include performance of the mechanical design type test in 6.1.5 on packagings manufactured from each batch of recycled plastics material. In this testing, stacking performance may be verified by appropriate dynamic compression testing rather than static load testing.

6.1.4.8.9 Maximum capacity of drums and jerricans: 1H1, 1H2: 450 litres
3H1, 3H2: 60 litres.

6.1.4.8.10 Maximum net mass: 1H1, 1H2: 400 kg
3H1, 3H2: 120 kg.

6.1.4.9 ***Boxes of natural wood***

4C1 ordinary
4C2 with sift-proof walls

6.1.4.9.1 The wood used shall be well seasoned, commercially dry and free from defects that would materially lessen the strength of any part of the box. The strength of the material used and the method of construction shall be appropriate to the capacity and intended use of the box. The tops and bottoms may be made of water resistant reconstituted wood such as hardboard, particle board or other suitable type.

6.1.4.9.2 Fastenings shall be resistant to vibration experienced under normal conditions of carriage. End grain nailing shall be avoided whenever practicable. Joins which are likely to be highly stressed shall be made using clenched or annular ring nails or equivalent fastenings.

6.1.4.9.3 Box 4C2: each part shall consist of one piece or be equivalent thereto. Parts are considered equivalent to one piece when one of the following methods of glued assembly is used: Lindermann joint, tongue and groove joint, ship lap or rabbet joint or butt joint with at least two corrugated metal fasteners at each joint.

6.1.4.9.4 Maximum net mass: 400 kg.

6.1.4.10 ***Plywood boxes***

4D

6.1.4.10.1 Plywood used shall be at least 3-ply. It shall be made from well seasoned rotary cut, sliced or sawn veneer, commercially dry and free from defects that would materially lessen the strength of the box. The strength of the material used and the method of construction shall be appropriate to the capacity and intended use of the box. All adjacent plies shall be glued with water resistant adhesive. Other suitable materials may be used together with plywood in the construction of boxes. Boxes shall be firmly nailed or secured to corner posts or ends or be assembled by equally suitable devices.

6.1.4.10.2 Maximum net mass: 400 kg.

6.1.4.11 ***Reconstituted wood boxes***

4F

6.1.4.11.1 The walls of boxes shall be made of water resistant reconstituted wood such as hardboard, particle board or other suitable type. The strength of the material used and the method of construction shall be appropriate to the capacity of the boxes and to their intended use.

6.1.4.11.2 Other parts of the boxes may be made of other suitable material.

6.1.4.11.3 Boxes shall be securely assembled by means of suitable devices.

6.1.4.11.4 Maximum net mass: 400 kg.

6.1.4.12 ***Fibreboard boxes***

4G

6.1.4.12.1 Strong and good quality solid or double-faced corrugated fibreboard (single or multiwall) shall be used, appropriate to the capacity of the box and to its intended use. The water

resistance of the outer surface shall be such that the increase in mass, as determined in a test carried out over a period of 30 minutes by the Cobb method of determining water absorption, is not greater than 155 g/m^2 - see ISO 535:l991. It shall have proper bending qualities. Fibreboard shall be cut, creased without scoring, and slotted so as to permit assembly without cracking, surface breaks or undue bending. The fluting of corrugated fibreboard shall be firmly glued to the facings.

6.1.4.12.2 The ends of boxes may have a wooden frame or be entirely of wood or other suitable material. Reinforcements of wooden battens or other suitable material may be used.

6.1.4.12.3 Manufacturing joins in the body of boxes shall be taped, lapped and glued, or lapped and stitched with metal staples. Lapped joins shall have an appropriate overlap.

6.1.4.12.4 Where closing is effected by gluing or taping, a water resistant adhesive shall be used.

6.1.4.12.5 Boxes shall be designed so as to provide a good fit to the contents.

6.1.4.12.6 Maximum net mass: 400 kg.

6.1.4.13 ***Plastics boxes***

4H1 expanded plastics boxes
4H2 solid plastics boxes

6.1.4.13.1 The box shall be manufactured from suitable plastics material and be of adequate strength in relation to its capacity and intended use. The box shall be adequately resistant to ageing and to degradation caused either by the substance contained or by ultra-violet radiation.

6.1.4.13.2 An expanded plastics box shall comprise two parts made of a moulded expanded plastics material, a bottom section containing cavities for the inner packagings and a top section covering and interlocking with the bottom section. The top and bottom sections shall be designed so that the inner packagings fit snugly. The closure cap for any inner packaging shall not be in contact with the inside of the top section of this box.

6.1.4.13.3 For dispatch, an expanded plastics box shall be closed with a self-adhesive tape having sufficient tensile strength to prevent the box from opening. The adhesive tape shall be weather resistant and its adhesive compatible with the expanded plastics material of the box. Other closing devices at least equally effective may be used.

6.1.4.13.4 For solid plastics boxes, protection against ultra-violet radiation, if required, shall be provided by the addition of carbon black or other suitable pigments or inhibitors. These additives shall be compatible with the contents and remain effective throughout the life of the box. Where use is made of carbon black, pigments or inhibitors other than those used in the manufacture of the tested design type, retesting may be waived if the carbon black content does not exceed 2% by mass or if the pigment content does not exceed 3% by mass; the content of inhibitors of ultra-violet radiation is not limited.

6.1.4.13.5 Additives serving purposes other than protection against ultra-violet radiation may be included in the composition of the plastics material provided that they do not adversely affect the chemical or physical properties of the material of the box. In such circumstances, retesting may be waived.

6.1.4.13.6 Solid plastics boxes shall have closure devices made of a suitable material of adequate strength and so designed as to prevent the box from unintentional opening.

6.1.4.13.7 Where recycled plastics material is used for production of new packaging, the specific properties of the recycled material shall be assured and documented regularly as part of a quality assurance programme recognised by the competent authority. The quality assurance programme shall include a record of proper pre-sorting and verification that each batch of recycled plastics material has the proper melt flow rate, density, and tensile yield strength, consistent with that of the design type manufactured from such recycled material. This necessarily includes knowledge about the packaging material from which the recycled plastics have been derived, as well as the awareness of the prior contents of those packagings if those prior contents might reduce the capability of new packaging produced using that material. In addition, the packaging manufacturer's quality assurance programme under 6.1.1.4 shall include performance of the mechanical design type test in 6.1.5 on packagings manufactured from each batch of recycled plastics material. In this testing, stacking performance may be verified by appropriate dynamic compression testing rather than static load testing.

6.1.4.13.8 Maximum net mass 4H1: 60 kg
4H2: 400 kg.

6.1.4.14 ***Steel or aluminium boxes***

4A steel
4B aluminium

6.1.4.14.l The strength of the metal and the construction of the box shall be appropriate to the capacity of the box and to its intended use.

6.1.4.14.2 Boxes shall be lined with fibreboard or felt packing pieces or shall have an inner liner or coating of suitable material, as required. If a double seamed metal liner is used, steps shall be taken to prevent the ingress of substances, particularly explosives, into the recesses of the seams.

6.1.4.14.3 Closures may be of any suitable type; they shall remain secured under normal conditions of carriage.

6.1.4.14.4 Maximum net mass: 400 kg.

6.1.4.15 ***Textile bags***

5L1 without inner liner or coating
5L2 sift-proof
5L3 water resistant

6.1.4.15.1 The textiles used shall be of good quality. The strength of the fabric and the construction of the bag shall be appropriate to the capacity of the bag and to its intended use.

6.1.4.15.2 Bags, sift-proof, 5L2: the bag shall be made sift-proof, for example by the use of:

(a) paper bonded to the inner surface of the bag by a water resistant adhesive such as bitumen; or

(b) plastics film bonded to the inner surface of the bag; or

(c) one or more inner liners made of paper or plastics material.

6.1.4.15.3 Bags, water resistant, 5L3: to prevent the entry of moisture the bag shall be made waterproof, for example by the use of:

(a) separate inner liners of water resistant paper (e.g. waxed kraft paper, tarred paper or plastics-coated kraft paper); or

(b) plastics film bonded to the inner surface of the bag; or

(c) one or more inner liners made of plastics material.

6.1.4.15.4 Maximum net mass: 50 kg.

6.1.4.16 ***Woven plastics bags***

5H1 without inner liner or coating
5H2 sift-proof
5H3 water resistant

6.1.4.16.1 Bags shall be made from stretched tapes or monofilaments of a suitable plastics material. The strength of the material used and the construction of the bag shall be appropriate to the capacity of the bag and to its intended use.

6.1.4.16.2 If the fabric is woven flat, the bags shall be made by sewing or some other method ensuring closure of the bottom and one side. If the fabric is tubular, the bag shall be closed by sewing, weaving or some other equally strong method of closure.

6.1.4.16.3 Bags, sift-proof, 5H2: the bag shall be made sift-proof, for example by means of:

(a) paper or a plastics film bonded to the inner surface of the bag; or

(b) one or more separate inner liners made of paper or plastics material.

6.1.4.16.4 Bags, water resistant, 5H3: to prevent the entry of moisture, the bag shall be made waterproof, for example by means of:

(a) separate inner liners of water resistant paper (e.g. waxed kraft paper, double-tarred kraft paper or plastics-coated kraft paper); or

(b) plastics film bonded to the inner or outer surface of the bag; or

(c) one or more inner plastics liners.

6.1.4.16.5 Maximum net mass: 50 kg.

6.1.4.17 ***Plastics film bags***

5H4

6.1.4.17.1 Bags shall be made of a suitable plastics material. The strength of the material used and the construction of the bag shall be appropriate to the capacity of the bag and to its intended use. Joins and closures shall withstand pressures and impacts liable to occur under normal conditions of carriage.

6.1.4.17.2 Maximum net mass: 50 kg.

6.1.4.18 ***Paper bags***

5M1 multiwall
5M2 multiwall, water resistant

6.1.4.18.1 Bags shall be made of a suitable kraft paper or of an equivalent paper with at least three plies. The strength of the paper and the construction of the bags shall be appropriate to the capacity of the bag and to its intended use. Joins and closures shall be sift-proof.

6.1.4.18.2 Bags 5M2: to prevent the entry of moisture, a bag of four plies or more shall be made waterproof by the use of either a water resistant ply as one of the two outermost plies or a water resistant barrier made of a suitable protective material between the two outermost plies; a bag of three plies shall be made waterproof by the use of a water resistant ply as the outermost ply. Where there is a danger of the substance contained reacting with moisture or where it is packed damp, a waterproof ply or barrier, such as double-tarred kraft paper, plastics-coated kraft paper, plastics film bonded to the inner surface of the bag, or one or more inner plastics liners, shall also be placed next to the substance. Joins and closures shall be waterproof.

6.1.4.18.3 Maximum net mass : 50 kg.

6.1.4.19 ***Composite packagings (plastics material)***

6HA1 plastics receptacle with outer steel drum
6HA2 plastics receptacle with outer steel crate or box
6HB1 plastics receptacle with outer aluminium drum
6HB2 plastics receptacle with outer aluminium crate or box
6HC plastics receptacle with outer wooden box
6HD1 plastics receptacle with outer plywood drum
6HD2 plastics receptacle with outer plywood box
6HG1 plastics receptacle with outer fibre drum
6HG2 plastics receptacle with outer fibreboard box
6HH1 plastics receptacle with outer plastics drum
6HH2 plastics receptacle with outer solid plastics box

6.1.4.19.1 *Inner receptacle*

6.1.4.19.1.1 The requirements of 6.1.4.8.1 and 6.1.4.8.4 to 6.1.4.8.7 apply to plastics inner receptacles.

6.1.4.19.1.2 The plastics inner receptacle shall fit snugly inside the outer packaging, which shall be free of any projection that might abrade the plastics material.

6.1.4.19.1.3 Maximum capacity of inner receptacle:

6HA1, 6HB1, 6HD1, 6HG1, 6HH1:	250 litres
6HA2, 6HB2, 6HC, 6HD2, 6HG2, 6HH2:	60 litres.

6.1.4.19.1.4 Maximum net mass:

6HA1, 6HB1, 6HD1, 6HG1, 6HH1:	400 kg
6HA2, 6HB2, 6HC, 6HD2, 6HG2, 6HH2:	75 kg.

6.1.4.19.2 *Outer packaging*

6.1.4.19.2.1 Plastics receptacle with outer steel or aluminium drum 6HA1 or 6HB1; the relevant requirements of 6.1.4.1 or 6.1.4.2, as appropriate, apply to the construction of the outer packaging.

6.1.4.19.2.2 Plastics receptacle with outer steel or aluminium crate or box 6HA2 or 6HB2; the relevant requirements of 6.1.4.14 apply to the construction of the outer packaging.

6.1.4.19.2.3 Plastics receptacle with outer wooden box 6HC; the relevant requirements of 6.1.4.9 apply to the construction of the outer packaging.

6.1.4.19.2.4 Plastics receptacle with outer plywood drum 6HD1; the relevant requirements of 6.1.4.5 apply to the construction of the outer packaging.

6.1.4.19.2.5 Plastics receptacle with outer plywood box 6HD2; the relevant requirements of 6.1.4.10 apply to the construction of the outer packaging.

6.1.4.19.2.6 Plastics receptacle with outer fibre drum 6HG1; the requirements of 6.1.4.7.1 to 6.1.4.7.4 apply to the construction of the outer packaging.

6.1.4.19.2.7 Plastics receptacle with outer fibreboard box 6HG2; the relevant requirements of 6.1.4.12 apply to the construction of the outer packaging.

6.1.4.19.2.8 Plastics receptacle with outer plastics drum 6HH1; the requirements of 6.1.4.8.1 to 6.1.4.8.6 apply to the construction of the outer packaging.

6.1.4.19.2.9 Plastics receptacles with outer solid plastics box (including corrugated plastics material) 6HH2; the requirements of 6.1.4.13.1 and 6.1.4.13.4 to 6.1.4.13.6 apply to the construction of the outer packaging.

6.1.4.20 ***Composite packagings (glass, porcelain or stoneware)***

6PA1	receptacle with outer steel drum
6PA2	receptacle with outer steel crate or box
6PB1	receptacle with outer aluminium drum
6PB2	receptacle with outer aluminium crate or box
6PC	receptacle with outer wooden box
6PD1	receptacle with outer plywood drum
6PD2	receptacle with outer wickerwork hamper
6PG1	receptacle with outer fibre drum
6PG2	receptacle with outer fibreboard box
6PH1	receptacle with outer expanded plastics packaging
6PH2	receptacle with outer solid plastics packaging

6.1.4.20.1 *Inner receptacle*

6.1.4.20.1.1 Receptacles shall be of a suitable form (cylindrical or pear-shaped) and be made of good quality material free from any defect that could impair their strength. The walls shall be sufficiently thick at every point and free from internal stresses.

6.1.4.20.1.2 Screw-threaded plastics closures, ground glass stoppers or closures at least equally effective shall be used as closures for receptacles. Any part of the closure likely to come into contact with the contents of the receptacle shall be resistant to those contents. Care shall be taken to ensure that the closures are so fitted as to be leakproof and are suitably secured to prevent any loosening during carriage. If vented closures are necessary, they shall comply with 4.1.1.8.

6.1.4.20.1.3 The receptacle shall be firmly secured in the outer packaging by means of cushioning and/or absorbent materials.

6.1.4.20.1.4 Maximum capacity of receptacle: 60 litres.

6.1.4.20.1.5 Maximum net mass: 75 kg.

6.1.4.20.2 *Outer packaging*

6.1.4.20.2.1 Receptacle with outer steel drum 6PA1; the relevant requirements of 6.1.4.1 apply to the construction of the outer packaging. The removable lid required for this type of packaging may nevertheless be in the form of a cap.

6.1.4.20.2.2 Receptacle with outer steel crate or box 6PA2; the relevant requirements of 6.1.4.14 apply to the construction of the outer packaging. For cylindrical receptacles the outer packaging shall, when upright, rise above the receptacle and its closure. If the crate surrounds a pear-shaped receptacle and is of matching shape, the outer packaging shall be fitted with a protective cover (cap).

6.1.4.20.2.3 Receptacle with outer aluminium drum 6PB1; the relevant requirements of 6.1.4.2 apply to the construction of the outer packaging.

6.1.4.20.2.4 Receptacle with outer aluminium crate or box 6PB2; the relevant requirements of 6.1.4.14 apply to the construction of the outer packaging.

6.1.4.20.2.5 Receptacle with outer wooden box 6PC; the relevant requirements of 6.1.4.9 apply to the construction of the outer packaging.

6.1.4.20.2.6 Receptacle with outer plywood drum 6PD1; the relevant requirements of 6.1.4.5 apply to the construction of the outer packaging.

6.1.4.20.2.7 Receptacle with outer wickerwork hamper 6PD2. The wickerwork hamper shall be properly made with material of good quality. It shall be fitted with a protective cover (cap) so as to prevent damage to the receptacle.

6.1.4.20.2.8 Receptacle with outer fibre drum 6PG1; the relevant requirements of 6.1.4.7.1 to 6.1.4.7.4 apply to the construction of the outer packaging.

6.1.4.20.2.9 Receptacle with outer fibreboard box 6PG2; the relevant requirements of 6.1.4.12 apply to the construction of the outer packaging.

6.1.4.20.2.10 Receptacle with outer expanded plastics or solid plastics packaging (6PH1 or 6PH2); the materials of both outer packagings shall meet the relevant requirements of 6.1.4.13. Outer solid plastics packaging shall be manufactured from high density polyethylene or some other comparable plastics material. The removable lid for this type of packaging may nevertheless be in the form of a cap.

6.1.4.21 ***Combination packagings***

The relevant requirements of section 6.1.4 for the outer packagings to be used, are applicable.

NOTE: *For the inner and outer packagings to be used, see the relevant packing instructions in Chapter 4.1.*

6.1.4.22 ***Light gauge metal packagings***

0A1 non-removable-head
0A2 removable-head

6.1.4.22.1 The sheet metal for the body and ends shall be of suitable steel, and of a gauge appropriate to the capacity and intended use of the packaging.

6.1.4.22.2 The joints shall be welded, at least double-seamed by welting or produced by a method ensuring a similar degree of strength and leakproofness.

6.1.4.22.3 Inner coatings of zinc, tin, lacquer, etc. shall be tough and shall adhere to the steel at every point, including the closures.

6.1.4.22.4 Openings for filling, emptying and venting in the bodies or heads of non-removable head (0A1) packagings shall not exceed 7 cm in diameter. Packagings with larger openings shall be considered to be of the removable-head type (0A2).

6.1.4.22.5 The closures of non-removable-head packagings (0A1) shall either be of the screw-threaded type or be capable of being secured by a screwable device or a device at least equally effective. The closures of removable-head packagings (0A2) shall be so designed and fitted that they stay firmly closed and the packagings remain leakproof in normal conditions of carriage.

6.1.4.22.6 Maximum capacity of packagings: 40 litres.

6.1.4.22.7 Maximum net mass: 50 kg.

6.1.5 Test requirements for packagings

6.1.5.1 ***Performance and frequency of tests***

6.1.5.1.1 The design type of each packaging shall be tested as provided in 6.1.5 in accordance with procedures established and approved by the competent authority.

6.1.5.1.2 Tests shall be successfully performed on each packaging design type before such packaging is used. A packaging design type is defined by the design, size, material and thickness, manner of construction and packing, but may include various surface treatments. It also includes packagings which differ from the design type only in their lesser design height.

6.1.5.1.3 Tests shall be repeated on production samples at intervals established by the competent authority. For such tests on paper or fibreboard packagings, preparation at ambient conditions is considered equivalent to the requirements of 6.1.5.2.3.

6.1.5.1.4 Tests shall also be repeated after each modification which alters the design, material or manner of construction of a packaging.

6.1.5.1.5 The competent authority may permit the selective testing of packagings that differ only in minor respects from a tested type, e.g. smaller sizes of inner packagings or inner packagings of lower net mass; and packagings such as drums, bags and boxes which are produced with small reductions in external dimension(s).

6.1.5.1.6 Where an outer packaging of a combination packaging has been successfully tested with different types of inner packagings, a variety of such different inner packagings may also be assembled in this outer packaging. In addition, provided an equivalent level of performance is maintained, the following variations in inner packagings are allowed without further testing of the package:

(a) Inner packagings of equivalent or smaller size may be used provided:

(i) the inner packagings are of similar design to the tested inner packagings (e.g. shape - round, rectangular, etc.);

(ii) the material of construction of the inner packagings (glass, plastics, metal, etc.) offers resistance to impact and stacking forces equal to or greater than that of the originally tested inner packaging;

(iii) the inner packagings have the same or smaller openings and the closure is of similar design (e.g. screw cap, friction lid, etc.);

(iv) sufficient additional cushioning material is used to take up void spaces and to prevent significant movement of the inner packagings; and

(v) inner packagings are oriented within the outer packaging in the same manner as in the tested package.

(b) A lesser number of the tested inner packagings, or of the alternative types of inner packagings identified in (a) above, may be used provided sufficient cushioning is added to fill the void space(s) and to prevent significant movement of the inner packagings.

6.1.5.1.7 Articles or inner packagings of any type for solids or liquids may be assembled and carried without testing in an outer packaging under the following conditions:

(a) The outer packaging shall have been successfully tested in accordance with 6.1.5.3 with fragile (e.g. glass) inner packagings containing liquids using the packing group I drop height;

(b) The total combined gross mass of inner packagings shall not exceed one half the gross mass of inner packagings used for the drop test in (a) above;

(c) The thickness of cushioning material between inner packagings and between inner packagings and the outside of the packaging shall not be reduced below the corresponding thicknesses in the originally tested packaging; and if a single inner packaging was used in the original test, the thicknesses of cushioning between inner packagings shall not be less than the thickness of cushioning between the outside of the packaging and the inner packaging in the original test. If either fewer or smaller inner packagings are used (as compared to the inner packagings used in the drop test), sufficient additional cushioning material shall be used to take up void spaces;

(d) The outer packaging shall have passed successfully the stacking test in 6.1.5.6 while empty. The total mass of identical packages shall be based on the combined mass of inner packagings used for the drop test in (a) above;

(e) Inner packagings containing liquids shall be completely surrounded with a sufficient quantity of absorbent material to absorb the entire liquid contents of the inner packagings;

(f) If the outer packaging is intended to contain inner packagings for liquids and is not leakproof, or is intended to contain inner packagings for solids and is not siftproof, a means of containing any liquid or solid contents in the event of leakage shall be provided in the form of a leakproof liner, plastics bag or other equally efficient means of containment. For packagings containing liquids, the absorbent material required in (e) above shall be placed inside the means of containing the liquid contents;

(g) Packagings shall be marked in accordance with 6.1.3 as having been tested to packing group I performance for combination packagings. The marked gross mass in kilograms shall be the sum of the mass of the outer packaging plus one half of the mass of the inner packaging(s) as used for the drop test referred to in (a) above. Such a package mark shall also contain a letter "V" as described in 6.1.2.4.

6.1.5.1.8 The competent authority may at any time require proof, by tests in accordance with this section, that serially-produced packagings meet the requirements of the design type tests. For verification purposes records of such tests shall be maintained.

6.1.5.1.9 If an inner treatment or coating is required for safety reasons, it shall retain its protective properties even after the tests.

6.1.5.1.10 Provided the validity of the test results is not affected and with the approval of the competent authority, several tests may be made on one sample.

6.1.5.1.11 *Salvage packagings*

Salvage packagings (see 1.2.1) shall be tested and marked in accordance with the requirements applicable to packing group II packagings intended for the carriage of solids or inner packagings, except as follows:

(a) The test substance used in performing the tests shall be water, and the packagings shall be filled to not less than 98% of their maximum capacity. It is permissible to use additives, such as bags of lead shot, to achieve the requisite total package mass so long as they are placed so that the test results are not affected. Alternatively, in performing the drop test, the drop height may be varied in accordance with 6.1.5.3.4(b);

(b) Packagings shall, in addition, have been successfully subjected to the leakproofness test at 30 kPa, with the results of this test reflected in the test report required by 6.1.5.9; and

(c) Packagings shall be marked with the letter "T" as described in 6.1.2.4.

6.1.5.2 ***Preparation of packagings for testing***

6.1.5.2.1 Tests shall be carried out on packagings prepared as for carriage including, with respect to combination packagings, the inner packagings used. Inner or single receptacles or packagings shall be filled to not less than 98% of their maximum capacity for liquids or 95% for solids. For combination packagings where the inner packaging is designed to carry liquids and solids, separate testing is required for both liquid and solid contents. The substances or articles to be carried in the packagings may be replaced by other substances or articles except where this would invalidate the results of the tests. For solids, when another substance is used it shall have the same physical characteristics (mass, grain size, etc.) as the substance to be carried. It is permissible to use additives, such as bags of lead shot, to achieve the requisite total package mass, so long as they are placed so that the test results are not affected.

6.1.5.2.2 In the drop tests for liquids, when another substance is used, it shall be of similar relative density and viscosity to those of the substance being carried. Water may also be used for the liquid drop test under the conditions in 6.1.5.3.4.

6.1.5.2.3 Paper or fibreboard packagings shall be conditioned for at least 24 hours in an atmosphere having a controlled temperature and relative humidity (r.h.). There are three options, one of which shall be chosen. The preferred atmosphere is 23 ± 2 °C and 50% ± 2% r.h. The two other options are 20 ± 2 °C and 65% ± 2% r.h. or 27 ± 2 °C and 65% ± 2% r.h.

NOTE: *Average values shall fall within these limits. Short-term fluctuations and measurement limitations may cause individual measurements to vary by up to ± 5% relative humidity without significant impairment of test reproducibility.*

6.1.5.2.4 Bung-type barrels made of natural wood shall be left filled with water for at least 24 hours before the tests.

6.1.5.2.5 To check that their chemical compatibility with the liquids is sufficient, plastics drums and jerricans in accordance with 6.1.4.8 and if necessary composite packagings (plastics material) in accordance with 6.1.4.19 shall be subjected to storage at ambient temperature for six months, during which time the test samples shall be kept filled with the goods they are intended to carry.

For the first and last 24 hours of storage, the test samples shall be placed with the closure downwards. However, packagings fitted with a vent shall be so placed on each occasion for five minutes only. After this storage the test samples shall undergo the tests prescribed in 6.1.5.3 to 6.1.5.6.

When it is known that the strength properties of the plastics material of the inner receptacles of composite packagings (plastics material) are not significantly altered by the action of the filling substance, it shall not be necessary to check that the chemical compatibility is sufficient.

A significant alteration in strength properties means:

(a) distinct embrittlement; or

(b) a considerable decrease in elasticity, unless related to a not less than proportionate increase in the elongation under load.

Where the behaviour of the plastics material has been established by other means, the above compatibility test may be dispensed with. Such procedures shall be at least equivalent to the above compatibility test and be recognized by the competent authority.

NOTE*: For plastics drums and jerricans and composite packagings (plastics material) made of high or average molecular mass polyethylene, see also 6.1.5.2.6 below.*

6.1.5.2.6 For high molecular mass polyethylene drums and jerricans in accordance with 6.1.4.8 and if necessary composite packagings of high molecular mass polyethylene in accordance with 6.1.4.19, conforming to the following specifications:

- relative density at 23 °C after thermal conditioning for one hour at 100 °C > 0.940, in accordance with ISO Standard 1183,

- melt flow rate at 190 °C/21.6 kg load < 12 g/10 min, in accordance with ISO Standard 1133,

for jerricans in accordance with 6.1.4.8 of packing groups II and III and, if necessary, for composite packagings in accordance with 6.1.4.19 in average molecular mass polyethylene meeting the following specifications:

- relative density at 23 °C after thermal conditioning for one hour at 100 °C > 0.940, in accordance with ISO Standard 1183,

- melt flow rate at 190 °C/2.160 kg load < 0.5 g/10 min and > 0.1 g/10 min, in accordance with ISO Standard 1133,

- melt flow rate at 190 °C/5 kg load < 3 g/10 min and > 0.5 g/10 min, in accordance with ISO Standard 1133,

chemical compatibility with the liquids listed in 6.1.6.2 may be verified as follows with standard liquids (see 6.1.6.1).

The sufficient chemical compatibility of these packagings may be verified by storage for three weeks at 40 °C with the appropriate standard liquid; where this standard liquid is water, proof of chemical compatibility is not required.

For the first and last 24 hours of storage, the test samples shall be placed with the closure downwards. However, packagings fitted with a vent shall be so placed on each occasion for five minutes only. After this storage, the test samples shall undergo the tests prescribed in 6.1.5.3 to 6.1.5.6.

When a packaging design-type has satisfied the approval tests with a standard liquid, the comparable filling substances listed in 6.1.6.2 may be accepted for carriage without further testing, subject to the following conditions:

- the relative densities of the filling substances shall not exceed that used to determine the height for the drop test and the mass for the stacking test;

- the vapour pressures of the filling substances at 50 °C or 55 °C shall not exceed that used to determine the pressure for the internal pressure test.

The compatibility test for tert-Butyl hydroperoxide with more than 40% peroxide content and peroxyacetic acids of Class 5.2, shall not be carried out using standard liquids. For these substances, proof of sufficient chemical compatibility of the test samples shall be provided during a storage period of six months at ambient temperature with the substances they are intended to carry.

The procedure in accordance with this paragraph also applies to high density, high or average molecular mass polyethylene packagings, the internal surface of which is fluorinated.

6.1.5.2.7 For drums and jerricans conforming to 6.1.4.8, and where necessary composite packagings conforming to 6.1.4.19, made of high or average molecular mass polyethylene, which have passed the test in 6.1.5.2.6, filling substances other than those listed in 6.1.6.2 may also be approved. Such approval shall be based on laboratory tests proving that the effect of such filling substances on the test specimens is less than that of the standard liquids. The processes of deterioration to be taken into account shall be the following: softening through swelling, cracking under stress and molecular degradation. The same conditions as those set out in 6.1.5.2.6 above shall apply with respect to relative density and vapour pressure.

6.1.5.2.8 Provided that the strength properties of the plastics inner packagings of a combination packaging are not significantly altered by the action of the filling substance, proof of chemical compatibility is not necessary. A significant alteration in strength properties means:

(a) distinct embrittlement;

(b) a considerable decrease in elasticity, unless related to a not less than proportionate increase in elastic elongation.

6.1.5.3 ***Drop test*** [3]

6.1.5.3.1 *Number of test samples (per design type and manufacturer) and drop orientation*

For other than flat drops the centre of gravity shall be vertically over the point of impact.

Where more than one orientation is possible for a given drop test, the orientation most likely to result in failure of the packaging shall be used.

Packaging	**No. of test samples**	**Drop orientation**
(a) Steel drums Aluminium drums Drums of metal other than steel or aluminium Steel jerricans Aluminium jerricans Plywood drums Wooden barrels Fibre drums Plastics drums and jerricans Composite packagings which are in the shape of a drum Light gauge metal packagings	Six (three for each drop)	First drop (using three samples): the packaging shall strike the target diagonally on the chime or, if the packaging has no chime, on a circumferential seam or an edge. Second drop (using the other three samples): the packaging shall strike the target on the weakest part not tested by the first drop, for example a closure or, for some cylindrical drums, the welded longitudinal seam of the drum body
(b) Boxes of natural wood Plywood boxes Reconstituted wood boxes Fibreboard boxes Plastics boxes Steel or aluminium boxes Composite packagings which are in the shape of a box	Five (one for each drop)	First drop: flat on the bottom Second drop: flat on the top Third drop: flat on the long side Fourth drop: flat on the short side Fifth drop: on a corner
(c) Bags - single-ply with a side seam	Three (three drops per bag)	First drop: flat on a wide face Second drop: flat on a narrow face Third drop: on an end of the bag
(d) Bags - single-ply without a side seam, or multi-ply	Three (two drops per bag)	First drop: flat on a wide face Second drop: on an end of the bag
(e) Composite packagings (glass, stoneware or porcelain), marked with the symbol "RID/ADR" according to 6.1.3.1 (a) (ii) and which are in the shape of a drum or box	Three (one for each drop)	Diagonally on the bottom chime, or, if there is no chime, on a circumferential seam or the bottom edge

[3] *See ISO Standard 2248.*

6.1.5.3.2 *Special preparation of test samples for the drop test*

The temperature of the test sample and its contents shall be reduced to -18 °C or lower for the following packagings:

(a) plastics drums (see 6.1.4.8);

(b) plastics jerricans (see 6.1.4.8);

(c) plastics boxes other than expanded plastics boxes (see 6.1.4.13);

(d) composite packagings (plastics material) (see 6.1.4.19) and;

(e) combination packagings with plastics inner packagings, other than plastics bags intended to contain solids or articles.

Where test samples are prepared in this way, the conditioning in 6.1.5.2.3 may be waived. Test liquids shall be kept in the liquid state by the addition of anti-freeze if necessary.

6.1.5.3.3 *Target*

The target shall be a rigid, non-resilient, flat and horizontal surface.

6.1.5.3.4 *Drop height*

For solids and liquids, if the test is performed with the solid or liquid to be carried or with another substance having essentially the same physical characteristics:

Packing Group I	**Packing Group II**	**Packing Group III**
1.8 m	1.2 m	0.8 m

For liquids if the test is performed with water:

(a) where the substances to be carried have a relative density not exceeding 1.2:

Packing Group I	**Packing Group II**	**Packing Group III**
1.8 m	1.2 m	0.8 m

(b) where the substances to be carried have a relative density exceeding 1.2, the drop height shall be calculated on the basis of the relative density (d) of the substance to be carried, rounded up to the first decimal, as follows:

Packing Group I	**Packing Group II**	**Packing Group III**
d × 1.5 (m)	d × 1.0 (m)	d × 0.67 (m)

(c) for light-gauge metal packagings, marked with symbol "RID/ADR" according to 6.1.3.1(a) (ii) intended for the carriage of substances having a viscosity at 23 °C greater than 200 mm^2/s (corresponding to a flow time of 30 seconds with an ISO flow

cup having a jet orifice of 6 mm diameter in accordance with ISO Standard 2431:1993)

(i) if the relative density does not exceed 1.2:

Packing group II	Packing group III
0.6 m	0.4 m

(ii) where the substances to be carried have a relative density (d) exceeding 1.2 the drop height shall be calculated on the basis of the relative density (d) of the substance to be carried, rounded up to the first decimal place, as follows:

Packing group II	Packing group III
d × 0.5 m	d × 0.33 m

6.1.5.3.5 *Criteria for passing the test*

6.1.5.3.5.1 Each packaging containing liquid shall be leakproof when equilibrium has been reached between the internal and external pressures, however for inner packagings of combination packagings and except for inner receptacles of composite packagings (glass, porcelain or stoneware), marked with the symbol "RID/ADR" according to 6.1.3.1 (a) (ii) it is not necessary that the pressures be equalized.

6.1.5.3.5.2 Where a packaging for solids undergoes a drop test and its upper face strikes the target, the test sample passes the test if the entire contents are retained by an inner packaging or inner receptacle (e.g. a plastics bag), even if the closure is no longer sift-proof.

6.1.5.3.5.3 The packaging or outer packaging of a composite or combination packaging shall not exhibit any damage liable to affect safety during carriage. There shall be no leakage of the filling substance from the inner receptacle or inner packaging(s).

6.1.5.3.5.4 Neither the outermost ply of a bag nor an outer packaging may exhibit any damage liable to affect safety during carriage.

6.1.5.3.5.5 A slight discharge from the closure(s) upon impact is not considered to be a failure of the packaging provided that no further leakage occurs.

6.1.5.3.5.6 No rupture is permitted in packagings for goods of Class 1 which would permit the spillage of loose explosive substances or articles from the outer packaging.

6.1.5.4 ***Leakproofness test***

The leakproofness test shall be performed on all design types of packagings intended to contain liquids; however, this test is not required for

- inner packagings of combination packagings;

- inner receptacles of composite packagings (glass, porcelain or stoneware), marked with the symbol "RID/ADR" according to 6.1.3.1 (a) (ii);

- light gauge metal packagings, marked with the symbol "RID/ADR" according to 6.1.3.1 (a) (ii) intended for substances with a viscosity at 23 °C exceeding 200 mm^2/s.

6.1.5.4.1 *Number of test samples:* three test samples per design type and manufacturer.

6.1.5.4.2 *Special preparation of test samples for the test*: either vented closures shall be replaced by similar non-vented closures or the vent shall be sealed.

6.1.5.4.3 *Test method and pressure to be applied*: the packagings including their closures shall be restrained under water for 5 minutes while an internal air pressure is applied, the method of restraint shall not affect the results of the test.

The air pressure (gauge) to be applied shall be:

Packing Group I	**Packing Group II**	**Packing Group III**
Not less than 30 kPa (0.3 bar)	Not less than 20 kPa (0.2 bar)	Not less than 20 kPa (0.2 bar)

Other methods at least equally effective may be used.

6.1.5.4.4 *Criterion for passing the test*: there shall be no leakage.

6.1.5.5 ***Internal pressure (hydraulic) test***

6.1.5.5.1 *Packagings to be tested*

The internal pressure (hydraulic) test shall be carried out on all design types of metal, plastics and composite packagings intended to contain liquids. This test is not required for:

- inner packagings of combination packagings;

- inner receptacles of composite packagings (glass, porcelain or stoneware), marked with the symbol "RID/ADR" according to 6.1.3.1 (a) (ii);

- light gauge metal packagings, marked with the symbol "RID/ADR" according to 6.1.3.1 (a) (ii) intended for substances with a viscosity at 23 °C exceeding 200 mm^2/s.

6.1.5.5.2 *Number of test samples*: three test samples per design type and manufacturer.

6.1.5.5.3 *Special preparation of packagings for testing*: either vented closures shall be replaced by similar non-vented closures or the vent shall be sealed.

6.1.5.5.4 *Test method and pressure to be applied*: metal packagings and composite packagings (glass, porcelain or stoneware), including their closures, shall be subjected to the test pressure for 5 minutes. Plastics packagings and composite packagings (plastics material) including their closures shall be subjected to the test pressure for 30 minutes. This pressure is the one to be

included in the marking required by 6.1.3.1 (d). The manner in which the packagings are supported shall not invalidate the test. The test pressure shall be applied continuously and evenly; it shall be kept constant throughout the test period. The hydraulic pressure (gauge) applied, as determined by any one of the following methods, shall be:

(a) not less than the total gauge pressure measured in the packaging (i.e. the vapour pressure of the filling substance and the partial pressure of the air or other inert gases, minus 100 kPa) at 55 °C, multiplied by a safety factor of 1.5; this total gauge pressure shall be determined on the basis of a maximum degree of filling in accordance with 4.1.1.4 and a filling temperature of l5 °C; or

(b) not less than 1.75 times the vapour pressure at 50 °C of the substance to be carried, minus 100 kPa but with a minimum test pressure of 100 kPa; or

(c) not less than 1.5 times the vapour pressure at 55 °C of the substance to be carried, minus 100 kPa but with a minimum test pressure of 100 kPa.

6.1.5.5.5 In addition, packagings intended to contain substances of Packing Group I shall be tested to a minimum test pressure of 250 kPa (gauge) for a test period of 5 or 30 minutes depending upon the material of construction of the packaging.

6.1.5.5.6 *Criterion for passing the test*: no packaging may leak.

6.1.5.6 ***Stacking test***

All design types of packagings other than bags and other than non-stackable composite packagings (glass, porcelain, or stoneware), marked with the symbol "RID/ADR" according to 6.1.3.1 (a) (ii) shall be subjected to a stacking test.

6.1.5.6.1 *Number of test samples*: three test samples per design type and manufacturer.

6.1.5.6.2 *Test method*: the test sample shall be subjected to a force applied to the top surface of the test sample equivalent to the total weight of identical packages which might be stacked on it during carriage; where the contents of the test sample are non-dangerous liquids with relative density different from that of the liquid to be carried, the force shall be calculated in relation to the latter. The minimum height of the stack including the test sample shall be 3 metres. The duration of the test shall be 24 hours except that plastics drums, jerricans, and composite packagings 6HH1 and 6HH2 intended for liquids shall be subjected to the stacking test for a period of 28 days at a temperature of not less than 40 °C.

For the test in accordance with 6.1.5.2.5, the original filling substance shall be used. For the test in accordance with 6.1.5.2.6, a stacking test shall be carried out with a standard liquid.

6.1.5.6.3 *Criteria for passing the test*: no test sample shall leak. In composite packagings or combination packagings, there shall be no leakage of the filling substance from the inner receptacle or inner packaging. No test sample shall show any deterioration which could adversely affect transport safety or any distortion liable to reduce its strength or cause instability in stacks of packages. Plastics packagings shall be cooled to ambient temperature before the assessment.

6.1.5.7 ***Cooperage test for bung type wooden barrels***

6.1.5.7.1 *Number of samples*: one barrel.

6.1.5.7.2 *Method of testing*: remove all hoops above the bilge of an empty barrel at least two days old.

6.1.5.7.3 *Criterion for passing test*: the diameter of the cross session of the upper part of the barrel shall not increase by more than 10 %.

6.1.5.8 ***Supplementary permeability test for plastics drums and jerricans in accordance with 6.1.4.8 and for composite packagings (plastics material) in accordance with 6.1.4.19 intended for the carriage of liquids having a flash-point # 61 °C, other than 6HA1 packagings***

Polyethylene packagings need be subjected to this test only if they are to be approved for the carriage of benzene, toluene, xylene or mixtures and preparations containing those substances.

6.1.5.8.1 *Number of test samples:* three packagings per design type and manufacturer.

6.1.5.8.2 *Special preparation of the test sample for the test:* the test samples are to be pre-stored with the original filling substance in accordance with 6.1.5.2.5, or, for high molecular mass polyethylene packagings, with the standard liquid mixture of hydrocarbons (white spirit) in accordance with 6.1.5.2.6.

6.1.5.8.3 *Test method:* the test samples filled with the substance for which the packaging is to be approved shall be weighed before and after storage for 28 days at 23 °C and 50 % relative atmospheric humidity. For high molecular mass polyethylene packagings, the test may be carried out with the standard liquid mixture of hydrocarbons (white spirit) in place of benzene, toluene or xylene.

6.1.5.8.4 *Criterion for passing the test:* permeability shall not exceed 0.008 g/l.h.

6.1.5.9 ***Test Report***

6.1.5.9.1 A test report containing at least the following particulars shall be drawn up and shall be available to the users of the packaging:

1. Name and address of the test facility;
2. Name and address of applicant (where appropriate);
3. A unique test report identification;
4. Date of the test report;
5. Manufacturer of the packaging;
6. Description of the packaging design type (e.g. dimensions, materials, closures, thickness, etc.), including method of manufacture (e.g. blow moulding) and which may include drawing(s) and/or photograph(s);
7. Maximum capacity;
8. Characteristics of test contents, e.g. viscosity and relative density for liquids and particle size for solids;
9. Test descriptions and results;
10. The test report shall be signed with the name and status of the signatory.

6.1.5.9.2 The test report shall contain statements that the packaging prepared as for carriage was tested in accordance with the appropriate requirements of this section and that the use of other packaging methods or components may render it invalid. A copy of the test report shall be available to the competent authority.

6.1.6 Standard liquids for verifying the chemical compatibility of high or average molecular mass polyethylene packagings in accordance with 6.1.5.2.6 and list of substances to which the standard liquids may be regarded as equivalents

6.1.6.1 ***Standard liquids for verifying the chemical compatibility of high or average molecular mass polyethylene packagings in accordance with 6.1.5.2.6***

The following standard liquids shall be used for this plastics material.

(a) ***Wetting Solution*** for substances causing severe cracking in polyethylene under stress, in particular for all solutions and preparations containing wetting agents.

An aqueous solution of 1 to 10 % of a wetting agent shall be used. The surface tension of this solution shall be 31 to 35 mN/m at 23 °C.

The stacking test shall be carried out on the basis of a relative density of not less than 1.20.

A compatibility test with acetic acid is not required if adequate chemical compatibility is proved with a wetting solution.

For filling substances causing cracking in polyethylene under stress which is resistant to the wetting solution, adequate chemical compatibility may be proved after preliminary storing for three weeks at 40 °C in accordance with 6.1.5.2.6, but with the original filling matter.

(b) ***Acetic acid*** for substances and preparations causing cracking in polyethylene under stress, in particular for monocarboxylic acids and monovalent alcohols.

Acetic acid in 98 to 100 % concentration shall be used.
Relative density = 1.05.

The stacking test shall be carried out on the basis of a relative density not less than 1.1.

In the case of filling substances causing polyethylene to swell more than acetic acid and to such an extent that the polyethylene mass is increased by up to 4 %, adequate chemical compatibility may be proved after preliminary storing for three weeks at 40 °C, in accordance with 6.1.5.2.6 but with the original filling matter.

(c) ***Normal butyl acetate/normal butyl acetate-saturated wetting solution*** for substances and preparations causing polyethylene to swell to such an extent that the polyethylene mass is increased by about 4 % and at the same time causing cracking under stress, in particular for phyto-sanitary products, liquid paints and esters. Normal butyl acetate in 98 to 100 % concentration shall be used for preliminary storage in accordance with 6.1.5.2.6.

For the stacking test in accordance with 6.1.5.6, a test liquid consisting of a 1 to 10 % aqueous wetting solution mixed with 2% normal butyl acetate conforming to (a) above shall be used.
The stacking test shall be carried out on the basis of a relative density not less than 1.0.

In the case of filling substances causing polyethylene to swell more than normal butyl acetate and to such an extent that the polyethylene mass is increased by up to 7.5 %,

adequate chemical compatibility may be proved after preliminary storing for three weeks at 40 °C, in accordance with 6.1.5.2.6 but with the original filling matter.

(d) ***Mixture of hydrocarbons (white spirit)*** for substances and preparations causing polyethylene to swell, in particular for hydrocarbons, esters and ketones.

A mixture of hydrocarbons having a boiling range 160 °C to 220 °C, relative density 0.78-0.80, flash-point > 50 °C and an aromatic content 16 % to 21 % shall be used.

The stacking test shall be carried out on the basis of a relative density not less than 1.0.

In the case of filling substances causing polyethylene to swell to such an extent that the polyethylene mass is increased by more than 7.5 %, adequate chemical compatibility may be proved after preliminary storing for three weeks at 40 °C, in accordance with 6.1.5.2.6 but with the original filling matter.

(e) ***Nitric acid*** for all substances and preparations having an oxidizing effect on polyethylene and causing molecular degradation identical to or less than 55 % nitric acid.

Nitric acid in a concentration of not less than 55 % shall be used.

The stacking test shall be carried out on the basis of a relative density of not less than 1.4.

In the case of filling substances more strongly oxidizing than 55 % nitric acid or causing degradation of the molecular mass proceed in accordance with 6.1.5.2.5.

The period of use shall be determined in such cases by observing the degree of damage (e.g. two years for nitric acid in not less than 55 % concentration).

(f) ***Water*** for substances which do not attack polyethylene in any of the cases referred to under (a) to (e), in particular for inorganic acids and lyes, aqueous saline solutions, polyvalent alcohols and organic substances in aqueous solution.

The stacking test shall be carried out on the basis of a relative density of not less than 1.2.

6.1.6.2 ***List of substances to which the standard liquids may be regarded as equivalents for the purposes of 6.1.5.2.6***

Class 3

Substance	Standard Liquid
Flammable liquids of packing group II, without subsidiary risk (classification code F1, packing group II)	
Substances having a vapour pressure at 50 °C of not more than 110 kPa (1.1 bar)	
- Crude petroleum and other crude oils	Mixture of hydrocarbons
- Hydrocarbons	Mixture of hydrocarbons
- Halogenated substances	Mixture of hydrocarbons
- Alcohols	Acetic acid
- Ethers	Mixture of hydrocarbons
- Aldehydes	Mixture of hydrocarbons
- Ketones	Mixture of hydrocarbons
- Esters	Normal butyl acetate where the swelling effect is up to 4% (mass): other cases, mixture of hydrocarbons
Mixtures of above-mentioned substances having a boiling point or initial boiling point exceeding 35 °C, containing not more than 55 % nitrocellulose with a nitrogen content not exceeding 12.6 % (UN No. 2059).	Normal butyl acetate/normal butyl acetate-saturated wetting solution and mixture of hydrocarbons
Viscous substances that meet the classification criteria of 2.2.3.1.4	Mixture of hydrocarbons
Flammable liquids of packing group II, toxic (classification code FT1, packing group II)	
Methanol (UN No.1230)	Acetic acid
Flammable liquids of packing group III, without subsidiary risk (classification code F1, packing group III)	
- Petroleum, solvent naphtha	Mixture of hydrocarbons
- White spirit (turpentine substitute)	Mixture of hydrocarbons
- Hydrocarbons	Mixture of hydrocarbons
- Halogenated substances	Mixture of hydrocarbons
- Alcohols	Acetic acid
- Ethers	Mixture of hydrocarbons
- Aldehydes	Mixture of hydrocarbons
- Ketones	Mixture of hydrocarbons
- Esters	Normal butyl acetate where the swelling effect is up to 4% (mass): other cases, mixture of hydrocarbons
- Nitrogenous substances	Mixture of hydrocarbons
Mixtures of above-mentioned substances containing not more than 55 % nitrocellulose with a nitrogen content not exceeding 12.6 % (UN No. 2059).	Normal butyl acetate/normal butyl acetate-saturated wetting solution and mixture of hydrocarbons

Class 5.1

Oxidizing liquids, corrosive (classification code OC1)	
Hydrogen peroxides, aqueous solutions with not less than 20 % but not more than 60 % hydrogen peroxide (UN No. 2014) [4]	Water
Perchloric acid with more than 50 % but not more than 72 % acid (mass) (UN No. 1873)	Nitric acid
Oxidizing liquids, without subsidiary risk (classification code O1)	
Hydrogen peroxide, aqueous solutions with not less than 8 % but less than 20% hydrogen peroxide (UN No. 2984) [4]	Water
Calcium chlorate solution (UN No.2429) Potassium chlorate solution (UN No. 2427) Sodium chlorate solution (UN No. 2428)	Water Water Water

Class 5.2

NOTE: *tert-butyl hydroperoxide with more than 40 % peroxide content and peroxyacetic acids are excluded.*	
All organic peroxides in a technically pure form or in solution in solvents which, as far as their compatibility is concerned, are covered by the standard liquid "mixture of hydrocarbons" in this list (UN Nos. 3101, 3103, 3105, 3107, 3109, 3111, 3113, 3115, 3117, 3119)	Normal butyl acetate/ wetting solution with 2% normal butyl acetate and mixture of hydrocarbons and nitric acid at 55%
Compatibility of vents and gaskets with organic peroxides may be verified, also independently of the design type test, by laboratory tests with nitric acid.	

Class 6.1

Toxic organic liquids without subsidiary risk (classification code T1)	
Aniline (UN No.1547)	Acetic acid
Furfuryl alcohol (UN No. 2874)	Acetic acid
Phenol solution (UN No. 2821, packing group III)	Acetic acid
Toxic organic liquids, corrosive (classification code TC1)	
Cresols (UN No. 2076) or cresylic acid (UN No. 2022)	Acetic acid

Class 6.2

All infectious substances (UN Nos. 2814 and 2900, risk group 2, and UN No.3291) considered to be liquids in accordance with 2.1.2.6	Water

[4] *Test to be performed only with a vent.*

Class 8

Corrosive acid inorganic liquids, without subsidiary risk (classification code C1)	
Sulphuric acid (UN Nos. 1830 and 2796)	Water
Sulphuric acid, spent (UN No. 1832)	Water
Nitric acid (UN No. 2031) with not more than 55 % acid	Nitric acid
Perchloric acid with not more than 50 % acid, by mass in aqueous solution (UN No. 1802)	Nitric acid
Hydrochloric acid (UN No. 1789) with not more than 36 % pure acid Hydrobromic acid (UN No. 1788) Hydriodic acid (UN No. 1787)	Water
Hydrofluoric acid (UN No. 1790) with not more than 60 % hydrogen fluoride 5[5]	Water
Fluoroboric acid (UN No. 1775) with not more than 50 % pure acid	Water
Fluorosilicic acid (UN No. 1778)	Water
Chromic acid solution (UN No. 1755) with not more than 30 % pure acid	Nitric acid
Phosphoric acid (UN No. 1805)	Water
Corrosive acid organic liquids (classification code C3)	
Acrylic acid (UN No. 2218), formic acid (UN No. 1779), acetic acid (UN Nos. 2789 and 2790), thioglycolic acid (UN No. 1940)	Acetic acid
Methacrylic acid (UN No. 2531), propionic acid (UN No. 1848)	Acetic acid
Alkylphenols, liquid, n.o.s. (UN No. 3145, packing group III)	Acetic acid
Corrosive basic inorganic liquids, without subsidiary risk (classification code C5)	
Sodium hydroxide solution (UN No. 1824), potassium hydroxide solution (UN No. 1814)	Water
Ammonia solution (UN No. 2672)	Water
Hydrazine, aqueous solutions with not more than 64 % hydrazine, by mass (UN No. 2030)	Water
Other corrosive liquids (classification code C9)	
Chlorite solution (UN No. 1906) and hypochlorite solution [6] (UN No. 1791, packing group III)	Nitric acid
Formaldehyde solutions (UN No. 2209)	Water

[5] *Maximum 60 litres; permissible period of use two years.*

[6] *Test to be carried out only with vent. If the test is carried out with nitric acid as the standard liquid, an acid-resistant vent and gasket shall be used. For hypochlorite solutions, vents and gaskets of the same design type, resistant to hypochlorite (e.g. of silicone rubber) but not resistant to nitric acid, are also permitted.*

CHAPTER 6.2

REQUIREMENTS FOR THE CONSTRUCTION AND TESTING OF RECEPTACLES FOR GASES, AEROSOL DISPENSERS AND SMALL RECEPTACLES CONTAINING GAS (GAS CARTRIDGES)

6.2.1 General requirements for receptacles for gases

NOTE: *For aerosol dispensers and small receptacles containing gas (gas cartridges) see 6.2.4.*

6.2.1.1 *Design and construction*

6.2.1.1.1 Receptacles and their closures shall be designed, calculated, manufactured, tested and equipped in such a way as to withstand all conditions to which they will be subjected during their normal use and during normal conditions of carriage.

In the design of pressure receptacles, all relevant factors shall be taken into account such as:

- internal pressure;
- ambient and operational temperatures, including during carriage;
- dynamic loads.

Normally the wall thickness shall be determined by calculation, accompanied, if needed, by experimental stress analysis. The wall thickness may be determined by experimental means.

Appropriate design calculations for the pressure envelope and supporting components shall be used to ensure the safety of the receptacles concerned.

The minimum wall thickness to withstand pressure shall be calculated in particular with regard to:

- the calculation pressures, which shall not be less than the test pressure;
- the calculation temperatures allowing for appropriate safety margins;
- the maximum stresses and peak stress concentrations where necessary;
- factors inherent to the properties of the material.

The test pressure of receptacles is prescribed in packing instruction P200 in 4.1.4.1 for cylinders, tubes, pressure drums and bundles of cylinders. The test pressure for cryogenic receptacles, closed, shall not be less than 1.3 times the maximum working pressure increased by 1 bar for vacuum insulated receptacles.

Material characteristics to be considered are, when applicable:

- yield stress;

- tensile strength;

- time-dependent strength;

- fatigue data;

- Young's modulus (modulus of elasticity);

- appropriate amount of plastic strain;

- impact strength;

- fracture resistance.

6.2.1.1.2 Receptacles for UN No.1001, acetylene, dissolved, shall be filled entirely with a porous material, uniformly distributed, of a type approved by the competent authority and which:

(a) does not attack the receptacles or form harmful or dangerous compounds either with the acetylene or with the solvent;

(b) is capable of preventing the spread of decomposition of the acetylene in the mass.

The solvent shall not attack the receptacles.

6.2.1.2 ***Materials of receptacles***

The materials of which the receptacles and their closures are made as well as all substances that might come into contact with the contents shall not be liable to attack the contents or form harmful or dangerous compounds therewith.

The following materials may be used:

(a) carbon steel for compressed, liquefied, refrigerated liquefied gases and gases dissolved under pressure;

(b) alloy steel (special steels), nickel, nickel alloy (such as monel) for compressed, liquefied, refrigerated liquefied gases and gases dissolved under pressure;

(c) copper for:

(i) gases of classification codes 1A, 1O, 1F and 1TF, whose filling pressure referred to a temperature of 15 °C does not exceed 2 MPa (20 bar);

(ii) gases of classification code 2A and also UN No. 1033 dimethyl ether; UN No.1037 ethyl chloride; UN No.1063 methyl chloride; UN

No.1079 sulphur dioxide; UN No.1085 vinyl bromide; UN No. 1086 vinyl chloride; and UN No.3300 ethylene oxide and carbon dioxide mixture with more than 87% ethylene oxide;

(iii) gases of classification codes 3A, 3O and 3F;

(d) aluminium alloy: see special requirement "a" of packing instruction P200 (12) in 4.1.4.1;

(e) composite material for compressed, liquefied, refrigerated liquefied gases and gases dissolved under pressure;

(f) synthetic materials for refrigerated liquefied gases; and

(g) glass for the refrigerated liquefied gases of classification code 3A other than UN No.2187 carbon dioxide, refrigerated, liquid or mixtures thereof, and gases of classification code 3O.

6.2.1.3 ***Service equipment***

6.2.1.3.1 *Openings*

Apart from a manhole which, if provided, shall be closed by an effective closure and apart from the necessary orifice for the removal of deposits, pressure drums shall not be equipped with more than two openings one for the filling and one for the discharge.

Cylinders and pressure drums, intended for the carriage of gases of classification code 2F may be provided with other openings intended in particular for verifying the level of the liquid and the gauge pressure.

6.2.1.3.2 *Fittings*

(a) If cylinders are fitted with a device to prevent rolling, this device shall not be integral with the valve cap;

(b) Pressure drums which are capable of being rolled shall be equipped with rolling hoops or be otherwise protected against damage due to rolling (e.g. by corrosion resistant metal sprayed on to the receptacle surface);

(c) Pressure drums and cryogenic receptacles, which are not capable of being rolled, shall be fitted with devices (skids, rings, straps,) ensuring that they can be safely handled by mechanical means and so arranged as not to impair the strength of, nor cause undue stresses in, the wall of the receptacle;

(d) Bundles of cylinders shall be fitted with appropriate devices ensuring that they can be handled and carried safely. The manifold shall have at least the same test pressure as the cylinders. The manifold and the master cock shall be situated so as to be protected against any damage.

6.2.1.3.3 *Safety valves*

Cryogenic receptacles, closed, shall be fitted with one or more pressure relief devices to protect the vessel against excess pressure. Excess pressure means a pressure in excess of 110% of the maximum working pressure due to normal heat leak or in excess of the test pressure due to the loss of vacuum for vacuum insulated receptacles or due to the failure in the open position of a pressure build up system.

6.2.1.4 ***Approval of receptacles***

6.2.1.4.1 The conformity of receptacles, having a test pressure capacity product of more than 150 MPa.litre (1 500 bar.litre) with the provisions of Class 2, shall be assessed by one of the following methods:

(a) Single receptacles shall be examined, tested and approved by a testing and certifying body approved by the competent authority of the country of approval [1], on the basis of the technical documentation and declaration of the manufacturer on compliance with the relevant provisions of Class 2.

The technical documentation shall include full specifications on design and construction, and full documentation on the manufacturing and testing; or

(b) The construction of the receptacles shall be tested and approved by a testing and certifying body approved by the competent authority of the country of approval [1] on the basis of the technical documentation with regard to their compliance with the relevant provisions of Class 2.

Receptacles shall furthermore be designed, manufactured and tested according to a comprehensive quality assurance programme for design, manufacture, final inspection and testing. The quality assurance programme shall guarantee the conformity of the receptacles with the relevant provisions of Class 2 and shall be approved and supervised by a testing and certifying body approved by the competent authority of the country of approval [1]; or

(c) The design type of the receptacles shall be approved by a testing and certifying body approved by the competent authority of the country of approval [1]. Any receptacle of this design shall be manufactured and tested according to a quality assurance programme for production, final inspection and testing, which shall be approved and supervised by a testing and certifying body approved by the competent authority of the country of approval [1]; or

(d) The design type of the receptacles shall be approved by a testing and certifying body approved by the competent authority of the country of approval [1]. Any receptacle of this design shall be tested under the supervision of a testing and certifying body approved by the competent authority of the country of approval [1] on the basis of a declaration of the manufacturer on compliance with the approved design and the relevant provisions of Class 2.

[1] *If the country of approval is not a contracting party to ADR, the competent authority of a contracting party to ADR.*

6.2.1.4.2 The conformity of receptacles having a test pressure capacity product of more than 30 MPa.litre (300 bar.litre) and not more than 150 MPa.litre (1 500 bar.litre) with the provisions of Class 2 shall be assessed by one of the methods described in 6.2.1.4.1 or by one of the following methods:

(a) The receptacles shall be designed, manufactured and tested according to a comprehensive quality assurance programme for their design, manufacture, final inspection and testing, approved and supervised by a testing and certifying body approved by the competent authority of the country of approval [1]; or

(b) The design type of the receptacle shall be approved by a testing and certifying body approved by the competent authority of the country of approval [1]. The compliance of any receptacle with the approved design shall be declared in writing by the manufacturer on the basis of his quality assurance programme for final inspection and testing of receptacles, approved and supervised by a testing and certifying body approved by the competent authority of the country of approval [1]; or

(c) The design type of the receptacle shall be approved by a testing and certifying body approved by the competent authority of the country of approval [1]. The compliance of any receptacle with the approved design shall be declared in writing by the manufacturer and all receptacles of this type shall be tested under the supervision of a testing and certifying body approved by the competent authority of the country of approval[1];

6.2.1.4.3 The conformity of receptacles, having a test pressure capacity product of not more than 30 MPa.litre (300 bar.litre) with the provisions for Class 2 shall be assessed by one of the methods described in 6.2.1.4.1 or 6.2.1.4.2 or by one of the following methods:

(a) The compliance of any receptacle with a design, fully specified in technical documentation, shall be declared in writing by the manufacturer and receptacles of this design shall be tested under the supervision of a testing and certifying body approved by the competent authority of the country of approval [1]; or

(b) The design type of the receptacles shall be approved by a testing and certifying body approved by the competent authority of the country of approval [1]. The compliance of all receptacles with the approved design shall be declared in writing by the manufacturer and all receptacles of this type shall be tested individually.

6.2.1.4.4 The requirements of 6.2.1.4.1 to 6.2.1.4.3 shall be deemed to be complied with:

(a) as regards the quality assurance systems mentioned in 6.2.1.4.1 and 6.2.1.4.2, if they conform to the relevant European Standard of the EN ISO 9000 series;

---

[1] *If the country of approval is not a contracting party to ADR, the competent authority of a contracting party to ADR.*

(b) in their entirety, if the relevant conformity assessment procedures of Council Directive 99/36/EC [2] have been complied with as follows:

(i) for the receptacles listed under 6.2.1.4.1, the modules G, or H1, or B in combination with D, or B in combination with F;

(ii) for the receptacles listed under 6.2.1.4.2, the modules H, or B in combination with E, or B in combination C1, or B1 in combination with F, or B1 in combination with D;

(iii) for the receptacles listed under 6.2.1.4.3, the modules A1, or D1, or E1.

6.2.1.4.5 *Requirements for manufacturers*

The manufacturer shall be technically competent and shall possess all suitable means required for the satisfactory manufacture of receptacles; this relates in particular to qualified personnel:

(a) to supervise the entire manufacturing process;

(b) to carry out joining of materials;

(c) to carry out the relevant tests.

The proficiency test of a manufacturer shall in all instances be carried out by a testing and certifying body approved by the competent authority of the country of approval [1]. The particular certification process the manufacturer intends to apply shall be taken into consideration.

6.2.1.4.6 *Requirements for testing and certifying bodies*

Testing and certifying bodies shall be independent from manufacturing enterprises and technologically competent to the degree required. These requirements shall be deemed to be met if the bodies have been approved on the basis of an accreditation procedure in accordance with the relevant European standards of series EN 45 000.

6.2.1.5 *Initial inspection*

6.2.1.5.1 Receptacles shall be subjected to initial inspection in accordance with the following specifications:

On an adequate sample of receptacles:

(a) Testing of the material of construction in respect at least of yield stress, tensile strength, and permanent elongation at fracture;

(b) Measurement of wall thickness at the thinnest point, and calculation of the stress;

[2] *Council Directive 99/36/EC concerning transportable pressure equipment (Official Journal of the European Communities, No. L 138 of 1.06.1999).*

(c) Checking the homogeneity of the material for each manufacturing batch, and examination of the external and internal condition of the receptacles;

For all receptacles:

(d) A hydraulic pressure test. Receptacles shall withstand the test pressure without undergoing permanent deformation or exhibiting cracks;

NOTE: *With the agreement of the testing and certifying body approved by the competent authority of the country of approval [1], the hydraulic pressure test may be replaced by a test using a gas, where such operation does not entail any danger.*

(e) An examination of the markings on the receptacles, see 6.2.1.7;

(f) In addition, receptacles intended for the carriage of UN No. 1001 acetylene, dissolved, shall have an inspection of the nature of the porous material and the quantity of solvent.

6.2.1.5.2 *Specific provisions applying to aluminium alloy receptacles*

(a) In addition to the initial inspection required by 6.2.1.5.1, it is necessary to test for possible intercrystalline corrosion of the inside wall of the receptacles where use is made of an aluminium alloy containing copper, or where use is made of an aluminium alloy containing magnesium and manganese and the manganese content is greater than 3.5% or the manganese content lower than 0.5%.

(b) In the case of an aluminium/copper alloy the test shall be carried out by the manufacturer at the time of approval of a new alloy by the competent authority; it shall thereafter be repeated in the course of production, for each pour of the alloy.

(c) In the case of an aluminium/magnesium alloy the test shall be carried out by the manufacturer at the time of approval of a new alloy and of the manufacturing process by the competent authority. The test shall be repeated whenever a change is made in the composition of the alloy or in the manufacturing process.

6.2.1.6 ***Periodic inspection***

6.2.1.6.1 Refillable receptacles shall be subjected to periodic inspections under the supervision of a testing and certifying body approved by the competent authority of the country of approval [1], in accordance with the periodicities defined in the relevant packing instruction P200 or P203 in 4.1.4.1 and in accordance with the following specifications:

(a) External examination of the receptacle, equipment and markings;

[1] *If the country of approval is not a contracting party to ADR, the competent authority of a contracting party to ADR.*

[1] *If the country of approval is not a contracting party to ADR, the competent authority of a contracting party to ADR.*

(b) Internal examination of the receptacle (e.g. by weighing, examination of the internal condition, checks of wall thickness);

(c) The hydraulic pressure test and, if necessary, inspection of the characteristics of the material by suitable tests;

***NOTE 1**: With the agreement of the testing and certifying body approved by the competent authority of the country of approval [1], the hydraulic pressure test may be replaced by a test using a gas, where such operation does not entail any danger, or by an equivalent method based on ultrasound.*

***NOTE 2**: With the agreement of the testing and certifying body approved by the competent authority of the country of approval [1], the hydraulic pressure test of cylinders and tubes may be replaced by an equivalent method based on acoustic emission.*

***NOTE 3**: With the agreement of the testing and certifying body approved by the competent authority of the country of approval [1], the hydraulic pressure test of each welded steel cylinder intended for the carriage of gases of UN No.1965, hydrocarbon gas mixture liquefied, n.o.s., with a capacity below 6,5 l may be replaced by another test ensuring an equivalent level of safety.*

6.2.1.6.2 For receptacles intended for the carriage of UN No.1001 acetylene, dissolved, only the external condition (corrosion, deformation) and the condition of the porous mass (loosening, settlement) shall be examined.

6.2.1.6.3 By derogation from 6.2.1.6.1 (c) closed cryogenic receptacles shall be subjected to external inspection and to a leakproofness test. The leakproofness test shall be carried out with the gas contained in the receptacle or with an inert gas. Checking shall be performed by means of a pressure gauge or by vacuum measurement. The thermal insulation need not be removed.

6.2.1.7 ***Marking of receptacles***

6.2.1.7.1 Refillable receptacles shall bear the following particulars in clearly legible and durable characters:

(a) The manufacturer's name or mark;

(b) The approval number (if the design type of the receptacle is approved according to 6.2.1.4);

(c) The manufacturer's serial number;

(d) The tare of the receptacle without fittings and accessories, when the check of wall thickness required during the periodic inspection is performed by weighing;

(e) The test pressure (gauge pressure);

(f) The date (month and year) of the initial inspection and the most recent periodic inspection;

***NOTE**: The month need not be indicated for gases for which the interval between periodic inspection is 10 years or more (see 4.1.4.1 packing instructions P200 (9) and P203 (8)).*

(g) The stamp of the expert who carried out the tests and inspections;

(h) In the case of UN No.1001 acetylene, dissolved: the permitted filling pressure (see 4.1.4.1, packing instruction P200 (6)) and the total of the mass of: the empty receptacle, the fittings and accessories, the porous mass and the solvent;

(i) The water capacity in litres;

(j) For compressed gases filled by pressure, the maximum filling pressure at 15 °C allowed for the receptacle.

These marks shall be immovably affixed, e.g. engraved, either on a reinforced part of the receptacle, on a ring, or on immovably affixed attachments.

They can also be engraved on the receptacle directly, provided it can be demonstrated that the strength of the receptacle is not impaired by the marking.

***NOTE**: See also 5.2.1.6*

6.2.1.7.2 Non-refillable receptacles shall bear the following particulars in clearly legible and durable characters:

(a) The manufacturer's name or mark;

(b) The approval number (if the design type of the receptacle is approved according to 6.2.1.4);

(c) The manufacturer's serial or batch number;

(d) The test pressure (gauge pressure);

(e) The date (month and year) of manufacture;

(f) The stamp of the expert who carried out the initial inspection;

(g) The UN number and the proper shipping name as determined in accordance with Chapter 3.1;

In the case of gases classified under an N.O.S. entry, only the UN number and the technical name [3] of the gas have to be indicated;

[3] *Instead of the technical name the use of one of the following names is permitted:*

- *For UN No. 1078 refrigerant gas, n.o.s.: mixture F1, mixture F2, mixture F3;*
- *For UN No. 1060 methylacetylene and propadiene mixtures, stabilized: mixture P1, mixture P2;*

In the case of mixtures, not more than the two constituents which most predominantly contribute to the hazards have to be indicated;

(h) The words '**DO NOT REFILL**"; this marking shall be a minimum of 6 mm in height.

The marks mentioned in this paragraph, other than (g), shall be immovably affixed, e.g. engraved, either on a reinforced part of the receptacle, on a ring, or on immovably affixed attachments. They can also be engraved on the receptacle directly, provided it can be demonstrated that the strength of the receptacle is not impaired by the marking.

6.2.2 Receptacles designed, constructed and tested according to standards

The requirements of 6.2.1 are considered to have been complied with if the following standards, as relevant, are applied:

Reference	Title of document	Applicable sub-sections and paragraphs
for materials		
EN 1797-1:1998	Cryogenic vessels -Gas/material compatibility - Part 1: Oxygen compatibility.	6.2.1.2
EN ISO 11114-1:1997	Transportable gas cylinders - Compatibility of cylinder and valve materials with gas contents -Part 1: Metallic materials.	6.2.1.2
EN ISO 11114-2:2000	Transportable gas cylinders - Compatibility of cylinder and valve materials with gas contents -Part 2: Non-metallic materials.	6.2.1.2
EN 1252-1: 1998	Cryogenic vessels – Materials - Part 1: Toughness requirements for temperature below -80 °C.	6.2.1.2
for cylinders		
Annex I, Parts 1 to 3 to 84/525/EEC	Council directive on the approximation of the laws of the Member States relating to seamless steel gas cylinders.	6.2.1.1 and 6.2.1.5
Annex I, Parts 1 to 3 to 84/526/EEC	Council directive on the approximation of the laws of the Member States relating to seamless, unalloyed aluminium and aluminium alloy gas cylinders.	6.2.1.1 and 6.2.1.5
Annex I, Parts 1 to 3 to 84/527/EEC	Council directive on the approximation of the laws of the Member States relating to welded unalloyed steel gas cylinders.	6.2.1.1 and 6.2.1.5
EN 1442:1998	Transportable refillable welded steel cylinders for liquefied petroleum gas (LPG) - Design and construction.	6.2.1.1, 6.2.1.5 and 6.2.1.7
EN 1800:1998/AC: 1999	Transportable gas cylinders - Acetylene cylinders - Basic requirements and definitions.	6.2.1.1.2
EN 1964-1:1999	Transportable gas cylinders – Specifications for the design and construction of refillable transportable seamless steel gas cylinders of capacity from 0.5 litres up to 150 litres – Part 1: Cylinders made of seamless steel with a Rm value of less than	6.2.1.1 and 6.2.1.5

- *For UN No. 1965 hydrocarbon gas mixture, liquefied, n.o.s.: mixture A or butane, mixture A01 or butane, mixture A02 or butane, mixture A0 or butane, mixture A1, mixture B1, mixture B2, mixture B, mixture C or propane.*

Reference	Title of document	Applicable sub-sections and paragraphs
	1 100 MPa.	
EN 1975:1999 (except Annex G)	Transportable gas cylinders – Specifications for the design and construction of refillable transportable seamless aluminium and aluminium alloy gas cylinders of capacity from 0.5 litres up to 150 litres.	6.2.1.1 and 6.2.1.5
EN ISO 11120:1999	Gas cylinders – Refillable seamless steel tubes for compressed gas transport of water capacity between 150 litres and 3 000 litres – Design, construction and testing.	6.2.1.1 and 6.2.1.5
EN 1964-3: 2000	Transportable gas cylinders-Specifications for the design and construction of refillable transportable seamless steel gas cylinders of capacity from 0.5 litre up to 150 litres - Part 3: Cylinders made of stainless steel.	6.2.1.1 and 6.2.1.5
EN 12862: 2000	Transportable gas cylinders- Specifications for the design and construction of refillable transportable welded aluminium alloy gas cylinders.	6.2.1.1 and 6.2.1.5
EN 1251-1: 2000	Cryogenic vessels- Transportable, vacuum insulated, of not more than 1 000 litres volume- Part 1: Fundamental requirements	6.2.1.7.1
EN 1251-2: 2000	Cryogenic vessels- Transportable, vacuum insulated, of not more than 1000 litres volume- Part 2: Design, fabrication, inspection and testing	6.2.1.1 and 6.2.1.5
EN 1251-3: 2000	Cryogenic vessels- Transportable, vacuum insulated, of not more than 1 000 litres volume- Part 3: Operational requirements	6.2.1.6
for closures		
EN 849:1996 (except Annex A)	Transportable gas cylinders - Cylinder valves: Specification and type testing	6.2.1.1
for markings		
EN 1089-1: 1996	Transportable gas cylinders - Gas cylinder identification (excluding LPG) - Part 1: Stampmarking	6.2.1.7.1 except (b) and 6.2.1.7.2 except (b)

6.2.3 Requirements for receptacles not designed, constructed and tested according to standards

Receptacles not designed, constructed and tested according to standards listed in the table of 6.2.2 shall be designed, constructed and tested in accordance with the provisions of a technical code providing the same level of safety and recognised by the competent authority. The requirements of 6.2.1 and the following requirements however shall be met:

6.2.3.1 *Metal cylinders, tubes, pressure drums and bundles of cylinders*

At the test pressure, the stress in the metal at the most severely stressed point of the receptacle shall not exceed 77% of the guaranteed minimum yield stress (Re).

"Yield stress" means the stress at which a permanent elongation of 2 per thousand (i.e. 0.2%) or, for austenitic steels, 1% of the gauge length on the test-piece, has been produced.

NOTE: *In the case of sheet-metal the axis of the tensile test-piece shall be at right angles to the direction of rolling. The permanent elongation at fracture, shall be measured on a test-piece of circular cross-section in which the gauge length "l" is equal to five times the diameter "d" (l=5d); if test pieces of rectangular cross-section are used, the gauge length "l" shall be calculated by the formula:*

$$l = 5.65\sqrt{Fo}$$

where Fo indicates the initial cross-sectional area of the test-piece.

Receptacles and their closures shall be made of suitable materials which shall be resistant to brittle fracture and to stress corrosion cracking between -20 °C and +50 °C.

For welded receptacles only materials of faultless weldability whose adequate impact strength at an ambient temperature of -20 °C can be guaranteed, particularly in the weld seams and the zones adjacent thereto, shall be used.

Welds shall be skilfully made and shall afford the fullest safety.

Any additional thickness to allow for corrosion shall not be taken into consideration in calculating the thickness of the walls.

6.2.3.2 ***Additional provisions relating to aluminium-alloy receptacles for compressed gases, liquefied gases, gases dissolved under pressure and non pressurized gases subject to special requirements (gas samples) as well as articles containing gas under pressure other than aerosol dispensers and small receptacles containing gas (gas cartridges)***

6.2.3.2.1 *The materials of aluminium-alloy receptacles which are to be accepted shall satisfy the following requirements:*

	A	**B**	**C**	**D**
Tensile strength, Rm, in MPa (=N/mm^2)	49 to 186	196 to 372	196 to 372	343 to 490
Yield stress, Re, in MPa (=N/mm^2) (permanent set λg = 0.2%)	10 to 167	59 to 314	137 to 334	206 to 412
Permanent elongation at fracture (l = 5d) in per cent	12 to 40	12 to 30	12 to 30	11 to 16
Bend test (diameter of former d = n x e, where e is the thickness of the test piece)	n=5(Rm ≤ 98) n=6(Rm>98)	n=6(Rm ≤ 325) n=7(Rm >325)	n=6(Rm ≤ 325) n=7(Rm>325)	n=7(Rm ≤ 392) n=8(Rm>392)
Aluminium Association Series Number [a]	1 000	5 000	6 000	2 000

[a] *See "Aluminium Standards and Data", Fifth edition, January 1976, published by the Aluminium Association, 750 Third Avenue, New York.*

The actual properties will depend on the composition of the alloy concerned and on the final treatment of the receptacle, but whatever alloy is used the thickness of the receptacle shall be calculated by one of the following formulae:

$$e = \frac{P_{MPa}\ D}{\frac{2Re}{1.3} + P_{MPa}} \quad or \quad e = \frac{P_{bar}\ D}{\frac{20Re}{1.3} + P_{bar}}$$

where e = minimum thickness of receptacle wall, in mm;
P_{MPa} = test pressure, in MPa
P_{bar} = test pressure, in bar
D = nominal external diameter of the receptacle, in mm; and
Re = guaranteed minimum proof stress with 0.2 % proof stress, in MPa ($=N/mm^2$)

In addition, the value of the minimum guaranteed proof stress (Re) introduced into the formula is in no case to be greater than 0.85 times the guaranteed minimum tensile strength (Rm), whatever the type of alloy used.

NOTE 1: *The above characteristics are based on previous experience with the following materials used for receptacles:*

Column A: Aluminium, unalloyed, 99.5 g pure;

Column B: Alloys of aluminium and magnesium;

Column C: Alloys of aluminium, silicon and magnesium, such as ISO/R209-Al-Si-Mg (Aluminium Association 6351);

Column D: Alloys of aluminium, copper and magnesium;

NOTE 2: *The permanent elongation at fracture is measured by means of test-pieces of circular cross-section in which the gauge length "l" is equal to five times the diameter "d" (l= 5d); if test-pieces of rectangular section are used the gauge length shall be calculated by the formula:*

$$l = 5.65\sqrt{Fo}$$

where Fo is the initial cross-section area of the test-piece.

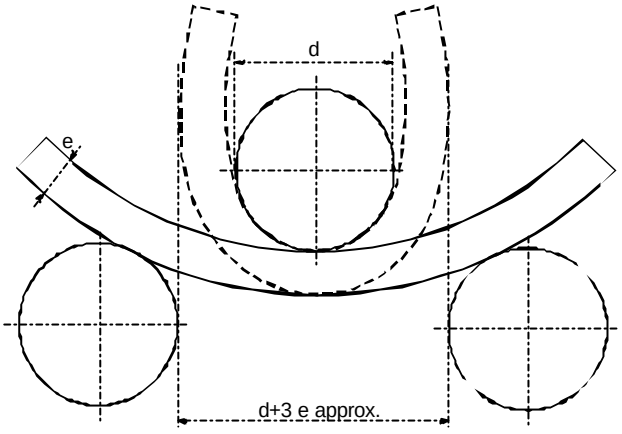
NOTE 3: *(a) The bend test (see diagram) shall be carried out on specimens obtained by cutting into two equal parts of width 3e, but in no case less than 25 mm, an annular section of a cylinder. The specimens shall not be machined elsewhere than on the edges.*

(b) The bend test shall be carried out between a mandrel of diameter (d) and two circular supports separated by a distance of (d + 3e). During the test the inner faces shall be separated by a distance not greater than the diameter of the mandrel.

(c) The specimen shall not exhibit cracks when it has been bent inwards around the mandrel until the inner faces are separated by a distance not greater than the diameter of the mandrel.

(d) The ratio (n) between the diameter of the mandrel and the thickness of the specimen shall conform to the values given in the table.

Diagram of bend test



6.2.3.2.2 A lower minimum elongation value is acceptable on condition that an additional test approved by the competent authority of the country in which the receptacles are made proves that safety of carriage is ensured to the same extent as in the case of receptacles constructed to comply with the characteristics given in the table in 6.2.3.2.1 (see also annex G of EN 1975: 1999).

6.2.3.2.3 The wall thickness of the receptacles at the thinnest point shall be the following:

- where the diameter of the receptacle is less than 50 mm: not less than 1.5 mm;
- where the diameter of the receptacle is from 50 to 150 mm: not less than 2 mm; and
- where the diameter of the receptacle is more than 150 mm: not less than 3 mm.

6.2.3.2.4 The ends of the receptacles shall have a semicircular, elliptical or "basket-handle" section; they shall afford the same degree of safety as the body of the receptacle.

6.2.3.3 ***Receptacles in composite materials***

For composite cylinders, tubes, pressure drums and bundles of cylinders which make use of composite materials i.e. comprising a liner hoop wrapped or fully wrapped with reinforcement material, the construction shall be such that a minimum burst ratio (burst pressure divided by test pressure) is:

- 1.67 for hoop wrapped receptacles;
- 2.00 for fully wrapped receptacles.

6.2.3.4 ***Closed cryogenic receptacles***

The following requirements apply to the construction of closed cryogenic receptacles for refrigerated liquefied gases:

6.2.3.4.1 All the mechanical and technological characteristics of the metal used shall be established for each receptacle at the initial inspection; with regard to the impact strength, see 6.8.5.3;

6.2.3.4.2 If other materials are used, they shall resist brittle fracture at the lowest working temperature of the receptacle and its fittings;

6.2.3.4.3 Receptacles shall be fitted with a safety valve which shall be capable of opening at the working pressure shown on the receptacle. The valves shall be so constructed as to work perfectly even at their lowest working temperature. Their reliability of functioning at that temperature shall be established and checked by testing each valve or a sample of valves of the same type of construction;

6.2.3.4.4 The vents and safety valves of receptacles shall be so designed as to prevent the liquid from splashing out;

6.2.3.4.5 Receptacles whose filling is measured by volume shall be provided by a level indicator;

6.2.3.4.6 The receptacles shall be thermally insulated. The thermal insulation shall be protected against impact by means of continuous sheathing. If the space between the receptacle and the sheathing is airless (vacuum-insulation), the protective sheathing shall be designed to withstand without deformation an external pressure of at least 100 kPa (1 bar). If the sheathing is so closed as to be gas-tight (e.g. in the case of vacuum-insulation), a device shall be provided to prevent any dangerous pressure from developing in the insulating layer in the event of inadequate gas-tightness of the receptacle or its fittings. The device shall prevent moisture from penetrating into the insulation.

6.2.4 General requirements for aerosol dispensers and small receptacles containing gas (gas cartridges)

6.2.4.1 *Design and construction*

6.2.4.1.1 Aerosol dispensers (UN No.1950 aerosols) containing only a gas or a mixture of gases, and small receptacles containing gas (gas cartridges) (UN No.2037), shall be made of metal. This requirement shall not apply to aerosols and small receptacles containing gas (gas cartridges) with a maximum capacity of 100 ml for UN No. 1011 butane. Other aerosol dispensers (UN No.1950 aerosols) shall be made of metal, synthetic material or glass. Receptacles made of metal and having an outside diameter of not less than 40 mm shall have a concave bottom.

6.2.4.1.2 The capacity of receptacles made of metal shall not exceed 1 000 ml; that of receptacles made of synthetic material or of glass shall not exceed 500 ml.

6.2.4.1.3 Each model of receptacles (aerosol dispensers or cartridges) shall, before being put into service, satisfy a hydraulic pressure test carried out in conformity with 6.2.4.2.

6.2.4.1.4 The release valves and dispersal devices of aerosol dispensers (UN No.1950 aerosols) and the valves of UN No.2037 small receptacles containing gas (gas cartridges) shall ensure that the receptacles are so closed as to be leakproof and shall

be protected against accidental opening. Valves and dispersal devices which close only by the action of the internal pressure are not to be accepted.

6.2.4.2 ***Initial testing***

6.2.4.2.1 The internal pressure to be applied (test pressure) shall be 1.5 times the internal pressure at 50 °C, with a minimum pressure of 1 MPa (10 bar).

6.2.4.2.2 The hydraulic pressure tests shall be carried out on at least five empty receptacles of each model:

(a) until the prescribed test pressure is reached, by which time no leakage or visible permanent deformation shall have occurred; and

(b) until leakage or bursting occurs; the dished end, if any, shall yield first and the receptacle shall not leak or burst until a pressure 1.2 times the test pressure has been reached or passed.

6.2.4.3 ***Reference to standards***

The requirements of this section are deemed to be met if the following standards are complied with:

- for aerosol dispensers (UN No. 1950 aerosols): Annex to Council Directive 75/324/EEC [4] as amended by Commission Directive 94/1/EC [5];

- for UN No.2037, small recipients containing gas (gas cartridges) containing UN No. 1965, hydrocarbon gas mixture n.o.s, liquefied: EN 417:1992 Non-refillable metallic gas cartridges for liquefied petroleum gases, with or without a valve, for use with portable appliances - Construction, inspection, testing and marking.

---

[4] *Council Directive 75/324/EEC of 20 May 1975 on the approximation of the laws of the Member States relating to aerosol dispensers, published in the Official Journal of the European Communities No. L 147 of 9.06.1975.*

[5] *Commission Directive 94/1/EC of January 1994, adapting some technicalities of Council Directive 75/324/EEC on the approximation of the laws of the relating Member States to aerosol dispensers published in the Official Journal of the European Communities No. L 23 of 28.01.1994.*

CHAPTER 6.3

REQUIREMENTS FOR THE CONSTRUCTION AND TESTING OF PACKAGINGS FOR CLASS 6.2 SUBSTANCES

NOTE: *The requirements of this Chapter don't apply to packagings used for the carriage of Class 6.2 substances according to packing instruction P621 of 4.1.4.1.*

6.3.1 General

6.3.1.1 A packaging that meets the requirements of this section and of 6.3.2 may, after decision by the competent authority, be marked with:

(a) the United Nations packaging symbol;

(b) the code designating the type of packaging according to the requirements of 6.1.2;

(c) the text "CLASS 6.2";

(d) the last two digits of the year of manufacture of the packaging;

(e) the state authorizing the allocation of the mark, indicated by the distinguishing sign for motor vehicles in international traffic [1];

(f) the name of the manufacturer or other identification of the packaging specified by the competent authority;

(g) for packagings meeting the requirements of 6.3.2.9, the letter "U", inserted immediately following the marking required in (b) above.

6.3.1.2 ***Example of marking***

4G/CLASS 6.2/92 as in 6.3.1.1 (a), (b), (c) and (d)
S/SP-9989-ERIKSSON as in 6.3.1.1 (e), (f)

6.3.2 Test requirements for packagings

6.3.2.1 Other than for packagings for live animals and organisms, samples of each packaging shall be prepared for testing as described in 6.3.2.2 and then subjected to the tests in 6.3.2.4 to 6.3.2.6. If the nature of the packaging makes it necessary, equivalent preparation and tests are permitted, provided that these may be demonstrated to be at least as effective.

6.3.2.2 Samples of each packaging shall be prepared as for carriage, except that the substance to be carried shall be replaced by water or, where conditioning at -18 °C is

[1] *Distinguishing sign for motor vehicles in international traffic prescribed in Vienna Convention on Road Traffic (1968).*

specified, by water/antifreeze. Each primary receptacle shall be filled to 98% capacity.

6.3.2.3 ***Tests required***

Material of					**Tests required**				
outer packaging			**inner packaging**		**Refer to 6.3.2.5**				**Refer to 6.3.2.6**
Fibre - board	**Plastics**	**Other**	**Plastics**	**Other**	**(a)**	**(b)**	**(c)**	**(d)**	
x			x			x	x	when dry	x
x				x		x		ice is used	x
	x		x				x		x
	x			x			x		x
		x	x				x		x
		x		x	x				x

6.3.2.4 Packagings prepared as for carriage shall be subjected to the tests in 6.3.2.3, which - for test purposes - categorizes packagings according to their material characteristics. For outer packagings, the headings in the table relate to fibreboard or similar materials whose performance may be rapidly affected by moisture; plastics which may embrittle at low temperature; and other materials such as metal whose performance is not affected by moisture or temperature. If a primary receptacle and a secondary packaging are made of different materials, the material of the primary receptacle determines the appropriate test. In instances where a primary receptacle is made of two materials, the material most liable to damage shall determine the appropriate tests.

6.3.2.5 (a) Samples shall be subjected to free-fall drops on to a rigid, non-resilient, flat, horizontal surface from a height of 9 m. Where the samples are in the shape of a box, five shall be dropped in sequence:

(i) one flat on to the base,

(ii) one flat on to the top,

(iii) one flat on to the long side,

(iv) one flat on to the short side,

(v) one on to a corner.

Where the samples are in the shape of a drum, three shall be dropped in sequence:

(vi) one diagonally on to the top chime, with the centre of gravity directly above the point of impact,

(vii) one diagonally on to the base chime,

(viii) one flat on to the side.

Following the appropriate drop sequence, there shall be no leakage from the primary receptacle(s) which shall remain protected by absorbent material in the secondary packaging.

NOTE: *While the sample shall be released in the required orientation, it is accepted that for aerodynamic reasons the impact may not take place in that orientation.*

(b) The samples shall be subjected to a water spray that simulates exposure to rainfall of approximately 5 cm per hour for at least one hour. It shall then be subjected to the test described in (a).

(c) The samples shall be conditioned in an atmosphere of -18 °C or less for a period of at least 24 hours and within 15 minutes of removal from that atmosphere be subjected to the test described in (a). Where the samples contain dry ice, the conditioning period may be reduced to 4 hours.

(d) Where the packaging is intended to contain dry ice, a test additional to that specified in (a) or (b) or (c) shall be carried out. One sample shall be stored so that all the dry ice dissipates and then be subjected to the test described in (a).

6.3.2.6 Packagings with a gross mass of 7 kg or less shall be subjected to the tests described in (a) below and packagings with a gross mass exceeding 7 kg to the tests in (b) below.

(a) Samples shall be placed on a level hard surface. A cylindrical steel rod with a mass of at least 7 kg, a diameter not exceeding 38 mm and whose impact end edges have a radius not exceeding 6 mm, shall be dropped in a vertical free fall from a height of 1 m, measured from the impact end to the impact surface of the sample. One sample shall be placed on its base. A second sample shall be placed in an orientation perpendicular to that used for the first. In each instance the steel rod shall be aimed to impact the primary receptacle. Following each impact, penetration of the secondary packaging is acceptable, provided that there is no leakage from the primary receptacle(s).

(b) Samples shall be dropped on to the end of a cylindrical steel rod. The rod shall be set vertically in a level hard surface. It shall have a diameter of 38 mm and the edges of the upper end a radius not exceeding 6 mm. The rod shall protrude from the surface a distance at least equal to that between the primary receptacle(s) and the outer surface of the outer packaging with a minimum of 200 mm. One sample shall be dropped in a vertical free fall from a height of 1 m, measured from the top of the steel rod. A second sample shall be dropped from the same height in an orientation perpendicular to that used for the first. In each instance, the packaging shall be so orientated that the steel rod could penetrate the primary receptacle(s). Following each impact, there shall be no leakage from the primary receptacle(s).

6.3.2.7 The competent authority may permit the selective testing of packagings that differ only in minor respects from a tested type, e.g. smaller sizes of inner packagings or inner packagings of lower net mass; and packagings such as drums, bags and boxes which are produced with small reductions in external dimension(s).

6.3.2.8 Provided an equivalent level of performance is maintained, the following variations in the primary receptacles placed within a secondary packaging are allowed without the need for further testing of the completed packaging:

(a) Primary receptacles of equivalent or smaller size as compared to the tested primary receptacles may be used provided:

(i) the primary receptacles are of similar design to the primary receptacle tested (e.g. shape: round, rectangular, etc.);

(ii) the material of construction of the primary receptacles (e.g. glass, plastics, metal) offers resistance to impact and stacking forces equivalent to or better than that of the primary receptacles originally tested;

(iii) the primary receptacles have the same or smaller openings and the closure is of equivalent design (e.g. screw cap, friction lid, etc.);

(iv) sufficient additional cushioning material is used to take up empty spaces and to prevent significant movement of the primary receptacles; and

(v) primary receptacles are oriented within the secondary packagings in the same manner as in the tested package.

(b) A lesser number of the tested primary receptacles, or of the alternative types of primary receptacles identified in (a) above, may be used provided sufficient cushioning is added to fill the void space(s) and to prevent significant movement of the primary receptacles.

6.3.2.9 Inner receptacles of any type may be assembled within an intermediate (secondary) packaging and carried without testing in the outer packaging under the following conditions:

(a) The intermediate/outer packaging combination shall have been successfully tested in accordance with 6.3.2.3 with fragile (e.g. glass) inner receptacles;

(b) The total combined gross mass of inner receptacles shall not exceed one half the gross mass of inner receptacles used for the drop test in (a) above;

(c) The thickness of cushioning between inner receptacles and between inner receptacles and the outside of the intermediate packaging shall not be reduced below the corresponding thicknesses in the originally tested packaging; and if a single inner receptacle was used in the original test, the thickness of cushioning between inner receptacles shall not be less than the thickness of cushioning between the outside of the intermediate packaging and the inner receptacle in the original test. When either fewer or smaller inner receptacles are used (as compared to the inner receptacles used in the drop test), sufficient additional cushioning material shall be used to take up the void;

(d) The outer packaging shall have successfully passed the stacking test in 6.1.5.6 while empty. The total mass of identical packages shall be based on the combined mass of inner receptacles used in the drop test in (a) above;

(e) For inner receptacles containing liquids, an adequate quantity of absorbent material to absorb the entire liquid content of the inner receptacles shall be present;

(f) If the outer packaging is intended to contain inner receptacles for liquids and is not leakproof, or is intended to contain inner receptacles for solids and is not siftproof, a means of containing any liquid or solid contents in the event of leakage shall be provided in the form of a leakproof liner, plastics bag or other equally effective means of containment;

(g) In addition to the markings prescribed in 6.3.1.1(a) to (f), packagings shall be marked in accordance with 6.3.1.1 (g).

CHAPTER 6.4

REQUIREMENTS FOR THE CONSTRUCTION, TESTING AND APPROVAL OF PACKAGES AND MATERIAL OF CLASS 7

6.4.1 *(Reserved)*

6.4.2 General requirements

6.4.2.1 The package shall be so designed in relation to its mass, volume and shape that it can be easily and safely carried. In addition, the package shall be so designed that it can be properly secured in or on the vehicle during carriage.

6.4.2.2 The design shall be such that any lifting attachments on the package will not fail when used in the intended manner and that, if failure of the attachments should occur, the ability of the package to meet other requirements of this Annex would not be impaired. The design shall take account of appropriate safety factors to cover snatch lifting.

6.4.2.3 Attachments and any other features on the outer surface of the package which could be used to lift it shall be designed either to support its mass in accordance with the requirements of 6.4.2.2 or shall be removable or otherwise rendered incapable of being used during carriage.

6.4.2.4 As far as practicable, the packaging shall be so designed and finished that the external surfaces are free from protruding features and can be easily decontaminated.

6.4.2.5 As far as practicable, the outer layer of the package shall be so designed as to prevent the collection and the retention of water.

6.4.2.6 Any features added to the package at the time of carriage which are not part of the package shall not reduce its safety.

6.4.2.7 The package shall be capable of withstanding the effects of any acceleration, vibration or vibration resonance which may arise under routine conditions of carriage without any deterioration in the effectiveness of the closing devices on the various receptacles or in the integrity of the package as a whole. In particular, nuts, bolts and other securing devices shall be so designed as to prevent them from becoming loose or being released unintentionally, even after repeated use.

6.4.2.8 The materials of the packaging and any components or structures shall be physically and chemically compatible with each other and with the radioactive contents. Account shall be taken of their behaviour under irradiation.

6.4.2.9 All valves through which the radioactive contents could otherwise escape shall be protected against unauthorized operation.

6.4.2.10 The design of the package shall take into account ambient temperatures and pressures that are likely to be encountered in routine conditions of carriage.

6.4.2.11 For radioactive material having other dangerous properties the package design shall take into account those properties; see 2.1.3.5.3 and 4.1.9.1.5.

6.4.3 *(Reserved)*

6.4.4 Requirements for excepted packages

An excepted package shall be designed to meet the requirements specified in 6.4.2.

6.4.5 Requirements for Industrial packages

6.4.5.1 Industrial packages Types 1, 2, and 3 (Types IP-1, IP-2, and IP-3) shall meet the requirements specified in 6.4.2 and 6.4.7.2.

6.4.5.2 An Industrial package Type 2 (Type IP-2) shall, if it were subjected to the tests specified in 6.4.15.4 and 6.4.15.5, prevent:

(a) Loss or dispersal of the radioactive contents; and

(b) Loss of shielding integrity which would result in more than a 20% increase in the radiation level at any external surface of the package.

6.4.5.3 An Industrial package Type 3 (Type IP-3) shall meet all the requirements specified in 6.4.7.2 to 6.4.7.15.

6.4.5.4 ***Alternative requirements for Industrial packages Types 2 and 3 (Types IP-2 and IP-3)***

6.4.5.4.1 Packages may be used as Industrial package Type 2 (Type IP-2) provided that:

(a) They satisfy the requirements of 6.4.5.1;

(b) They are designed to conform to the standards prescribed in Chapter 6.1 or other requirements at least equivalent to those standards; and

(c) When subjected to the tests required for packing groups I or II in Chapter 6.1, they would prevent:

(i) loss or dispersal of the radioactive contents; and

(ii) loss of shielding integrity which would result in more than a 20% increase in the radiation level at any external surface of the package.

6.4.5.4.2 Tank-containers and portable tanks may also be used as Industrial package Types 2 or 3 (Types IP-2 or IP-3), provided that:

(a) They satisfy the requirements of 6.4.5.1;

(b) They are designed to conform to the standards prescribed in Chapter 6.7 or Chapter 6.8, or other requirements at least equivalent to those standards, and are capable of withstanding a test pressure of 265 kPa; and

(c) They are designed so that any additional shielding which is provided shall be capable of withstanding the static and dynamic stresses resulting from handling and routine conditions of carriage and of preventing a loss of shielding integrity which would result in more than a 20% increase in the radiation level at any external surface of the portable tanks or tank-containers.

6.4.5.4.3 Tanks, other than portable tanks and tank-containers, may also be used as Industrial package Types 2 or 3 (Types IP-2 or IP-3) for carrying LSA-I and LSA-II liquids and gases as prescribed in Table 4.1.9.2.4, provided that they conform to standards at least equivalent to those prescribed in 6.4.5.4.2.

6.4.5.4.4 Containers may also be used as Industrial package Types 2 or 3 (Types IP-2 or IP-3), provided that:

(a) The radioactive contents are restricted to solid materials;

(b) They satisfy the requirements of 6.4.5.1; and

(c) They are designed to conform to ISO 1496-1:1990: "Series 1 Containers - Specifications and Testing - Part 1: General Cargo Containers" excluding dimensions and ratings. They shall be designed such that if subjected to the tests prescribed in that document and the accelerations occurring during routine conditions of carriage they would prevent:

(i) loss or dispersal of the radioactive contents; and

(ii) loss of shielding integrity which would result in more than a 20% increase in the radiation level at any external surface of the containers.

6.4.5.4.5 Metal intermediate bulk containers may also be used as Industrial package Type 2 or 3 (Type IP-2 or IP-3) provided that:

(a) They satisfy the requirements of 6.4.5.1; and

(b) They are designed to conform to the standards and tests prescribed in Chapter 6.5 for packing groups I or II, but with the drop test conducted in the most damaging orientation, they would prevent:

(i) loss or dispersal of the radioactive contents; and

(ii) loss of shielding integrity which would result in more than a 20% increase in the radiation level at any external surface of the intermediate bulk container.

6.4.6 Requirements for packages containing uranium hexafluoride

6.4.6.1 Except as allowed in 6.4.6.4, uranium hexafluoride shall be packaged and carried in accordance with the provisions of ISO 7195:1993 "Packaging of uranium hexafluoride (UF_6) for transport", and the requirements of 6.4.6.2 and 6.4.6.3. The package shall also meet the requirements prescribed elsewhere in ADR which pertain to the radioactive and fissile properties of the material.

6.4.6.2 Each package designed to contain 0.1 kg or more of uranium hexafluoride shall be designed so that it would meet the following requirements:

(a) Withstand without leakage and without unacceptable stress, as specified in ISO 7195:1993, the structural test as specified in 6.4.21.5;

(b) Withstand without loss or dispersal of the uranium hexafluoride the test specified in 6.4.15.4; and

(c) Withstand without rupture of the containment system the test specified in 6.4.17.3.

6.4.6.3 Packages designed to contain 0.1 kg or more of uranium hexafluoride shall not be provided with pressure relief devices.

6.4.6.4 Subject to the approval of the competent authority, packages designed to contain 0.1 kg or more of uranium hexafluoride may be carried if:

(a) The packages are designed to requirements other than those given in ISO 7195:1993 and 6.4.6.2 and 6.4.6.3 but, notwithstanding, the requirements of 6.4.6.2 and 6.4.6.3 are met as far as practicable;

(b) The packages are designed to withstand without leakage and without unacceptable stress a test pressure less than 2.76 MPa as specified in 6.4.21.5; or

(c) For packages designed to contain 9 000 kg or more of uranium hexafluoride, the packages do not meet the requirement of 6.4.6.2 (c).

6.4.7 Requirements for Type A packages

6.4.7.1 Type A packages shall be designed to meet the general requirements of 6.4.2 and of 6.4.7.2 to 6.4.7.17.

6.4.7.2 The smallest overall external dimension of the package shall not be less than 10 cm.

6.4.7.3 The outside of the package shall incorporate a feature such as a seal, which is not readily breakable and which, while intact, will be evidence that it has not been opened.

6.4.7.4 Any tie-down attachments on the package shall be so designed that, under normal and accident conditions of carriage, the forces in those attachments shall not impair the ability of the package to meet the requirements of ADR.

6.4.7.5 The design of the package shall take into account temperatures ranging from -40°C to +70°C for the components of the packaging. Attention shall be given to freezing temperatures for liquids and to the potential degradation of packaging materials within the given temperature range.

6.4.7.6 The design and manufacturing techniques shall be in accordance with national or international standards, or other requirements, acceptable to the competent authority.

6.4.7.7 The design shall include a containment system securely closed by a positive fastening device which cannot be opened unintentionally or by a pressure which may arise within the package.

6.4.7.8 Special form radioactive material may be considered as a component of the containment system.

6.4.7.9 If the containment system forms a separate unit of the package, it shall be capable of being securely closed by a positive fastening device which is independent of any other part of the packaging.

6.4.7.10 The design of any component of the containment system shall take into account, where applicable, the radiolytic decomposition of liquids and other vulnerable materials and the generation of gas by chemical reaction and radiolysis.

6.4.7.11 The containment system shall retain its radioactive contents under a reduction of ambient pressure to 60 kPa.

6.4.7.12 All valves, other than pressure relief valves, shall be provided with an enclosure to retain any leakage from the valve.

6.4.7.13 A radiation shield which encloses a component of the package specified as a part of the containment system shall be so designed as to prevent the unintentional release of that component from the shield. Where the radiation shield and such component within it form a separate unit, the radiation shield shall be capable of being securely closed by a positive fastening device which is independent of any other packaging structure.

6.4.7.14 A package shall be so designed that if it were subjected to the tests specified in 6.4.15, it would prevent:

(a) Loss or dispersal of the radioactive contents; and

(b) Loss of shielding integrity which would result in more than a 20% increase in the radiation level at any external surface of the package.

6.4.7.15 The design of a package intended for liquid radioactive material shall make provision for ullage to accommodate variations in the temperature of the contents, dynamic effects and filling dynamics.

Type A packages to contain liquids

6.4.7.16 A Type A package designed to contain liquids shall, in addition:

(a) Be adequate to meet the conditions specified in 6.4.7.14 above if the package is subjected to the tests specified in 6.4.16; and

(b) Either

(i) be provided with sufficient absorbent material to absorb twice the volume of the liquid contents. Such absorbent material shall be suitably positioned so as to contact the liquid in the event of leakage; or

(ii) be provided with a containment system composed of primary inner and secondary outer containment components designed to ensure retention of the liquid contents, within the secondary outer containment components, even if the primary inner components leak.

Type A packages to contain gas

6.4.7.17 A package designed for gases shall prevent loss or dispersal of the radioactive contents if the package were subjected to the tests specified in 6.4.16. A Type A package designed for tritium gas or for noble gases shall be excepted from this requirement.

6.4.8 Requirements for Type B(U) packages

6.4.8.1 Type B(U) packages shall be designed to meet the requirements specified in 6.4.2, and of 6.4.7.2 to 6.4.7.15, except as specified in 6.4.7.14 (a), and, in addition, the requirements specified in 6.4.8.2 to 6.4.8.15.

6.4.8.2 A package shall be so designed that, under the ambient conditions specified in 6.4.8.4 and 6.4.8.5 heat generated within the package by the radioactive contents shall not, under normal conditions of carriage, as demonstrated by the tests in 6.4.15, adversely affect the package in such a way that it would fail to meet the applicable requirements for containment and shielding if left unattended for a period of one week. Particular attention shall be paid to the effects of heat, which may:

(a) Alter the arrangement, the geometrical form or the physical state of the radioactive contents or, if the radioactive material is enclosed in a can or receptacle (for example, clad fuel elements), cause the can, receptacle or radioactive material to deform or melt; or

(b) Lessen the efficiency of the packaging through differential thermal expansion or cracking or melting of the radiation shielding material; or

(c) In combination with moisture, accelerate corrosion.

6.4.8.3 A package shall be so designed that, under the ambient condition specified in 6.4.8.4, the temperature of the accessible surfaces of a package shall not exceed 50 °C, unless the package is carried under exclusive use.

6.4.8.4 The ambient temperature shall be assumed to be 38 °C.

6.4.8.5 The solar insolation conditions shall be assumed to be as specified in Table 6.4.8.5.

Table 6.4.8.5: Insolation data

Form and location of surface	**Insolation for 12 hours per day (W/m^2)**
Flat surfaces carried horizontally:	
- base	none
- other surfaces	800
Flat surfaces not carried horizontally:	
- each surface	200 [a]
Curved surfaces	400 [a]

[a] *Alternatively, a sine function may be used, with an absorption coefficient adopted and the effects of possible reflection from neighbouring objects neglected.*

6.4.8.6 A package which includes thermal protection for the purpose of satisfying the requirements of the thermal test specified in 6.4.17.3 shall be so designed that such protection will remain effective if the package is subjected to the tests specified in 6.4.15 and 6.4.17.2 (a) and (b) or 6.4.17.2 (b) and (c), as appropriate. Any such protection on the exterior of the package shall not be rendered ineffective by ripping, cutting, skidding, abrasion or rough handling.

6.4.8.7 A package shall be so designed that, if it were subjected to:

(a) The tests specified in 6.4.15, it would restrict the loss of radioactive contents to not more than 10^{-6} A_2 per hour; and

(b) The tests specified in 6.4.17.1, 6.4.17.2 (b), 6.4.17.3, and 6.4.17.4 and the tests in

(i) 6.4.17.2 (c), when the package has a mass not greater than 500 kg, an overall density not greater than 1 000 kg/m^3 based on the external dimensions, and radioactive contents greater than 1 000 A_2 not as special form radioactive material, or

(ii) 6.4.17.2 (a), for all other packages, it would meet the following requirements:

- retain sufficient shielding to ensure that the radiation level at 1 m from the surface of the package would not exceed 10 mSv/h with the maximum radioactive contents which the package is designed to contain; and

- restrict the accumulated loss of radioactive contents in a period of one week to not more than 10 A_2 for krypton-85 and not more than A_2 for all other radionuclides.

Where mixtures of different radionuclides are present, the provisions of 2.2.7.7.2.4 to 2.2.7.7.2.6 shall apply except that for krypton-85 an effective A_2(i) value equal to 10 A_2 may be used. For case (a) above, the assessment shall take into account the external contamination limits of 4.1.9.1.2.

6.4.8.8 A package for radioactive contents with activity greater than 10^5 A_2 shall be so designed that if it were subjected to the enhanced water immersion test specified in 6.4.18, there would be no rupture of the containment system.

6.4.8.9 Compliance with the permitted activity release limits shall depend neither upon filters nor upon a mechanical cooling system.

6.4.8.10 A package shall not include a pressure relief system from the containment system which would allow the release of radioactive material to the environment under the conditions of the tests specified in 6.4.15 and 6.4.17.

6.4.8.11 A package shall be so designed that if it were at the maximum normal operating pressure and it were subjected to the tests specified in 6.4.15 and 6.4.17, the level of strains in the containment system would not attain values which would adversely affect the package in such a way that it would fail to meet the applicable requirements.

6.4.8.12 A package shall not have a maximum normal operating pressure in excess of a gauge pressure of 700 kPa.

6.4.8.13 The maximum temperature of any surface readily accessible during carriage of a package shall not exceed 85 °C in the absence of insolation under the ambient conditions specified in 6.4.8.4. The package shall be carried under exclusive use, as specified in 6.4.8.3, if this maximum temperature exceeds 50 °C. Account may be taken of barriers or screens intended to give protection to persons without the need for the barriers or screens being subject to any test.

6.4.8.14 *(Reserved)*

6.4.8.15 A package shall be designed for an ambient temperature range from -40 °C to +38 °C.

6.4.9 Requirements for Type B(M) packages

6.4.9.1 Type B(M) packages shall meet the requirements for Type B(U) packages specified in 6.4.8.1, except that for packages to be carried solely within a specified country or solely between specified countries, conditions other than those given in 6.4.7.5, 6.4.8.4, 6.4.8.5, and 6.4.8.8 to 6.4.8.15 above may be assumed with the approval of the competent authorities of these countries. Notwithstanding, the requirements for Type B(U) packages specified in 6.4.8.8 to 6.4.8.15 shall be met as far as practicable.

6.4.9.2 Intermittent venting of Type B(M) packages may be permitted during carriage, provided that the operational controls for venting are acceptable to the relevant competent authorities.

6.4.10 *(Reserved)*

6.4.11 Requirements for packages containing fissile material

6.4.11.1 Fissile material shall be carried so as to:

(a) Maintain sub-criticality during normal and accident conditions of carriage; in particular, the following contingencies shall be considered:

(i) water leaking into or out of packages;

(ii) the loss of efficiency of built-in neutron absorbers or moderators;

(iii) rearrangement of the contents either within the package or as a result of loss from the package;

(iv) reduction of spaces within or between packages;

(v) packages becoming immersed in water or buried in snow; and

(vi) temperature changes; and

(b) Meet the requirements:

(i) of 6.4.7.2 for fissile material contained in packages;

(ii) prescribed elsewhere in ADR which pertain to the radioactive properties of the material; and

(iii) specified in 6.4.11.3 to 6.4.11.12, unless excepted by 6.4.11.2.

6.4.11.2 Fissile material meeting one of the provisions (a) to (d) of this paragraph is excepted from the requirement to be carried in packages that comply with 6.4.11.3 to 6.4.11.12 as well as the other requirements of ADR that apply to fissile material. Only one type of exception is allowed per consignment.

(a) A mass limit per consignment such that:

$$\frac{\textit{mass of uranium - 235 (g)}}{X} + \frac{\textit{mass of other fissile material (g)}}{Y} < 1$$

where X and Y are the mass limits defined in Table 6.4.11.2, provided that either:

(i) each individual package contains not more than 15 g of fissile material; for unpackaged material, this quantity limitation shall apply to the consignment being carried in or on the vehicle; or

(ii) the fissile material is a homogeneous hydrogenous solution or mixture where the ratio of fissile nuclides to hydrogen is less than 5% by mass; or

(iii) there is not more than 5 g of fissile material in any 10 litre volume of material.

Neither beryllium nor deuterium shall be present in quantities exceeding 0.1% of the fissile material mass;

(b) Uranium enriched in uranium-235 to a maximum of 1% by mass, and with a total plutonium and uranium-233 content not exceeding 1% of the mass of uranium-235, provided that the fissile material is distributed essentially homogeneously throughout the material. In addition, if uranium-235 is present in metallic, oxide or carbide forms, it shall not form a lattice arrangement;

(c) Liquid solutions of uranyl nitrate enriched in uranium-235 to a maximum of 2% by mass, with a total plutonium and uranium-233 content not exceeding 0.002% of the mass of uranium, and with a minimum nitrogen to uranium atomic ratio (N/U) of 2;

(d) Packages containing, individually, a total plutonium mass not more than 1 kg, of which not more than 20% by mass may consist of plutonium-239, plutonium-241 or any combination of those radionuclides.

Table 6.4.11.2: Consignment mass limits for exceptions from the requirements for packages containing fissile material

Fissile material	Fissile material mass (g) mixed with substances having an average hydrogen density less than or equal to water	Fissile material mass (g) mixed with substances having an average hydrogen density greater than water
Uranium -235(X)	400	290
Other fissile material (Y)	250	180

6.4.11.3 Where the chemical or physical form, isotopic composition, mass or concentration, moderation ratio or density, or geometric configuration is not known, the assessments of 6.4.11.7 to 6.4.11.12 shall be performed assuming that each parameter that is not known has the value which gives the maximum neutron multiplication consistent with the known conditions and parameters in these assessments.

6.4.11.4 For irradiated nuclear fuel the assessments of 6.4.11.7 to 6.4.11.12 shall be based on an isotopic composition demonstrated to provide:

(a) The maximum neutron multiplication during the irradiation history; or

(b) A conservative estimate of the neutron multiplication for the package assessments. After irradiation but prior to shipment, a measurement shall be performed to confirm the conservatism of the isotopic composition.

6.4.11.5 The packaging, after being subjected to the tests specified in 6.4.15, must prevent the entry of a 10 cm cube.

6.4.11.6 The package shall be designed for an ambient temperature range of -40°C to + 38°C unless the competent authority specifies otherwise in the certificate of approval for the package design.

6.4.11.7 For a package in isolation, it shall be assumed that water can leak into or out of all void spaces of the package, including those within the containment system. However, if the design incorporates special features to prevent such leakage of water into or out of certain void spaces, even as a result of error, absence of leakage may be assumed in respect of those void spaces. Special features shall include the following:

(a) Multiple high standard water barriers, each of which would remain watertight if the package were subject to the tests prescribed in 6.4.11.12 (b), a high degree of quality control in the manufacture, maintenance and repair of packagings and tests to demonstrate the closure of each package before each shipment; or

(b) For packages containing uranium hexafluoride only:

(i) packages where, following the tests prescribed in 6.4.11.12 (b), there is no physical contact between the valve and any other component of the packaging other than at its original point of attachment and where, in addition, following the test prescribed in 6.4.17.3 the valves remain leaktight; and

(ii) a high degree of quality control in the manufacture, maintenance and repair of packagings coupled with tests to demonstrate closure of each package before each shipment.

6.4.11.8 It shall be assumed that the confinement system shall be closely reflected by at least 20 cm of water or such greater reflection as may additionally be provided by the surrounding material of the packaging. However, when it can be demonstrated that the confinement system remains within the packaging following the tests prescribed in 6.4.11.12 (b), close reflection of the package by at least 20 cm of water may be assumed in 6.4.11.9 (c).

6.4.11.9 The package shall be subcritical under the conditions of 6.4.11.7 and 6.4.11.8 with the package conditions that result in the maximum neutron multiplication consistent with:

(a) Routine conditions of carriage (incident free);

(b) The tests specified in 6.4.11.11 (b);

(c) The tests specified in 6.4.11.12 (b).

6.4.11.10 *(Reserved)*

6.4.11.11 For normal conditions of carriage a number "N" shall be derived, such that five times "N" shall be sub-critical for the arrangement and package conditions that provide the maximum neutron multiplication consistent with the following:

(a) There shall not be anything between the packages, and the package arrangement shall be reflected on all sides by at least 20 cm of water; and

(b) The state of the packages shall be their assessed or demonstrated condition if they had been subjected to the tests specified in 6.4.15.

6.4.11.12 For accident conditions of carriage a number "N" shall be derived, such that two times "N" shall be sub-critical for the arrangement and package conditions that provide the maximum neutron multiplication consistent with the following:

(a) Hydrogenous moderation between packages, and the package arrangement reflected on all sides by at least 20 cm of water; and

(b) The tests specified in 6.4.15 followed by whichever of the following is the more limiting:

(i) the tests specified in 6.4.17.2 (b) and, either 6.4.17.2 (c) for packages having a mass not greater than 500 kg and an overall density not greater than 1 000 kg/m^3 based on the external dimensions, or 6.4.17.2 (a) for all other packages; followed by the test specified in 6.4.17.3 and completed by the tests specified in 6.4.19.1 to 6.4.19.3; or

(ii) the test specified in 6.4.17.4; and

(c) Where any part of the fissile material escapes from the containment system following the tests specified in 6.4.11.12 (b), it shall be assumed that fissile material escapes from each package in the array and all of the fissile material shall be arranged in the configuration and moderation that results in the maximum neutron multiplication with close reflection by at least 20 cm of water.

6.4.12 Test procedures and demonstration of compliance

6.4.12.1 Demonstration of compliance with the performance standards required in 2.2.7.3.3, 2.2.7.3.4, 2.2.7.4.1, 2.2.7.4.2, and 6.4.2 to 6.4.11 must be accomplished by any of the methods listed below or by a combination thereof:

(a) Performance of tests with specimens representing LSA-III material, or special form radioactive material, or with prototypes or samples of the packaging, where the contents of the specimen or the packaging for the tests shall simulate as closely as practicable the expected range of radioactive contents and the specimen or packaging to be tested shall be prepared as presented for carriage;

(b) Reference to previous satisfactory demonstrations of a sufficiently similar nature;

(c) Performance of tests with models of appropriate scale incorporating those features which are significant with respect to the item under investigation when

engineering experience has shown results of such tests to be suitable for design purposes. When a scale model is used, the need for adjusting certain test parameters, such as penetrator diameter or compressive load, shall be taken into account;

(d) Calculation, or reasoned argument, when the calculation procedures and parameters are generally agreed to be reliable or conservative.

6.4.12.2 After the specimen, prototype or sample has been subjected to the tests, appropriate methods of assessment shall be used to assure that the requirements for the test procedures have been fulfilled in compliance with the performance and acceptance standards prescribed in 2.2.7.3.3, 2.2.7.3.4, 2.2.7.4.1, 2.2.7.4.2, and 6.4.2 to 6.4.11.

6.4.12.3 All specimens shall be inspected before testing in order to identify and record faults or damage including the following:

(a) Divergence from the design;

(b) Defects in manufacture;

(c) Corrosion or other deterioration; and

(d) Distortion of features.

The containment system of the package shall be clearly specified. The external features of the specimen shall be clearly identified so that reference may be made simply and clearly to any part of such specimen.

6.4.13 Testing the integrity of the containment system and shielding and evaluating criticality safety

After each of the applicable tests specified in 6.4.15 to 6.4.21:

(a) Faults and damage shall be identified and recorded;

(b) It shall be determined whether the integrity of the containment system and shielding has been retained to the extent required in 6.4.2 to 6.4.11 for the package under test; and

(c) For packages containing fissile material, it shall be determined whether the assumptions and conditions used in the assessments required by 6.4.11.1 to 6.4.11.12 for one or more packages are valid.

6.4.14 Target for drop tests

The target for the drop tests specified in 2.2.7.4.5 (a), 6.4.15.4, 6.4.16 (a), 6.4.17.2 shall be a flat, horizontal surface of such a character that any increase in its resistance to displacement or deformation upon impact by the specimen would not significantly increase the damage to the specimen.

6.4.15 Tests for demonstrating ability to withstand normal conditions of carriage

6.4.15.1 The tests are: the water spray test, the free drop test, the stacking test and the penetration test. Specimens of the package shall be subjected to the free drop test, the stacking test and the penetration test, preceded in each case by the water spray test. One specimen may be used for all the tests, provided that the requirements of 6.4.15.2 are fulfilled.

6.4.15.2 The time interval between the conclusion of the water spray test and the succeeding test shall be such that the water has soaked in to the maximum extent, without appreciable drying of the exterior of the specimen. In the absence of any evidence to the contrary, this interval shall be taken to be two hours if the water spray is applied from four directions simultaneously. No time interval shall elapse, however, if the water spray is applied from each of the four directions consecutively.

6.4.15.3 Water spray test: The specimen shall be subjected to a water spray test that simulates exposure to rainfall of approximately 5 cm per hour for at least one hour.

6.4.15.4 Free drop test: The specimen shall drop onto the target so as to suffer maximum damage in respect of the safety features to be tested.

(a) The height of drop measured from the lowest point of the specimen to the upper surface of the target shall be not less than the distance specified in Table 6.4.15.4 for the applicable mass. The target shall be as defined in 6.4.14;

(b) For rectangular fibreboard or wood packages not exceeding a mass of 50 kg, a separate specimen shall be subjected to a free drop onto each corner from a height of 0.3 m;

(c) For cylindrical fibreboard packages not exceeding a mass of 100 kg, a separate specimen shall be subjected to a free drop onto each of the quarters of each rim from a height of 0.3 m.

Table 6.4.15.4: Free drop distance for testing packages to normal conditions of carriage

Package mass (kg)	Free drop distance (m)
Package mass < 5 000	1.2
5 000 ≤ Package mass < 10 000	0.9
10 000 ≤ Package mass < 15 000	0.6
15 000 ≤ Package mass	0.3

6.4.15.5 Stacking test: Unless the shape of the packaging effectively prevents stacking, the specimen shall be subjected, for a period of 24 h, to a compressive load equal to the greater of the following:

(a) The equivalent of 5 times the mass of the actual package; and

(b) The equivalent of 13 kPa multiplied by the vertically projected area of the package.

The load shall be applied uniformly to two opposite sides of the specimen, one of which shall be the base on which the package would typically rest.

6.4.15.6 Penetration test: The specimen shall be placed on a rigid, flat, horizontal surface which will not move significantly while the test is being carried out.

(a) A bar of 3.2 cm in diameter with a hemispherical end and a mass of 6 kg shall be dropped and directed to fall, with its longitudinal axis vertical, onto the centre of the weakest part of the specimen, so that, if it penetrates sufficiently far, it will hit the containment system. The bar shall not be significantly deformed by the test performance;

(b) The height of drop of the bar measured from its lower end to the intended point of impact on the upper surface of the specimen shall be 1 m.

6.4.16 Additional tests for Type A packages designed for liquids and gases

A specimen or separate specimens shall be subjected to each of the following tests unless it can be demonstrated that one test is more severe for the specimen in question than the other, in which case one specimen shall be subjected to the more severe test.

(a) Free drop test: The specimen shall drop onto the target so as to suffer the maximum damage in respect of containment. The height of the drop measured from the lowest part of the specimen to the upper surface of the target shall be 9 m. The target shall be as defined in 6.4.14;

(b) Penetration test: The specimen shall be subjected to the test specified in 6.4.15.6 except that the height of drop shall be increased to 1.7 m from the 1 m specified in 6.4.15.6 (b).

6.4.17 Tests for demonstrating ability to withstand accident conditions in carriage

6.4.17.1 The specimen shall be subjected to the cumulative effects of the tests specified in 6.4.17.2 and 6.4.17.3, in that order. Following these tests, either this specimen or a separate specimen shall be subjected to the effect(s) of the water immersion test(s) as specified in 6.4.17.4 and, if applicable, 6.4.18.

6.4.17.2 Mechanical test: The mechanical test consists of three different drop tests. Each specimen shall be subjected to the applicable drops as specified in 6.4.8.7 or 6.4.11.12. The order in which the specimen is subjected to the drops shall be such that, on completion of the mechanical test, the specimen shall have suffered such damage as will lead to the maximum damage in the thermal test which follows.

(a) For drop I, the specimen shall drop onto the target so as to suffer the maximum damage, and the height of the drop measured from the lowest point of the specimen to the upper surface of the target shall be 9 m. The target shall be as defined in 6.4.14;

(b) For drop II, the specimen shall drop so as to suffer the maximum damage onto a bar rigidly mounted perpendicularly on the target. The height of the drop measured from the intended point of impact of the specimen to the upper surface of the bar shall be 1 m. The bar shall be of solid mild steel of circular section, (15.0 cm ± 0.5 cm) in diameter and 20 cm long unless a longer bar would cause greater damage, in which case a bar of sufficient length to cause maximum damage shall be used. The upper end of the bar shall be flat and horizontal with its edges rounded off to a radius of not more than 6 mm. The target on which the bar is mounted shall be as described in 6.4.14;

(c) For drop III, the specimen shall be subjected to a dynamic crush test by positioning the specimen on the target so as to suffer maximum damage by the drop of a 500 kg mass from 9 m onto the specimen. The mass shall consist of a solid mild steel plate 1 m by 1 m and shall fall in a horizontal attitude. The height of the drop shall be measured from the underside of the plate to the highest point of the specimen. The target on which the specimen rests shall be as defined in 6.4.14.

6.4.17.3 Thermal test: The specimen shall be in thermal equilibrium under conditions of an ambient temperature of 38 °C, subject to the solar insolation conditions specified in Table 6.4.8.5 and subject to the design maximum rate of internal heat generation within the package from the radioactive contents. Alternatively, any of these parameters are allowed to have different values prior to and during the test, providing due account is taken of them in the subsequent assessment of package response.

The thermal test shall then consist of:

(a) Exposure of a specimen for a period of 30 minutes to a thermal environment which provides a heat flux at least equivalent to that of a hydrocarbon fuel/air fire in sufficiently quiescent ambient conditions to give a minimum average flame emissivity coefficient of 0.9 and an average temperature of at least 800 °C, fully engulfing the specimen, with a surface absorptivity coefficient of 0.8 or that value which the package may be demonstrated to possess if exposed to the fire specified, followed by,

(b) Exposure of the specimen to an ambient temperature of 38 °C, subject to the solar insolation conditions specified in Table 6.4.8.5 and subject to the design maximum rate of internal heat generation within the package by the radioactive contents for a sufficient period to ensure that temperatures in the specimen are everywhere decreasing and/or are approaching initial steady state conditions. Alternatively, any of these parameters are allowed to have different values following cessation of heating, providing due account is taken of them in the subsequent assessment of package response.

During and following the test the specimen shall not be artificially cooled and any combustion of materials of the specimen shall be permitted to proceed naturally.

6.4.17.4 Water immersion test: The specimen shall be immersed under a head of water of at least 15 m for a period of not less than eight hours in the attitude which will lead to maximum damage. For demonstration purposes, an external gauge pressure of at least 150 kPa shall be considered to meet these conditions.

6.4.18 Enhanced water immersion test for Type B(U) and Type B(M) packages containing more than 10^5 A_2

Enhanced water immersion test: The specimen shall be immersed under a head of water of at least 200 m for a period of not less than one hour. For demonstration purposes, an external gauge pressure of at least 2 MPa shall be considered to meet these conditions.

6.4.19 Water leakage test for package containing fissile material

6.4.19.1 Packages for which water in-leakage or out-leakage to the extent which results in greatest reactivity has been assumed for purposes of assessment under 6.4.11.7 to 6.4.11.12 shall be excepted from the test.

6.4.19.2 Before the specimen is subjected to the water leakage test specified below, it shall be subjected to the tests in 6.4.17.2 (b), and either 6.4.17.2 (a) or (c) as required by 6.4.11.12, and the test specified in 6.4.17.3.

6.4.19.3 The specimen shall be immersed under a head of water of at least 0.9 m for a period of not less than 8 hours and in the attitude for which maximum leakage is expected.

6.4.20 *(Reserved)*

6.4.21 Inspections for packagings designed to contain 0.1 kg or more of uranium hexafluoride

6.4.21.1 Every manufactured packaging and its service and structural equipment shall, either jointly or separately, undergo an inspection initially before being put into service and periodically thereafter. These inspections shall be performed and certified by agreement with the competent authority.

6.4.21.2 The initial inspection shall consist of a check of the design characteristics, a structural test, a leakproofness test, a water capacity test and a check of satisfactory operation of the service equipment.

6.4.21.3 The periodic inspections shall consist of a visual examination, a structural test, a leakproofness test and a check of satisfactory operation of the service equipment. The maximum intervals for periodic inspections shall be five years. Packagings which have not been inspected within this five-year period shall be examined before carriage in accordance with a programme approved by the competent authority . They shall not be refilled before completion of the full programme for periodic inspections.

6.4.21.4 The check of design characteristics shall demonstrate compliance with the design type specifications and the manufacturing programme.

6.4.21.5 For the initial structural test, packagings designed to contain 0.1 kg or more of uranium hexaflouride shall be tested hydraulically at an internal pressure of at least 1.38 MPa but, when the test pressure is less than 2.76 MPa, the design shall require multilateral approval. For retesting packagings, any other equivalent non-destructive testing may be applied subject to multilateral approval.

6.4.21.6 The leakproofness test shall be performed in accordance with a procedure which is capable of indicating leakages in the containment system with a sensitivity of 0.1 Pa.l/s (10^{-6} bar.l/s).

6.4.21.7 The water capacity of the packagings shall be established with an accuracy of ± 0.25% at a reference temperature of 15 °C. The volume shall be stated on the plate described in 6.4.21.8.

6.4.21.8 A plate made of non-corroding metal shall be durably attached to every packaging in a readily accessible place. The method of attaching the plate must not impair the strength of the packaging. The following particulars, at least, shall be marked on the plate by stamping or by any other equivalent method:

- Approval number;
- Manufacturer's serial number;
- Maximum working pressure (gauge pressure);
- Test pressure (gauge pressure);
- Contents: uranium hexafluoride;
- Capacity in litres;
- Maximum permissible filling mass of uranium hexafluoride;
- Tare mass;
- Date (month, year) of the initial test and the most recent periodic test;
- Stamp of the expert who performed the tests.

6.4.22 Approvals of package designs and materials

6.4.22.1 The approval of designs for packages containing 0.1 kg or more of uranium hexafluoride requires that:

(a) Each design that meets the requirements of 6.4.6.4 shall require multilateral approval;

(b) After 31 December 2003, each design that meets the requirements of 6.4.6.1 to 6.4.6.3 shall require unilateral approval by the competent authority of the country of origin of the design.

6.4.22.2 Each Type B(U) and Type C package design shall require unilateral approval, except that:

(a) A package design for fissile material, which is also subject to 6.4.22.4, 6.4.23.7, and 5.1.5.3.1 shall require multilateral approval; and

(b) A Type B(U) package design for low dispersible radioactive material shall require multilateral approval.

6.4.22.3 Each Type B(M) package design, including those for fissile material which are also subject to the requirements of 6.4.22.4, 6.4.23.7, and 5.1.5.3.1 and those for low dispersible radioactive material, shall require multilateral approval.

6.4.22.4 Each package design for fissile material which is not excepted according to 6.4.11.2 from the requirements that apply specifically to packages containing fissile material shall require multilateral approval.

6.4.22.5 The design for special form radioactive material shall require unilateral approval. The design for low dispersible radioactive material shall require multilateral approval (see also 6.4.23.8).

6.4.22.6 Any design that requires unilateral approval originating in a country Contracting Party to ADR shall be approved by the competent authority of this country; if the country where the package has been designed is not a Contracting Party to ADR, carriage is possible on condition that:

(a) a certificate has been supplied by this country, proving that the package satisfies the technical requirements of ADR, and that this certificate is countersigned by the competent authority of the first country Contracting Party to ADR reached by the consignment;

(b) if no certificate and no existing package design approval by a country Contracting Party to ADR has been supplied, the package design is approved by the competent authority of the first country Contracting Party to ADR reached by the consignment.

6.4.22.7 For designs approved under the transitional measures see 1.6.5.

6.4.23 Applications and approvals for radioactive material carriage

6.4.23.1 *(Reserved)*

6.4.23.2 An application for shipment approval shall include:

(a) The period of time, related to the shipment, for which the approval is sought;

(b) The actual radioactive contents, the expected modes of carriage, the type of vehicle, and the probable or proposed route; and

(c) The details of how the precautions and administrative or operational controls, referred to in the package design approval certificates issued under 5.1.5.3.1, are to be put into effect.

6.4.23.3 An application for approval of shipments under special arrangement shall include all the information necessary to satisfy the competent authority that the overall level of safety in carriage is at least equivalent to that which would be provided if all the applicable requirements of ADR had been met.

The application shall also include:

(a) A statement of the respects in which, and of the reasons why, the consignment cannot be made in full accordance with the applicable requirements of ADR; and

(b) A statement of any special precautions or special administrative or operational controls which are to be employed during carriage to compensate for the failure to meet the applicable requirements of ADR.

6.4.23.4 An application for approval of Type B(U) or Type C package design shall include:

(a) A detailed description of the proposed radioactive contents with reference to their physical and chemical states and the nature of the radiation emitted;

(b) A detailed statement of the design, including complete engineering drawings and schedules of materials and methods of manufacture;

(c) A statement of the tests which have been done and their results, or evidence based on calculative methods or other evidence that the design is adequate to meet the applicable requirements;

(d) The proposed operating and maintenance instructions for the use of the packaging;

(e) If the package is designed to have a maximum normal operating pressure in excess of 100 kPa gauge, a specification of the materials of manufacture of the containment system, the samples to be taken, and the tests to be made;

(f) Where the proposed radioactive contents are irradiated fuel, a statement and a justification of any assumption in the safety analysis relating to the characteristics of the fuel and a description of any pre-shipment measurement as required by 6.4.11.4 (b);

(g) Any special stowage provisions necessary to ensure the safe dissipation of heat from the package considering the various modes of carriage to be used and type of vehicle or container;

(h) A reproducible illustration, not larger than 21 cm by 30 cm, showing the make-up of the package; and

(i) A specification of the applicable quality assurance programme as required by 1.7.3.

6.4.23.5 An application for approval of a Type B(M) package design shall include, in addition to the general information required for package approval in 6.4.23.4 for Type B(U) packages:

(a) A list of the requirements specified in 6.4.7.5, 6.4.8.4, 6.4.8.5 and 6.4.8.8 to 6.4.8.15 with which the package does not conform;

(b) Any proposed supplementary operational controls to be applied during carriage not regularly provided for in this Annex, but which are necessary to ensure the safety of the package or to compensate for the deficiencies listed in (a) above;

(c) A statement relative to any restrictions on the mode of carriage and to any special loading, carriage, unloading or handling procedures; and

(d) The range of ambient conditions (temperature, solar radiation) which are expected to be encountered during carriage and which have been taken into account in the design.

6.4.23.6 The application for approval of designs for packages containing 0.1 kg or more of uranium hexafluoride shall include all information necessary to satisfy the competent authority that the design meets the applicable requirements of 6.4.6.1, and a description of the applicable quality assurance programme as required in 1.7.3.

6.4.23.7 An application for a fissile package approval shall include all information necessary to satisfy the competent authority that the design meets the applicable requirements of 6.4.11.1, and a specification of the applicable quality assurance programme as required by 1.7.3.

6.4.23.8 An application for approval of design for special form radioactive material and design for low dispersible radioactive material shall include:

(a) A detailed description of the radioactive material or, if a capsule, the contents; particular reference shall be made to both physical and chemical states;

(b) A detailed statement of the design of any capsule to be used;

(c) A statement of the tests which have been done and their results, or evidence based on calculative methods to show that the radioactive material is capable of meeting the performance standards, or other evidence that the special form radioactive material or low dispersible radioactive material meets the applicable requirements of ADR;

(d) A specification of the applicable quality assurance programme as required in 1.7.3; and

(e) Any proposed pre-shipment actions for use in the consignment of special form radioactive material or low dispersible radioactive material.

6.4.23.9 Each approval certificate issued by a competent authority shall be assigned an identification mark. The identification mark shall be of the following generalized type:

VRI/Number/Type Code

(a) Except as provided in 6.4.23.10 (b), VRI represents the international vehicle registration identification code of the country issuing the certificate [2];

(b) The number shall be assigned by the competent authority, and shall be unique and specific with regard to the particular design or shipment. The shipment approval identification mark shall be clearly related to the design approval identification mark;

(c) The following type codes shall be used in the order listed to indicate the types of approval certificates issued:

AF	Type A package design for fissile material
B(U)	Type B(U) package design [B(U) F if for fissile material]
B(M)	Type B(M) package design [B(M) F if for fissile material]
C	Type C package design (CF if for fissile material)
IF	Industrial package design for fissile material
S	Special form radioactive material
LD	Low dispersible radioactive material
T	Shipment
X	Special arrangement

In the case of package designs for non-fissile or fissile excepted uranium hexafluoride, where none of the above codes apply, then the following type codes shall be used:

H(U)	Unilateral approval
H(M)	Multilateral approval;

(d) For package design and special form radioactive material approval certificates, other than those issued under transitional packaging the provisions of 1.6.5.2 to 1.6.5.4, and for low dispersible radioactive material approval certificates, the symbols "-96" shall be added to the type code.

6.4.23.10 These type codes shall be applied as follows:

(a) Each certificate and each package shall bear the appropriate identification mark, comprising the symbols prescribed in 6.4.23.9 (a), (b), (c) and (d) above, except that, for packages, only the applicable design type codes including, if applicable, the symbols "-96", shall appear following the second stroke, that is, the "T" or "X" shall not appear in the identification marking on the package. Where the design approval and shipment approval are combined, the applicable type codes do not need to be repeated. For example:

[2] *See Vienna Convention on Road Traffic (1968).*

A/132/B(M)F-96: A Type B(M) package design approved for fissile material, requiring multilateral approval, for which the competent authority of Austria has assigned the design number 132 (to be marked on both the package and on the package design approval certificate);

A/132/B(M)F-96T: The shipment approval issued for a package bearing the identification mark elaborated above (to be marked on the certificate only);

A/137/X: A special arrangement approval issued by the competent authority of Austria, to which the number 137 has been assigned (to be marked on the certificate only);

A/139/IF-96: An industrial package design for fissile materia l approved by the competent authority of Austria, to which package design number 139 has been assigned (to be marked on both the package and on the package design approval certificate); and

A/145/H(U)-96: A package design for fissile excepted uranium hexafluoride approved by the competent authority of Austria, to which package design number 145 has been assigned (to be marked on both the package and on the package design approval certificate);

(b) Where multilateral approval is effected by validation according to 6.4.23.16, only the identification mark issued by the country of origin of the design or shipment shall be used. Where multilateral approval is effected by issue of certificates by successive countries, each certificate shall bear the appropriate identification mark and the package whose design was so approved shall bear all appropriate identification marks.

For example:

A/132/B(M)F-96
CH/28/B(M)F-96

would be the identification mark of a package which was originally approved by Austria and was subsequently approved, by separate certificate, by Switzerland. Additional identification marks would be tabulated in a similar manner on the package;

(c) The revision of a certificate shall be indicated by a parenthetical expression following the identification mark on the certificate. For example, A/132/B(M)F-96 (Rev.2) would indicate revision 2 of the Austrian package design approval certificate; or A/132/B(M)F-96 (Rev.0) would indicate the original issuance of the Austrian package design approval certificate. For original issuances, the parenthetical entry is optional and other words such as "original issuance" may also be used in place of "Rev.0". Certificate revision numbers may only be issued by the country issuing the original approval certificate;

(d) Additional symbols (as may be necessitated by national regulations) may be added in brackets to the end of the identification mark; for example, A/132/B(M)F-96(SP503);

(e) It is not necessary to alter the identification mark on the packaging each time that a revision to the design certificate is made. Such re-marking shall be required only in those cases where the revision to the package design certificate involves a change in the letter type codes for the package design following the second stroke.

6.4.23.11 Each approval certificate issued by a competent authority for special form radioactive material or low dispersible radioactive material shall include the following information:

(a) Type of certificate;

(b) The competent authority identification mark;

(c) The issue date and an expiry date;

(d) List of applicable national and international regulations, including the edition of the IAEA Regulations for the Safe Transport of Radioactive Material under which the special form radioactive material or low dispersible radioactive material is approved;

(e) The identification of the special form radioactive material or low dispersible radioactive material;

(f) A description of the special form radioactive material or low dispersible radioactive material;

(g) Design specifications for the special form radioactive material or low dispersible radioactive material which may include references to drawings;

(h) A specification of the radioactive contents which includes the activities involved and which may include the physical and chemical form;

(i) A specification of the applicable quality assurance programme as required in 1.7.3;

(j) Reference to information provided by the applicant relating to specific actions to be taken prior to shipment;

(k) If deemed appropriate by the competent authority, reference to the identity of the applicant;

(l) Signature and identification of the certifying official.

6.4.23.12 Each approval certificate issued by a competent authority for a special arrangement shall include the following information:

(a) Type of certificate;

(b) The competent authority identification mark;

(c) The issue date and an expiry date;

(d) Mode(s) of carriage;

(e) Any restrictions on the modes of carriage, type of vehicle, container, and any necessary routing instructions;

(f) List of applicable national and international regulations, including the edition of the IAEA Regulations for the Safe Transport of Radioactive Material under which the special arrangement is approved;

(g) The following statement:

"This certificate does not relieve the consignor from compliance with any requirement of the government of any country through or into which the package will be carried.";

(h) References to certificates for alternative radioactive contents, other competent authority validation, or additional technical data or information, as deemed appropriate by the competent authority;

(i) Description of the packaging by a reference to the drawings or a specification of the design. If deemed appropriate by the competent authority, a reproducible illustration, not larger than 21 cm by 30 cm, showing the make-up of the package shall also be provided, accompanied by a brief description of the packaging, including materials of manufacture, gross mass, general outside dimensions and appearance;

(j) A specification of the authorized radioactive contents, including any restrictions on the radioactive contents which might not be obvious from the nature of the packaging. This shall include the physical and chemical forms, the activities involved (including those of the various isotopes, if appropriate), amounts in grams (for fissile material), and whether special form radioactive material or low dispersible radioactive material, if applicable;

(k) Additionally, for packages containing fissile material:

(i) a detailed description of the authorized radioactive contents;

(ii) the value of the criticality safety index;

(iii) reference to the documentation that demonstrates the criticality safety of the contents;

(iv) any special features, on the basis of which the absence of water from certain void spaces has been assumed in the criticality assessment;

(v) any allowance (based on 6.4.11.4 (b)) for a change in neutron multiplication assumed in the criticality assessment as a result of actual irradiation experience; and

(vi) the ambient temperature range for which the special arrangement has been approved;

(l) A detailed listing of any supplementary operational controls required for preparation, loading, carriage, unloading and handling of the consignment, including any special stowage provisions for the safe dissipation of heat;

(m) If deemed appropriate by the competent authority, reasons for the special arrangement;

(n) Description of the compensatory measures to be applied as a result of the shipment being under special arrangement;

(o) Reference to information provided by the applicant relating to the use of the packaging or specific actions to be taken prior to the shipment;

(p) A statement regarding the ambient conditions assumed for purposes of design if these are not in accordance with those specified in 6.4.8.4, 6.4.8.5, and 6.4.8.15, as applicable;

(q) Any emergency arrangements deemed necessary by the competent authority;

(r) A specification of the applicable quality assurance programme as required in 1.7.3;

(s) If deemed appropriate by the competent authority, reference to the identity of the applicant and to the identity of the carrier;

(t) Signature and identification of the certifying official.

6.4.23.13 Each approval certificate for a shipment issued by a competent authority shall include the following information:

(a) Type of certificate;

(b) The competent authority identification mark(s);

(c) The issue date and an expiry date;

(d) List of applicable national and international regulations, including the edition of the IAEA Regulations for the Safe Transport of Radioactive Material under which the shipment is approved;

(e) Any restrictions on the modes of carriage, type of vehicle, container, and any necessary routeing instructions;

(f) The following statement:

"This certificate does not relieve the consignor from compliance with any requirement of the government of any country through or into which the package will be carried.";

(g) A detailed listing of any supplementary operational controls required for preparation, loading, carriage, unloading and handling of the consignment, including any special stowage provisions for the safe dissipation of heat or maintenance of criticality safety;

(h) Reference to information provided by the applicant relating to specific actions to be taken prior to shipment;

(i) Reference to the applicable design approval certificate(s);

(j) A specification of the actual radioactive contents, including any restrictions on the radioactive contents which might not be obvious from the nature of the packaging. This shall include the physical and chemical forms, the total activities involved (including those of the various isotopes, if appropriate), amounts in grams (for fissile material), and whether special form radioactive material or low dispersible radioactive material, if applicable;

(k) Any emergency arrangements deemed necessary by the competent authority;

(l) A specification of the applicable quality assurance programme as required in 1.7.3;

(m) If deemed appropriate by the competent authority, reference to the identity of the applicant;

(n) Signature and identification of the certifying official.

6.4.23.14 Each approval certificate of the design of a package issued by a competent authority shall include the following information:

(a) Type of certificate;

(b) The competent authority identification mark;

(c) The issue date and an expiry date;

(d) Any restriction on the modes of carriage, if appropriate;

(e) List of applicable national and international regulations, including the edition of the IAEA Regulations for the Safe Transport of Radioactive Material under which the design is approved;

(f) The following statement;

"This certificate does not relieve the consignor from compliance with any requirement of the government of any country through or into which the package will be carried.";

(g) References to certificates for alternative radioactive contents, other competent authority validation, or additional technical data or information, as deemed appropriate by the competent authority;

(h) A statement authorizing shipment where shipment approval is required under 5.1.5.2.2, if deemed appropriate;

(i) Identification of the packaging;

(j) Description of the packaging by a reference to the drawings or specification of the design. If deemed appropriate by the competent authority, a reproducible illustration, not larger than 21 cm by 30 cm, showing the make-up of the package should also be provided, accompanied by a brief description of the packaging, including materials of manufacture, gross mass, general outside dimensions and appearance;

(k) Specification of the design by reference to the drawings;

(l) A specification of the authorized radioactive content, including any restrictions on the radioactive contents which might not be obvious from the nature of the packaging. This shall include the physical and chemical forms, the activities involved (including those of the various isotopes, if appropriate), amounts in grams (for fissile material), and whether special form radioactive material or low dispersible radioactive material, if applicable;

(m) Additionally, for packages containing fissile material:

(i) a detailed description of the authorized radioactive contents;

(ii) the value of the criticality safety index;

(iii) reference to the documentation that demonstrates the criticality safety of the contents;

(iv) any special features, on the basis of which the absence of water from certain void spaces has been assumed in the criticality assessment;

(v) any allowance (based on 6.4.11.4 (b)) for a change in neutron multiplication assumed in the criticality assessment as a result of actual irradiation experience; and

(vi) the ambient temperature range for which the package design has been approved;

(n) For Type B(M) packages, a statement specifying those requirements of 6.4.7.5, 6.4.8.4, 6.4.8.5 and 6.4.8.8 to 6.4.8.15 with which the package does not conform and any amplifying information which may be useful to other competent authorities;

(o) A detailed listing of any supplementary operational controls required for preparation, loading, carriage, unloading and handling of the consignment, including any special stowage provisions for the safe dissipation of heat;

(p) Reference to information provided by the applicant relating to the use of the packaging or specific actions to be taken prior to shipment;

(q) A statement regarding the ambient conditions assumed for purposes of design if these are not in accordance with those specified in 6.4.8.4, 6.4.8.5 and 6.4.8.15, as applicable;

(r) A specification of the applicable quality assurance programme as required in 1.7.3;

(s) Any emergency arrangements deemed necessary by the competent authority;

(t) If deemed appropriate by the competent authority, reference to the identity of the applicant;

(u) Signature and identification of the certifying official.

6.4.23.15 The competent authority shall be informed of the serial number of each packaging manufactured to a design approved by them. The competent authority shall maintain a register of such serial numbers.

6.4.23.16 Multilateral approval may be by validation of the original certificate issued by the competent authority of the country of origin of the design or shipment. Such validation may take the form of an endorsement on the original certificate or the issuance of a separate endorsement, annex, supplement, etc., by the competent authority of the country through or into which the shipment is made.

CHAPTER 6.5

REQUIREMENTS FOR THE CONSTRUCTION AND TESTING OF INTERMEDIATE BULK CONTAINERS (IBCs)

6.5.1 General requirements applicable to all types of IBCs

6.5.1.1 *Scope*

6.5.1.1.1 The requirements of this Chapter apply to intermediate bulk containers (IBCs) the use of which is expressly authorized for the carriage of certain dangerous goods according to the packing instructions indicated in Column (8) of Table A in Chapter 3.2. Portable tanks and tank-containers which meet the requirements of Chapter 6.7 or 6.8 respectively are not considered to be IBCs. IBCs which meet the requirements of this Chapter are not considered to be containers for the purposes of ADR. The letters IBC only will be used in the rest of the text to refer to intermediate bulk containers.

6.5.1.1.2 Exceptionally, IBCs and their service equipment not conforming strictly to the requirements herein, but having acceptable alternatives, may be considered by the competent authority for approval. In addition, in order to take into account progress in science and technology, the use of alternative arrangements which offer at least equivalent safety in use in respect of compatibility with the properties of the substances carried and equivalent or superior resistance to impact, loading and fire, may be considered by the competent authority.

6.5.1.1.3 The construction, equipment, testing, marking and operation of IBCs shall be subject to acceptance by the competent authority of the country in which the IBCs are approved.

6.5.1.2 *(Reserved)*

6.5.1.3 *(Reserved)*

6.5.1.4 *Designatory code system for IBCs*

6.5.1.4.1 The code shall consist of two Arabic numerals as specified in (a), followed by a capital letter(s) specified in (b), followed, when specified in an individual section, by an Arabic numeral indicating the category of IBC.

(a)

Type	**For solids, loaded or discharged**		**For liquids**
	by gravity	**under pressure of more than 10 kPa (0.1 bar)**	
Rigid	11	21	31
Flexible	13	-	-

(b) Materials

A. Steel (all types and surface treatments)
B. Aluminium
C. Natural wood
D. Plywood
F. Reconstituted wood
G. Fibreboard
H. Plastics material
L. Textile
M. Paper, multiwall
N. Metal (other than steel or aluminium).

6.5.1.4.2 For composite IBCs, two capital letters in Latin characters shall be used in sequence in the second position of the code. The first shall indicate the material of the inner receptacle of the IBC and the second that of the outer packaging of the IBC.

6.5.1.4.3 The following types and codes of IBC are assigned:

Material	Category	Code	Sub-section
Metal			
A. Steel	for solids, loaded or discharged by gravity	11A	
	for solids, loaded or discharged under pressure	21A	
	for liquids	31A	
B. Aluminium	for solids, loaded or discharged by gravity	11B	6.5.3.1
	for solids, loaded or discharged under pressure	21B	
	for liquids	31B	
N. Other than steel or aluminium	for solids, loaded or discharged by gravity	11N	
	for solids, loaded or discharged under pressure	21N	
	for liquids	31N	
Flexible			
H. Plastics	woven plastics without coating or liner	13H1	
	woven plastics, coated	13H2	
	woven plastics with liner	13H3	
	woven plastics, coated and with liner	13H4	
	plastics film	13H5	
L. Textile	without coating or liner	13L1	6.5.3.2
	coated	13L2	
	with liner	13L3	
	coated and with liner	13L4	
M. Paper	multiwall	13M1	
	multiwall, water resistant	13M2	
H. Rigid plastics	for solids, loaded or discharged by gravity, fitted with structural equipment	11H1	
	for solids, loaded or discharged by gravity, freestanding	11H2	
	for solids, loaded or discharged under pressure, fitted with structural equipment	21H1	6.5.3.3
	for solids, loaded or discharged under pressure, freestanding	21H2	
	for liquids, fitted with structural equipment	31H1	
	for liquids, freestanding	31H2	
HZ. Composite with plastics inner receptacle [a]	for solids, loaded or discharged by gravity, with rigid plastics receptacle	11HZ1	
	for solids, loaded or discharged by gravity, with flexible plastics receptacle	11HZ2	
	for solids, loaded or discharged under pressure, with rigid plastics receptacle	21HZ1	6.5.3.4
	for solids, loaded or discharged under pressure, with flexible plastics receptacle	21HZ2	
	for liquids, with rigid plastics receptacle	31HZ1	
	for liquids, with flexible plastics receptacle	31HZ2	
G. Fibreboard	for solids, loaded or discharged by gravity	11G	6.5.3.5

Material	Category	Code	Sub-section
Wooden			
C. Natural wood	for solids, loaded or discharged by gravity with inner liner	11C	6.5.3.6
D. Plywood	for solids, loaded or discharged by gravity, with inner liner	11D	
F. Reconstituted wood	for solids, loaded or discharged by gravity, with inner liner	11F	

[a] *The code shall be completed by replacing the letter Z by a capital letter in accordance with 6.5.1.4.1 (b) to indicate the nature of the material used for the outer casing.*

6.5.1.4.4 The letter "W" may follow the IBC code. The letter "W" signifies that the IBC, although of the same type indicated by the code, is manufactured to a specification different from those in 6.5.3 and is considered equivalent in accordance with the requirements in 6.5.1.1.2.

6.5.1.5 ***Construction requirements***

6.5.1.5.1 IBCs shall be resistant to or adequately protected from deterioration due to the external environment.

6.5.1.5.2 IBCs shall be so constructed and closed that none of the contents can escape under normal conditions of carriage including the effect of vibration, or by changes in temperature, humidity or pressure.

6.5.1.5.3 IBCs and their closures shall be constructed of materials compatible with their contents, or be protected internally, so that they are not liable:

(a) To be attacked by the contents so as to make their use dangerous;

(b) To cause the contents to react or decompose, or form harmful or dangerous compounds with the IBCs.

6.5.1.5.4 Gaskets, where used, shall be made of materials not subject to attack by the contents of the IBCs.

6.5.1.5.5 All service equipment shall be so positioned or protected as to minimize the risk of escape of the contents owing to damage during handling and carriage.

6.5.1.5.6 IBCs, their attachments and their service and structural equipment shall be designed to withstand, without loss of contents, the internal pressure of the contents and the stresses of normal handling and carriage. IBCs intended for stacking shall be designed for stacking. Any lifting or securing features of IBCs shall be of sufficient strength to withstand the normal conditions of handling and carriage without gross distortion or failure and shall be so positioned that no undue stress is caused in any part of the IBC.

6.5.1.5.7 Where an IBC consists of a body within a framework it shall be so constructed that:

(a) The body does not chafe or rub against the framework so as to cause material damage to the body;

(b) The body is retained within the framework at all times;

(c) The items of equipment are fixed in such a way that they cannot be damaged if the connections between body and frame allow relative expansion or movement.

6.5.1.5.8 Where a bottom discharge valve is fitted, it shall be capable of being made secure in the closed position and the whole discharge system shall be suitably protected from damage. Valves having lever closures shall be able to be secured against accidental opening and the open or closed position shall be readily apparent. For IBCs containing liquids, a secondary means of sealing the discharge aperture shall also be provided, e.g. a blank flange or equivalent device.

6.5.1.5.9 Each IBC shall be capable of passing the relevant performance tests.

6.5.1.6 ***Testing, certification and inspection***

6.5.1.6.1 *Quality assurance*: the IBCs shall be manufactured and tested under a quality assurance programme which satisfies the competent authority, in order to ensure that each manufactured IBC meets the requirements of this Chapter.

6.5.1.6.2 *Test requirements:* IBCs shall be subject to design type tests and, if applicable, to initial and periodic tests in accordance with 6.5.4.14.

6.5.1.6.3 *Certification*: in respect of each design type of IBC a certificate and mark (as in 6.5.2) shall be issued attesting that the design type, including its equipment, meets the test requirements.

6.5.1.6.4 *Inspection*: every metal, rigid plastics and composite IBC shall be inspected to the satisfaction of the competent authority

(a) before it is put into service, and thereafter at intervals not exceeding five years, with regard to:

(i) conformity to design type including marking;

(ii) internal and external condition;

(iii) proper functioning of service equipment.

Thermal insulation, if any, need be removed only to the extent necessary for a proper examination of the body of the IBC.

(b) at intervals of not more than two and a half years, with regard to:

(i) external condition;

(ii) proper functioning of service equipment.

Thermal insulation, if any, need be removed only to the extent necessary for a proper examination of the body of the IBC.

A report of each inspection shall be kept by the owner at least until the date of the next inspection.

6.5.1.6.5 When the structure of an IBC is impaired as a result of impact, (e.g. accident) or any other cause, it shall be repaired and then subjected to the full testing and inspection as set out in 6.5.4.14.3 and 6.5.1.6.4 (a).

6.5.1.6.6 The competent authority may at any time require proof, by tests in accordance with this Chapter, that IBCs meet the requirements of the design type tests.

6.5.2 Marking

6.5.2.1 ***Primary marking***

6.5.2.1.1 Each IBC manufactured and intended for use according to ADR shall bear markings which are durable, legible and placed in a location so as to be readily visible. Letters, numerals and symbols shall be at least 12 mm high and shall show:

(a) The United Nations packaging symbol:

For metal IBCs on which the marking is stamped or embossed, the capital letters "UN" may be applied instead of the symbol;

(b) The code designating the type of IBC according to 6.5.1.4;

(c) A capital letter designating the packing group(s) for which the design type has been approved:

(i) X for packing groups I, II and III (IBCs for solids only);

(ii) Y for packing groups II and III;

(iii) Z for packing group III only;

(d) The month and year (last two digits) of manufacture;

(e) The State authorizing the allocation of the mark; indicated by the distinguishing sign for motor vehicles in international traffic [1];

(f) The name or symbol of the manufacturer and other identification of the IBC as specified by the competent authority;

(g) The stacking test load in kg. For IBCs not designed for stacking, the figure "0" shall be shown;

(h) The maximum permissible gross mass or, for flexible IBCs, the maximum permissible load, in kg.

The primary marking required above shall be applied in the sequence of the subparagraphs below. The marking required by 6.5.2.2 and any further marking authorized by a competent authority shall still enable the parts of the mark to be correctly identified.

[1] *Distinguishing sign for motor vehicles in international traffic prescribed in Vienna Convention on Road Traffic (1968).*

Examples of markings for various types of IBC in accordance with (a) to (h) above:

11A/Y/02 89
NL/Mulder 007
5500/1500

For a metal IBC for solids discharged for instance by gravity and made from steel/for packing groups II and III/ manufactured in February 1989/authorized by the Netherlands/manufactured by Mulder and of a design type to which the competent authority has allocated serial number 007/the stacking test load in kg/the maximum permissible gross mass in kg.

13H3/Z/03 89
F/Meunier 1713
0/1500

For a flexible IBC for solids discharged for instance by gravity and made from woven plastics with a liner/not designed to be stacked.

31H1/Y/04 89
GB/9099
10800/1200

For a rigid plastics IBC for liquids made from plastics with structural equipment withstanding the stack load.

31HA1/Y/05 91
D/Muller 1683
10800/1200

For a composite IBC for liquids with a rigid plastics inner receptacle and a steel outer casing.

11C/X/01 93
S/Aurigny 9876
3000/910

For a wooden IBC for solids with an inner liner authorized for packing group I solids.

6.5.2.2 ***Additional marking***

6.5.2.2.1 Each IBC shall bear the markings required in 6.5.2.1 and, in addition, the following information which may appear on a corrosion-resistant plate permanently attached in a place readily accessible for inspection:

Additional marking	**Category of IBC**				
	Metal	**Rigid plastics**	**Composite**	**Fibreboard**	**Wooden**
Capacity in litres [a] at 20 °C	X	X	X		
Tare mass in kg [a]	X	X	X	X	X
Test (gauge) pressure, in kPa or bar [a], if applicable		X	X		
Maximum loading / discharge pressure in kPa or bar [a] , if applicable	X	X	X		
Body material and its minimum thickness in mm	X				
Date of last leakproofness test, if applicable (month and year)	X	X	X		
Date of last inspection (month and year)	X	X	X		
Serial number of the manufacturer	X				

[a] *The unit used shall be indicated.*

6.5.2.2.2 In addition to the markings required in 6.5.2.1, flexible IBCs may bear a pictogram indicating recommended lifting methods.

6.5.2.2.3 The inner receptacle of composite IBCs shall be marked with at least the following information:

(a) The name or symbol of the manufacturer and other identification of the IBC as specified by the competent authority as in 6.5.2.1.1 (f);

(b) The date of manufacture, as in 6.5.2.1.1 (d);

(c) The distinguishing sign of the State authorizing the allocation of the mark, as in 6.5.2.1.1 (e).

6.5.2.2.4 Where a composite IBCs is designed in such a manner that the outer casing is intended to be dismantled for carriage when empty (such as for return of the IBC for reuse to the original consignor), each of the parts intended to be detached when so dismantled shall be marked with the month and year of manufacture and the name or symbol of the manufacturer and other identification of the IBC as specified by the competent authority (see 6.5.2.1.1 (f)).

6.5.2.3 ***Conformity to design type***

The marking indicates that IBCs correspond to a successfully tested design type and that the requirements referred to in the certificate have been met.

6.5.3 Specific requirements for IBCs

6.5.3.1 ***Specific requirements for metal IBCs***

6.5.3.1.1 These requirements apply to metal IBCs intended for the carriage of solids and liquids. There are three categories of metal IBCs:

(a) those for solids which are loaded or discharged by gravity (11A, 11B, 11N);

(b) those for solids which are loaded or discharged at a gauge pressure greater than 10 kPa (0.1 bar) (21A, 21B, 21N); and

(c) those for liquids (31A, 31B, 31N).

6.5.3.1.2 Bodies shall be made of suitable ductile metal in which the weldability has been fully demonstrated. Welds shall be skilfully made and afford complete safety. Low-temperature performance of the material shall be taken into account when appropriate.

6.5.3.1.3 Care shall be taken to avoid damage by galvanic action due to the juxtaposition of dissimilar metals.

6.5.3.1.4 Aluminium IBCs intended for the carriage of flammable liquids shall have no movable parts, such as covers, closures, etc., made of unprotected steel liable to rust, which might cause a dangerous reaction by coming into frictional or percussive contact with the aluminium.

6.5.3.1.5 Metal IBCs shall be made of metals which meet the following requirements:

(a) for steel the elongation at fracture, in %, shall not be less than $\frac{10000}{Rm}$ with an absolute minimum of 20 %;

where Rm = guaranteed minimum tensile strength of the steel to be used, in N/mm^2;

(b) for aluminium and its alloy the elongation at fracture, in %, shall not be less than $\frac{10000}{6Rm}$ with an absolute minimum of 8 %.

Specimens used to determine the elongation at fracture shall be taken transversely to the direction of rolling and be so secured that:

$L_o = 5d$ or

$L_o = 5.65\sqrt{A}$

where: L_o = gauge length of the specimen before the test

d = diameter

A = cross-sectional area of test specimen.

6.5.3.1.6 *Minimum wall thickness:*

(a) for a reference steel having a product of Rm x A_o = 10 000, the wall thickness shall not be less than:

Capacity (C) in litres	**Wall thickness (T) in mm**			
	Types 11A, 11B, 11N		**Types 21A, 21B, 21N, 31A, 31B, 31N**	
	Unprotected	**Protected**	**Unprotected**	**Protected**
C = 1000	2.0	1.5	2.5	2.0
1000 < C < 2000	T = C/2000 + 1.5	T = C/2000 + 1.0	T = C/2000 + 2.0	T = C/2000 + 1.5
2000 < C < 3000	T = C/2000 + 1.5	T = C/2000 + 1.0	T = C/2000 + 1.0	T = C/2000 + 1.5

where: A_o = minimum elongation (as a percentage) of the reference steel to be used on fracture under tensile stress (see 6.5.3.1.5);

(b) for metals other than the reference steel described in (a), the minimum wall thickness is given by the following equivalence formula:

$$e_1 = \frac{21.4 \times e_0}{\sqrt[3]{Rm_1 \times A_1}}$$

where: e_1 = required equivalent wall thickness of the metal to be used (in mm);

e_0 = required minimum wall thickness for the reference steel (in mm);

Rm_1 = guaranteed minimum tensile strength of the metal to be used (in N/mm^2) (see (c));

A_1 = minimum elongation (as a percentage) of the metal to be used on fracture under tensile stress (see 6.5.3.1.5).

However, in no case shall the wall thickness be less than 1.5 mm.

(c) For purposes of the calculation described in (b), the guaranteed minimum tensile strength of the metal to be used (Rm_1) shall be the minimum value according to national or international material standards. However, for austenitic steels, the specified value for Rm according to the material standards may be increased by up to 15 % when a greater value is attested in the material inspection certificate. When no material standard exists for the material in question, the value of Rm shall be the minimum value attested in the material inspection certificate.

6.5.3.1.7 Pressure-relief requirements: IBCs for liquids shall be capable of releasing a sufficient amount of vapour in the event of fire engulfment to ensure that no rupture of the body will occur. This can be achieved by conventional pressure relief devices or by other constructional means. The start-to-discharge pressure shall not be higher than 65 kPa (0.65 bar) and no lower than the total gauge pressure experienced in the IBC (i.e. the vapour pressure of the filling substance plus the partial pressure of the air or other inert gases, minus 100 kPa (1 bar)) at 55 °C, determined on the basis of a maximum degree of filling as defined in 4.1.1.4. The required relief devices shall be fitted in the vapour space.

6.5.3.2 ***Specific requirements for flexible IBCs***

6.5.3.2.1 These requirements apply to flexible IBCs of the following types:

13H1	woven plastics without coating or liner
13H2	woven plastics, coated
13H3	woven plastics with liner
13H4	woven plastics, coated and with liner
13H5	plastics film
13L1	textile without coating or liner
13L2	textile, coated
13L3	textile with liner
13L4	textile, coated and with liner
13M1	paper, multiwall
13M2	paper, multiwall, water resistant

Flexible IBCs are intended for the carriage of solids only.

6.5.3.2.2 Bodies shall be manufactured from suitable materials. The strength of the material and the construction of the flexible IBC shall be appropriate to its capacity and its intended use.

6.5.3.2.3 All materials used in the construction of flexible IBCs of types 13M1 and 13M2 shall, after complete immersion in water for not less than 24 hours, retain at least 85 % of the tensile strength as measured originally on the material conditioned to equilibrium at 67 % relative humidity or less.

6.5.3.2.4 Seams shall be formed by stitching, heat sealing, gluing or any equivalent method. All stitched seam-ends shall be secured.

6.5.3.2.5 Flexible IBCs shall provide adequate resistance to ageing and to degradation caused by ultraviolet radiation or the climatic conditions, or by the substance contained, thereby rendering them appropriate to their intended use.

6.5.3.2.6 For flexible plastics IBCs where protection against ultraviolet radiation is required, it shall be provided by the addition of carbon black or other suitable pigments or inhibitors. These additives shall be compatible with the contents and remain effective throughout the life of the body. Where use is made of carbon black, pigments or inhibitors other than those used in the manufacture of the tested design type, re-testing may be waived if changes in the carbon

black content, the pigment content or the inhibitor content do not adversely affect the physical properties of the material of construction.

6.5.3.2.7 Additives may be incorporated into the material of the body to improve the resistance to ageing or to serve other purposes, provided that these do not adversely affect the physical or chemical properties of the material.

6.5.3.2.8 No material recovered from used receptacles shall be used in the manufacture of IBC bodies. Production residues or scrap from the same manufacturing process may, however, be used. Component parts such as fittings and pallet bases may also be used provided such components have not in any way been damaged in previous use.

6.5.3.2.9 When filled, the ratio of height to width shall be not more than 2:1.

6.5.3.2.10 The liner shall be made of a suitable material. The strength of the material used and the construction of the liner shall be appropriate to the capacity of the IBC and the intended use. Joins and closures shall be siftproof and capable of withstanding pressures and impacts liable to occur under normal conditions of handling and carriage.

6.5.3.3 ***Specific requirements for rigid plastics IBCs***

6.5.3.3.1 These requirements apply to rigid plastics IBCs for the carriage of solids or liquids. Rigid plastics IBCs are of the following types:

11H1	fitted with structural equipment designed to withstand the whole load when IBCs are stacked, for solids which are loaded or discharged by gravity
11H2	freestanding, for solids which are loaded or discharged by gravity
21H1	fitted with structural equipment designed to withstand the whole load when IBCs are stacked, for solids which are loaded or discharged under pressure
21H2	freestanding, for solids which are loaded or discharged under pressure
31H1	fitted with structural equipment designed to withstand the whole load when IBCs are stacked, for liquids
31H2	freestanding, for liquids.

6.5.3.3.2 The body shall be manufactured from suitable plastics material of known specifications and be of adequate strength in relation to its capacity and its intended use. The material shall be adequately resistant to ageing and to degradation caused by the substance contained or, where relevant, by ultraviolet radiation. Low temperature performance shall be taken into account when appropriate. Any permeation of the substance contained shall not constitute a danger under normal conditions of carriage.

6.5.3.3.3 Where protection against ultraviolet radiation is required, it shall be provided by the addition of carbon black or other suitable pigments or inhibitors. These additives shall be compatible with the contents and remain effective throughout the life of the body. Where use is made of carbon black, pigments or inhibitors other than those used in the manufacture of the tested design type, re-testing may be waived if changes in the carbon black content, the pigment content or the inhibitor content do not adversely affect the physical properties of the material of construction.

6.5.3.3.4 Additives may be incorporated in the material of the body to improve the resistance to ageing or to serve other purposes, provided that these do not adversely affect the physical or chemical properties of the material.

6.5.3.3.5 No used material other than production residues or regrind from the same manufacturing process may be used in the manufacture of rigid plastics IBCs.

6.5.3.3.6 A relief device shall be fitted to each IBC intended for the carriage of liquids, capable of releasing sufficient vapour to prevent the body of the IBC from rupturing if it is subjected to an internal pressure in excess of that for which it was hydraulically tested. This can be achieved by conventional relief devices or by other means of construction. The start-to-discharge pressure shall not be higher than the pressure used in the hydraulic pressure test.

6.5.3.4 ***Specific requirements for composite IBCs with plastics inner receptacles***

6.5.3.4.1 These requirements apply to composite IBCs for the carriage of solids and liquids of the following types:

11HZ1 Composite IBCs with a rigid plastics inner receptacle, for solids loaded or discharged by gravity
11HZ2 Composite IBCs with a flexible plastics inner receptacle, for solids loaded or discharged by gravity
21HZ1 Composite IBCs with a rigid plastics inner receptacle, for solids loaded or discharged under pressure
21HZ2 Composite IBCs with a flexible plastics inner receptacle, for solids loaded or discharged under pressure
31HZ1 Composite IBCs with a rigid plastics inner receptacle, for liquids
31HZ2 Composite IBCs with a flexible plastics inner receptacle, for liquids.

This code shall be completed by replacing the letter Z by a capital letter in accordance with 6.5.1.4.1 (b) to indicate the nature of the material used for the outer casing.

6.5.3.4.2 The inner receptacle is not intended to perform a containment function without its outer casing. A "rigid" inner receptacle is a receptacle which retains its general shape when empty without closures in place and without benefit of the outer casing. Any inner receptacle that is not "rigid" is considered to be "flexible".

6.5.3.4.3 The outer casing normally consists of rigid material formed so as to protect the inner receptacle from physical damage during handling and carriage but is not intended to perform the containment function. It includes the base pallet where appropriate.

6.5.3.4.4 A composite IBC with a fully enclosing outer casing shall be so designed that the integrity of the inner receptacle may be readily assessed following the leakproofness and hydraulic pressure tests.

6.5.3.4.5 IBCs of type 31HZ2 shall be limited to a capacity of not more than 1 250 litres.

6.5.3.4.6 The inner receptacle shall be manufactured from suitable plastics material of known specifications and be of adequate strength in relation to its capacity and its intended use. The material shall be adequately resistant to ageing and to degradation caused by the substance contained or, where relevant, by ultraviolet radiation. Low temperature performance shall be taken into account when appropriate. Any permeation of the substance contained shall not constitute a danger under normal conditions of carriage.

6.5.3.4.7 Where protection against ultraviolet radiation is required, it shall be provided by the addition of carbon black or other suitable pigments or inhibitors. These additives shall be compatible with the contents and remain effective throughout the life of the inner receptacle. Where use is made of carbon black, pigments or inhibitors, other than those used in the manufacture of the tested design type, retesting may be waived if changes in carbon black content, the pigment content or the inhibitor content do not adversely affect the physical properties of the material of construction.

6.5.3.4.8 Additives may be incorporated in the material of the inner receptacle to improve the resistance to ageing or to serve other purposes, provided that these do not adversely affect the physical or chemical properties of the material.

6.5.3.4.9 No used material other than production residues or regrind from the same manufacturing process may be used in the manufacture of inner receptacles.

6.5.3.4.10 A relief device shall be fitted to each IBC intended for the carriage of liquids, capable of releasing sufficient vapour to prevent the inner receptacle of the IBC from rupturing if it is subjected to an internal pressure in excess of that for which it was hydraulically tested. This can be achieved by conventional relief devices or by other means of construction.

6.5.3.4.11 The inner receptacle of IBCs type 31HZ2 shall consist of at least three plies of film.

6.5.3.4.12 The strength of the material and the construction of the outer casing shall be appropriate to the capacity of the composite IBC and its intended use.

6.5.3.4.13 The outer casing shall be free of any projection that might damage the inner receptacle.

6.5.3.4.14 Metal outer casings shall be constructed of a suitable metal of adequate thickness.

6.5.3.4.15 Outer casings of natural wood shall be of well seasoned wood, commercially dry and free from defects that would materially lessen the strength of any part of the casing. The tops and bottoms may be made of water resistant reconstituted wood such as hardboard, partic le board or other suitable type.

6.5.3.4.16 Outer casings of plywood shall be made of well seasoned rotary cut, sliced or sawn veneer, commercially dry and free from defects that would materially lessen the strength of the casing. All adjacent plies shall be glued with water resistant adhesive. Other suitable materials may be used with plywood for the construction of casings. Casings shall be firmly nailed or secured to corner posts or ends or be assembled by equally suitable devices.

6.5.3.4.17 The walls of outer casings of reconstituted wood shall be made of water resistant reconstituted wood such as hardboard, particle board or other suitable type. Other parts of the casings may be made of other suitable material.

6.5.3.4.18 For fibreboard outer casings, strong and good quality solid or double-faced corrugated fibreboard (single or multiwall) shall be used appropriate to the capacity of the casing and to its intended use. The water resistance of the outer surface shall be such that the increase in mass, as determined in a test carried out over 30 minutes by the Cobb method of determining water absorption, is not greater than 155 g/m^2 (see ISO 535:1991). It shall have proper bending qualities. Fibreboard shall be cut, creased without scoring, and slotted so as to permit assembly without cracking, surface breaks or undue bending. The fluting of corrugated fibreboard shall be firmly glued to the facings.

6.5.3.4.19 The ends of fibreboard outer casings may have a wooden frame or be entirely of wood. Reinforcements of wooden battens may be used.

6.5.3.4.20 Manufacturing joins in the fibreboard outer casing shall be taped, lapped and glued, or lapped and stitched with metal staples. Lapped joins shall have an appropriate overlap. Where closing is effected by gluing or taping, a water resistant adhesive shall be used.

6.5.3.4.21 Where the outer casing is of plastics material, the relevant requirements of 6.5.3.4.6 to 6.5.3.4.9 apply, on the understanding that, in this case, the requirements applicable to the inner receptacle are applicable to the outer casing of composite IBCs.

6.5.3.4.22 The outer casing of an IBC type 31HZ2 shall enclose the inner receptacle on all sides.

6.5.3.4.23 Any integral pallet base forming part of an IBC or any detachable pallet shall be suitable for mechanical handling with the IBC filled to its maximum permissible gross mass.

6.5.3.4.24 The pallet or integral base shall be designed so as to avoid any protrusion of the base of the IBC that might be liable to damage in handling.

6.5.3.4.25 The outer casing shall be secured to any detachable pallet to ensure stability in handling and carriage. Where a detachable pallet is used, its top surface shall be free from sharp protrusions that might damage the IBC.

6.5.3.4.26 Strengthening devices such as timber supports to increase stacking performance may be used but shall be external to the inner receptacle.

6.5.3.4.27 Where IBCs are intended for stacking, the bearing surface shall be such as to distribute the load in a safe manner. Such IBCs shall be designed so that the load is not supported by the inner receptacle.

6.5.3.5 ***Specific requirements for fibreboard IBCs***

6.5.3.5.1 These requirements apply to fibreboard IBCs for the carriage of solids which are loaded or discharged by gravity. Fibreboard IBCs are of the following type: 11G.

6.5.3.5.2 Fibreboard IBCs shall not incorporate top lifting devices.

6.5.3.5.3 The body shall be made of strong and good quality solid or double-faced corrugated fibreboard (single or multiwall), appropriate to the capacity of the IBC and to its intended use. The water resistance of the outer surface shall be such that the increase in mass, as determined in a test carried out over a period of 30 minutes by the Cobb method of determining water absorption, is not greater than 155 g/m^2 (see ISO 535:1991). It shall have proper bending qualities. Fibreboard shall be cut, creased without scoring, and slotted so as to permit assembly without cracking, surface breaks or undue bending. The fluting or corrugated fibreboard shall be firmly glued to the facings.

6.5.3.5.4 The walls, including top and bottom, shall have a minimum puncture resistance of 15 J measured according to ISO 3036:1975.

6.5.3.5.5 Manufacturing joins in the body of IBCs shall be made with an appropriate overlap and shall be taped, glued, stitched with metal staples or fastened by other means at least equally effective. Where joins are effected by gluing or taping, a water resistant adhesive shall be used. Metal staples shall pass completely through all pieces to be fastened and be formed or protected so that any inner liner cannot be abraded or punctured by them.

6.5.3.5.6 The liner shall be made of a suitable material. The strength of the material used and the construction of the liner shall be appropriate to the capacity of the IBC and the intended use. Joins and closures shall be siftproof and capable of withstanding pressures and impacts liable to occur under normal conditions of handling and carriage.

6.5.3.5.7 Any integral pallet base forming part of an IBC or any detachable pallet shall be suitable for mechanical handling with the IBC filled to its maximum permissible gross mass.

6.5.3.5.8 The pallet or integral base shall be designed so as to avoid any protrusion of the base of the IBC that might be liable to damage in handling.

6.5.3.5.9 The body shall be secured to any detachable pallet to ensure stability in handling and carriage. Where a detachable pallet is used, its top surface shall be free from sharp protrusions that might damage the IBC.

6.5.3.5.10 Strengthening devices such as timber supports to increase stacking performance may be used but shall be external to the liner.

6.5.3.5.11 Where IBCs are intended for stacking, the bearing surface shall be such as to distribute the load in a safe manner.

6.5.3.6 ***Specific requirements for wooden IBCs***

6.5.3.6.1 These requirements apply to wooden IBCs for the carriage of solids which are loaded or discharged by gravity. Wooden IBCs are of the following types:

11C Natural wood with inner liner
11D Plywood with inner liner
11F Reconstituted wood with inner liner.

6.5.3.6.2 Wooden IBCs shall not incorporate top lifting devices.

6.5.3.6.3 The strength of the materials used and the method of construction of the body shall be appropriate to the capacity and intended use of the IBC.

6.5.3.6.4 Natural wood shall be well seasoned, commercially dry and free from defects that would materially lessen the strength of any part of the IBC. Each part of the IBC shall consist of one piece or be equivalent thereto. Parts are considered equivalent to one piece when a suitable method of glued assembly is used (as for instance Lindermann joint, tongue and groove joint, ship lap or rabbet joint); or butt joint with at least two corrugated metal fasteners at each joint, or when other methods at least equally effective are used.

6.5.3.6.5 Bodies of plywood shall be at least 3-ply. They shall be made of well seasoned rotary cut, sliced or sawn veneer, commercially dry and free from defects that would materially lessen the strength of the body. All adjacent plies shall be glued with water resistant adhesive. Other suitable materials may be used with plywood for the construction of the body.

6.5.3.6.6 Bodies of reconstituted wood shall be made of water resistant reconstituted wood such as hardboard, particle board or other suitable type.

6.5.3.6.7 IBCs shall be firmly nailed or secured to corner posts or ends or be assembled by equally suitable devices.

6.5.3.6.8 The liner shall be made of a suitable material. The strength of the material used and the construction of the liner shall be appropriate to the capacity of the IBC and the intended use. Joins and closures shall be siftproof and capable of withstanding pressures and impacts liable to occur under normal conditions of handling and carriage.

6.5.3.6.9 Any integral pallet base forming part of an IBC or any detachable pallet shall be suitable for mechanical handling with the IBC filled to its maximum permissible gross mass.

6.5.3.6.10 The pallet or integral base shall be designed so as to avoid any protrusion of the base of the IBC that might be liable to damage in handling.

6.5.3.6.11 The body shall be secured to any detachable pallet to ensure stability in handling and carriage. Where a detachable pallet is used, its top surface shall be free from sharp protrusions that might damage the IBC.

6.5.3.6.12 Strengthening devices such as timber supports to increase stacking performance may be used but shall be external to the liner.

6.5.3.6.13 Where IBCs are intended for stacking, the bearing surface shall be such as to distribute the load in a safe manner.

6.5.4 Test requirements for IBCs

6.5.4.1 ***Performance and frequency of tests***

6.5.4.1.1 The design type of each IBC shall be tested in accordance with procedures established and approved by the competent authority for each IBC design type before such an IBC is used. An IBC design type is defined by the design, size, material and thickness, manner of construction and means of filling and discharging but may include various surface treatments. It also includes IBCs which differ from the design type only in their lesser external dimensions.

6.5.4.1.2 Tests shall be carried out on IBCs prepared for carriage. IBCs shall be filled as indicated in the relevant sections. The substances to be carried in the IBCs may be replaced by other substances except where this would invalidate the results of the tests. For solids, when another substance is used it shall have the same physical characteristics (mass, grain size, etc.) as the substance to be carried. It is permissible to use additives, such as bags of lead shot, to achieve the requisite total package mass, so long as they are placed so that the test results are not affected.

6.5.4.1.3 In the drop tests for liquids, when another substance is used, its relative density and viscosity shall be similar to those of the substance to be carried. Water may also be used for the liquid drop test under the following conditions:

(a) where the substances to be carried have a relative density not exceeding 1.2, the drop heights shall be those shown in the table in 6.5.4.9.4;

(b) where the substances to be carried have a relative density exceeding 1.2, the drop heights shall be calculated on the basis of the relative density (d) of the substance to be carried rounded up to the first decimal as follows:

Packing group I	Packing group II	Packing group III
d x 1.5 m	d x 1.0 m	d x 0.67 m

6.5.4.2 ***Design type tests***

6.5.4.2.1 One IBC of each design type, size, wall thickness and manner of construction shall be submitted to the tests listed in the order shown in 6.5.4.3.5 and as set out in 6.5.4.5 to 6.5.4.12. These design type tests shall be carried out as required by the competent authority.

6.5.4.2.2 The competent authority may permit the selective testing of IBCs which differ only in minor respects from a tested type, e.g. with small reductions in external dimensions.

6.5.4.2.3 If detachable pallets are used in the tests, the test report issued in accordance with 6.5.4.13 shall include a technical description of the pallets used.

6.5.4.3 ***Preparation of IBCs for testing***

6.5.4.3.1 Paper and fibreboard IBCs and composite IBCs with fibreboard outer casings shall be conditioned for at least 24 hours in an atmosphere having a controlled temperature and

relative humidity (r.h.). There are three options, one of which shall be chosen. The preferred atmosphere is 23 ± 2 °C and 50 % ± 2 % r.h. The two other options are 20 ± 2 °C and 65 % ± 2 % r.h.; or 27 ± 2 °C and 65 % ± 2 % r.h.

NOTE: *Average values shall fall within these limits. Short-term fluctuations and measurement limitations may cause individual measurements to vary by up to ± 5 % relative humidity without significant impairment of test reproducibility.*

6.5.4.3.2 Additional steps shall be taken to ascertain that the plastics material used in the manufacture of rigid plastics IBCs (types 31H1 and 31H2) and composite IBCs (types 31HZ1 and 31HZ2) complies respectively with the requirements in 6.5.3.3.2 to 6.5.3.3.4 and 6.5.3.4.6 to 6.5.3.4.9.

6.5.4.3.3 To prove there is sufficient chemical compatibility with the contained goods, the sample IBC shall be subjected to a preliminary storage for six months, during which the samples shall remain filled with the substances they are intended to contain or with substances which are known to have at least as severe a stress-cracking, weakening or molecular degradation influence on the plastics materials in question, and after which the samples shall be submitted to the applicable tests listed in the table in 6.5.4.3.5.

6.5.4.3.4 Where the satisfactory behaviour of the plastics material has been established by other means, the above compatibility test may be dispensed with. Such procedures shall be at least equivalent to the above compatibility test and recognized by the competent authority.

6.5.4.3.5 *Design type tests required and sequential order*

Type of IBC	**Bottom lift**	**Top lift** [a]	**Stacking** [b]	**Leak-proofness**	**Hydraulic pressure**	**Drop**	**Tear**	**Topple**	**Righting** [c]
Metal: 11A, 11B, 11N,	1st [a]	2nd	3rd	-	-	4th [e]	-	-	-
21A, 21B, 21N, 31A, 31B, 31N	1st [a]	2nd	3rd	4th	5th	6th [e]	-	-	-
Flexible [d]	-	x [c]	x	-	-	x	x	x	x
Rigid plastics: 11H1, 11H2,	1st [a]	2nd	3rd	-	-	4th	-	-	-
21H1, 21H2, 31H1, 31H2	1st [a]	2nd	3rd	4th	5th	6th	-	-	-
Composite: 11HZ1, 11HZ2,	1st [a]	2nd	3rd	-	-	4th [e]	-	-	-
21HZ1, 21HZ2, 31HZ1, 31HZ2	1st [a]	2nd	3rd	4th	5th	6th [e]	-	-	-
Fibreboard	1st	-	2nd	-	-	3rd	-	-	-
Wooden	1st	-	2nd	-	-	3rd	-	-	-

[a] *When IBCs are designed for this method of handling.*

[b] *When IBCs are designed to be stacked.*

[c] *When IBCs are designed to be lifted from the top or the side.*

[d] *Required test indicated by x; an IBC which has passed one test may be used for other tests, in any order.*

[e] *Another IBC of the same design may be used for the drop test.*

6.5.4.4 ***Bottom lift test***

6.5.4.4.1 *Applicability*

For all fibreboard and wooden IBCs, and for all types of IBC which are fitted with means of lifting from the base, as a design type test.

6.5.4.4.2 *Preparation of IBCs for test*

The IBC shall be loaded to 1.25 times its maximum permissible gross mass, the load being evenly distributed.

6.5.4.4.3 *Method of testing*

The IBC shall be raised and lowered twice by a lift truck with the forks centrally positioned and spaced at three quarters of the dimension of the side of entry (unless the points of entry are fixed). The forks shall penetrate to three quarters of the direction of entry. The test shall be repeated from each possible direction of entry.

6.5.4.4.4 *Criteria for passing the test*

No permanent deformation which renders the IBC, including the base pallet, if any, unsafe for carriage and no loss of contents.

6.5.4.5 ***Top lift test***

6.5.4.5.1 *Applicability*

For all types of IBC which are designed to be lifted from the top and for flexible IBCs designed to be lifted from the top or the side, as a design type test.

6.5.4.5.2 *Preparation of IBCs for test*

Metal, rigid plastics and composite IBCs shall be loaded to twice their maximum permissible gross mass. Flexible IBCs shall be filled to six times their maximum permissible load, the load being evenly distributed.

6.5.4.5.3 *Methods of testing*

Metal and flexible IBCs shall be lifted in the manner for which they are designed until clear of the floor and maintained in that position for a period of five minutes.

Rigid plastics and composite IBCs shall be lifted:

(a) by each pair of diagonally opposite lifting devices, so that the hoisting forces are applied vertically, for a period of five minutes; and

(b) by each pair of diagonally opposite lifting devices, so that the hoisting forces are applied toward the centre at 45º to the vertical, for a period of five minutes.

6.5.4.5.4 Other methods of top lift testing and preparation at least equally effective may be used for flexible IBCs.

6.5.4.5.5 *Criteria for passing the test*

(a) Metal, rigid plastics and composite IBCs: no permanent deformation which renders the IBC, including the base pallet, if any, unsafe for carriage and no loss of contents.

(b) Flexible IBCs: no damage to the IBC or its lifting devices which renders the IBC unsafe for carriage or handling.

6.5.4.6 ***Stacking test***

6.5.4.6.1 *Applicability*

For all types of IBC which are designed to be stacked on each other, as a design type test.

6.5.4.6.2 *Preparation of IBCs for test*

IBCs, other than flexible IBCs, shall be loaded to their maximum permissible gross mass. Flexible IBCs shall be filled to not less than 95 % of their capacity and to their maximum permissible load, the load being evenly distributed.

6.5.4.6.3 *Method of testing*

(a) The IBC shall be placed on its base on level hard ground and subjected to a uniformly distributed superimposed test load (see 6.5.4.6.4). IBCs shall be subjected to the test load for a period of at least:

(i) 5 minutes, for metal IBCs;

(ii) 28 days at 40 ºC, for rigid plastics IBCs of types 11H2, 21H2 and 31H2 and for composite IBCs with outer casings of plastics material which bear the stacking load (i.e., types 11HH1, 11HH2, 21HH1, 21HH2, 31HH1 and 31HH2);

(iii) 24 hours, for all other types of IBCs;

(b) The load shall be applied by one of the following methods:

(i) one or more IBCs of the same type filled to the maximum permissible gross mass and, in the case of flexible IBCs, the maximum permissible load and stacked on the test IBC;

(ii) appropriate weights loaded on to either a flat plate or a reproduction of the base of the IBC, which is stacked on the test IBC.

6.5.4.6.4 *Calculation of superimposed test load*

The load to be placed on the IBC shall be 1.8 times the combined maximum permissible gross mass of the number of similar IBCs that may be stacked on top of the IBC during carriage.

6.5.4.6.5 *Criteria for passing the test*

(a) All types of IBC other than flexible IBCs: no permanent deformation which renders the IBC including the base pallet, if any, unsafe for carriage and no loss of contents.

(b) Flexible IBCs: no deterioration of the body which renders the IBC unsafe for carriage and no loss of contents.

6.5.4.7 ***Leakproofness test***

6.5.4.7.1 *Applicability*

For those types of IBC used for liquids or for solids loaded or discharged under pressure, as a design type test and periodic test.

6.5.4.7.2 *Preparation of IBCs for test*

The test shall be carried out before the fitting of any thermal insulation equipment. Vented closures shall either be replaced by similar non-vented closures or the vent shall be sealed.

6.5.4.7.3 *Method of testing and pressure to be applied*

The test shall be carried out for a period of at least 10 minutes using air at a gauge pressure of not less than 20 kPa (0.2 bar). The air tightness of the IBC shall be determined by a suitable method such as by air-pressure differential test or by immersing the IBC in water or, for metal IBCs, by coating the seams and joints with a soap solution. In the case of immersing a correction factor shall be applied for the hydrostatic pressure. Other methods at least equally effective may be used.

6.5.4.7.4 *Criterion for passing the test*

No leakage of air.

6.5.4.8 ***Internal pressure (hydraulic) test***

6.5.4.8.1 *Applicability*

For those types of IBCs used for liquids or for solids loaded or discharged under pressure, as a design type test.

6.5.4.8.2 *Preparation of IBCs for test*

The test shall be carried out before the fitting of any thermal insulation equipment. Pressure-relief devices shall be removed and their apertures plugged, or shall be rendered inoperative.

6.5.4.8.3 *Method of testing*

The test shall be carried out for a period of at least 10 minutes applying a hydraulic pressure not less than that indicated in 6.5.4.8.4. The IBCs shall not be mechanically restrained during the test.

6.5.4.8.4 *Pressures to be applied*

6.5.4.8.4.1 Metal IBCs:

(a) For IBCs of types 21A, 21B and 21N, for packing group I solids, a 250 kPa (2.5 bar) gauge pressure;

(b) For IBCs of types 21A, 21B, 21N, 31A, 31B and 31N, for packing groups II or III substances, a 200 kPa (2 bar) gauge pressure;

(c) In addition, for IBCs of types 31A, 31B and 31N, a 65kPa (0.65 bar) gauge pressure. This test shall be performed before the 200 kPa (2 bar) test.

6.5.4.8.4.2 Rigid plastics and composite IBCs:

(a) For IBCs of types 21H1, 2lH2, 21HZ1 and 21HZ2: 75 kPa (0.75 bar) (gauge);

(b) For IBCs of types 31H1, 31H2, 31HZ1 and 31HZ2: whichever is the greater of two values, the first as determined by one of the following methods:

(i) the total gauge pressure measured in the IBC (i.e. the vapour pressure of the filling substance and the partial pressure of the air or other inert gases, minus 100 kPa) at 55 °C multiplied by a safety factor of 1.5; this total gauge pressure shall be determined on the basis of a maximum degree of filling in accordance with 4.1.1.4 and a filling temperature of 15 °C;

(ii) 1.75 times the vapour pressure at 50 °C of the substance to be carried minus 100 kPa, but with a minimum test pressure of 100 kPa;

(iii) 1.5 times the vapour pressure at 55 °C of the substance to be carried minus 100 kPa, but with a minimum test pressure of 100 kPa;

and the second as determined by the following method:

(iv) twice the static pressure of the substance to be carried, with a minimum of twice the static pressure of water;

6.5.4.8.5 *Criteria for passing the test(s):*

(a) For IBCs of types 21A, 21B, 21N, 31A, 31B and 31N, when subjected to the test pressure specified in 6.5.4.8.4.1 (a) or (b): no leakage;

(b) For IBCs of types 31A, 31B and 31N, when subjected to the test pressure specified in 6.5.4.8.4.1 (c): no permanent deformation which renders the IBC unsafe for carriage and no leakage;

(c) For rigid plastics and composite IBCs: no permanent deformation which would render the IBC unsafe for carriage and no leakage.

6.5.4.9 *Drop test*

6.5.4.9.1 *Applicability*

For all types of IBCs, as a design type test.

6.5.4.9.2 *Preparation of IBCs for test*

(a) Metal IBCs: the IBC shall be filled to not less than 95 % of its capacity for solids or 98 % for liquids in accordance with the design type. Pressure-relief devices shall be removed and their apertures plugged, or shall be rendered inoperative;

(b) Flexible IBCs: the IBC shall be filled to not less than 95 % of its capacity and to its maximum permissible load, the load being evenly distributed;

(c) Rigid plastics and composite IBCs: the IBC shall be filled to not less than 95 % of its capacity for solids or 98 % for liquids in accordance with the design type. Arrangements provided for pressure relief may be removed and plugged or rendered inoperative. Testing of IBCs shall be carried out when the temperature of the test sample and its contents has been reduced to minus 18 °C or lower. Where test samples of composite IBCs are prepared in this way the conditioning specified in 6.5.4.3.1 may be waived. Test liquids shall be kept in the liquid state, if necessary by the addition of anti-freeze. This conditioning may be disregarded if the materials in question are of sufficient ductility and tensile strength at low temperatures;

(d) Fibreboard and wooden IBCs: The IBC shall be filled to not less than 95 % of its capacity in accordance with the design type.

6.5.4.9.3 *Method of testing*

The IBC shall be dropped on its base onto a rigid, non-resilient, smooth, flat and horizontal surface in such a manner as to ensure that the point of impact is that part of the base of the IBC considered to be the most vulnerable. IBCs of 0.45 m^3 or less capacity shall also be dropped:

(a) Metal IBCs: on the most vulnerable part other than the part of the base tested in the first drop;

(b) Flexible IBCs: on the most vulnerable side;

(c) Rigid plastics, composite, fibreboard and wooden IBCs: flat on a side, flat on the top and on a corner.

The same or different IBCs may be used for each drop.

6.5.4.9.4 *Drop height*

Packing group I	Packing group II	Packing group III
1.8 m	1.2 m	0.8 m

6.5.4.9.5 *Criteria for passing the test(s):*

(a) Metal IBCs: no loss of contents;

(b) Flexible IBCs: no loss of contents. A slight discharge, e.g. from closures or stitch holes, upon impact shall not be considered to be a failure of the IBC provided that no further leakage occurs after the IBC has been raised clear of the ground;

(c) Rigid plastics, composite, fibreboard and wooden IBCs: no loss of contents. A slight discharge from a closure upon impact shall not be considered to be a failure of the IBC provided that no further leakage occurs.

6.5.4.10 *Tear test*

6.5.4.10.1 *Applicability*

For all types of flexible IBCs, as a design type test.

6.5.4.10.2 *Preparation of IBCs for test*

The IBC shall be filled to not less than 95 % of its capacity and to its maximum permissible load, the load being evenly distributed.

6.5.4.10.3 *Method of testing*

Once the IBC is placed on the ground, a 100 mm knife score, completely penetrating the wall of a wide face, is made at a 45° angle to the principal axis of the IBC, halfway between the bottom surface and the top level of the contents. The IBC shall then be subjected to a uniformly distributed superimposed load equivalent to twice the maximum permissible load. The load shall be applied for at least five minutes. An IBC which is designed to be lifted from the top or the side shall then, after removal of the superimposed load, be lifted clear of the floor and maintained in that position for a period of five minutes.

6.5.4.10.4 *Criteria for passing the test*

The cut shall not propagate more than 25 % of its original length.

6.5.4.11 *Topple test*

6.5.4.11.1 *Applicability*

For all types of flexible IBC, as a design type test.

6.5.4.11.2 *Preparation of IBCs for test*

The IBC shall be filled to not less than 95 % of its capacity and to its maximum permissible load, the load being evenly distributed.

6.5.4.11.3 *Method of testing*

The IBC shall be caused to topple on to any part of its top on to a rigid, non-resilient, smooth, flat and horizontal surface.

6.5.4.11.4 *Topple height*

Packing group I	**Packing group II**	**Packing group III**
1.8 m	1.2 m	0.8 m

6.5.4.11.5 *Criteria for passing the test*

No loss of contents. A slight discharge, e.g. from closures or stitch holes, upon impact shall not be considered to be a failure of the IBC provided that no further leakage occurs.

6.5.4.12 *Righting test*

6.5.4.12.1 *Applicability*

For all flexible IBCs designed to be lifted from the top or side, as a design type test.

6.5.4.12.2 *Preparation of IBCs for test*

The IBC shall be filled to not less than 95 % of its capacity and to its maximum permissible load, the load being evenly distributed.

6.5.4.12.3 *Method of testing*

The IBC, lying on its side, shall be lifted at a speed of at least 0.1 m/s to upright position, clear of the floor, by one lifting device or by two lifting devices when four are provided.

6.5.4.12.4 *Criteria for passing the test*

No damage to the IBC or its lifting devices which renders the IBC unsafe for carriage or handling.

6.5.4.13 ***Test report***

6.5.4.13.1 A test report containing at least the following particulars shall be drawn up and shall be made available to the users of the IBC:

1. Name and address of the test facility;
2. Name and address of applicant (where appropriate);
3. A unique test report identification;
4. Date of the test report;
5. Manufacturer of the IBC;
6. Description of the IBC design type (e.g. dimensions, materials, closures, thickness, etc.) including method of manufacture (e.g. blow moulding) and which may include drawing(s) and/or photograph(s);
7. Maximum capacity;
8. Characteristics of test contents, e.g. viscosity and relative density for liquids and particle size for solids;
9. Test descriptions and results;
10. The test report shall be signed with the name and status of the signatory.

6.5.4.13.2 The test report shall contain statements that the IBC prepared as for carriage was tested in accordance with the appropriate requirements of this Chapter and that the use of other packaging methods or components may render it invalid. A copy of the test report shall be available to the competent authority.

6.5.4.14 ***Initial and periodic testing of individual metal, rigid plastics and composite IBCs***

6.5.4.14.1 These tests shall be carried out as required by the competent authority.

6.5.4.14.2 Each IBC shall correspond in all respects to its design type.

6.5.4.14.3 Each metal, rigid plastics and composite IBC for liquids, or for solids which are loaded or discharged under pressure, shall be subjected to the leakproofness test, as an initial test (i.e., before the IBC is first used for carriage) and at intervals of not more than two and a half years.

6.5.4.14.4 This leakproofness test shall also be repeated after any repair, before it is reused for carriage.

6.5.4.14.5 The results of tests shall be recorded in test reports to be kept by the owner of the IBC.

CHAPTER 6.6

REQUIREMENTS FOR THE CONSTRUCTION AND TESTING OF LARGE PACKAGINGS

6.6.1 General

6.6.1.1 The requirements of this Chapter do not apply to:

- packagings for Class 2, except large packagings for articles, including aerosols;
- packagings for Class 6.2, except large packagings for clinical waste of UN No.3291;
- Class 7 packages containing radioactive material.

6.6.1.2 Large packagings shall be manufactured and tested under a quality assurance programme which satisfies the competent authority in order to ensure that each manufactured packaging meets the requirements of this Chapter.

6.6.2 Code for designating types of large packagings

The code used for large packagings consist of:

(a) Two Arabic numerals:

50 for rigid large packagings; or
51 for flexible large packagings; and

(b) A capital letter in Latin character indicating the nature of the material, e.g. wood, steel etc. The capital letters used shall be those shown in 6.1.2.6.

6.6.3 Marking

6.6.3.1 ***Primary marking***. Each large packaging manufactured and intended for use in accordance with the provisions of ADR shall bear durable and legible markings showing:

(a) The United Nations packaging symbol 

For metal large packagings on which the marking is stamped or embossed, the capital letters "UN" may be applied instead of the symbol;

(b) The number "50" designating a large rigid packaging or "51" for flexible large packagings, followed by the material type in accordance with 6.5.1.4.1 (b);

(c) A capital letter designating the packing group(s) for which the design type has been approved:

X for packing groups I, II and III
Y for packing groups II and III
Z for packing group III only;

(d) The month and year (last two digits) of manufacture;

(e) The State authorizing the allocation of the mark; indicated by the distinguishing sign for motor vehicles in international traffic [1];

(f) The name or symbol of the manufacturer and other identification of the large packagings as specified by the competent authority;

(g) The stacking test load in kg. For large packagings not designed for stacking the figure "0" shall be shown;

(h) The maximum permissible gross mass in kilograms.

The primary marking required above shall be applied in the sequence of the sub-paragraphs.

6.6.3.2 ***Examples of the marking*:**

	50A/X/05 96/N/PQRS 2500/1000	For a large steel packaging suitable for stacking; stacking load: 2 500 kg; maximum gross mass: 1 000 kg.
	50H/Y/04 95/D/ABCD 987 0/800	For a large plastics packaging not suitable for stacking; maximum gross mass: 800 kg.
	51H/Z/0697/S/1999 0/500	For a large flexible packaging not suitable for stacking; maximum gross mass: 500 kg.

6.6.4 Specific requirements for large packagings

6.6.4.1 ***Specific requirements for metal large packagings***

50A steel
50B aluminium
50N metal (other than steel or aluminium)

6.6.4.1.1 The large packaging shall be made of suitable ductile metal in which the weldability has been fully demonstrated. Welds shall be skilfully made and afford complete safety. Low-temperature performance shall be taken into account when appropriate.

6.6.4.1.2 Care shall be taken to avoid damage by galvanic action due to the juxtaposition of dissimilar metals.

6.6.4.2 ***Specific requirements for flexible material large packagings***

51H flexible plastics
51M flexible paper

6.6.4.2.1 The large packaging shall be manufactured from suitable materials. The strength of the material and the construction of the flexible large packagings shall be appropriate to its capacity and its intended use.

6.6.4.2.2 All materials used in the construction of flexible large packagings of types 51M shall, after complete immersion in water for not less than 24 hours, retain at least 85% of the tensile

[1] *Distinguishing sign for motor vehicles in international traffic prescribed in the Vienna Convention on Road Traffic (1968).*

strength as measured originally on the material conditioned to equilibrium at 67% relative humidity or less.

6.6.4.2.3 Seams shall be formed by stitching, heat sealing, glueing or any equivalent method. All stitched seam-ends shall be secured.

6.6.4.2.4 Flexible large packagings shall provide adequate resistance to ageing and to degradation caused by ultraviolet radiation or the climatic conditions, or by the substance contained, thereby rendering them appropriate to their intended use.

6.6.4.2.5 For plastics flexible large packagings where protection against ultraviolet radiation is required, it shall be provided by the addition of carbon black or other suitable pigments or inhibitors. These additives shall be compatible with the contents and remain effective throughout the life of the large packaging. Where use is made of carbon black, pigments or inhibitors other than those used in the manufacture of the tested design type, re-testing may be waived if changes in the carbon black content, the pigment content or the inhibitor content do not adversely affect the physical properties of the material of construction.

6.6.4.2.6 Additives may be incorporated into the material of the large packaging to improve the resistance to ageing or to serve other purposes, provided that these do not adversely affect the physical or chemical properties of the material.

6.6.4.2.7 When filled, the ratio of height to width shall be not more than 2:1.

6.6.4.3 ***Specific requirements for plastics large packagings***

50H rigid plastics

6.6.4.3.1 The large packaging shall be manufactured from suitable plastics material of known specifications and be of adequate strength in relation to its capacity and its intended use. The material shall be adequately resistant to ageing and to degradation caused by the substance contained or, where relevant, by ultraviolet radiation. Low temperature performance shall be taken into account when appropriate. Any permeation of the substance contained shall not constitute a danger under normal conditions of carriage.

6.6.4.3.2 Where protection against ultraviolet radiation is required, it shall be provided by the addition of carbon black or other suitable pigments or inhibitors. These additives shall be compatible with the contents and remain effective throughout the life of the outer packaging. Where use is made of carbon black, pigments or inhibitors other than those used in the manufacture of the tested design type, re-testing may be waived if changes in the carbon black content, the pigment content or the inhibitor content do not adversely affect the physical properties of the material of construction.

6.6.4.3.3 Additives may be incorporated in the material of the large packaging to improve the resistance to ageing or to serve other purposes, provided that these do not adversely affect the physical or chemical properties of the material.

6.6.4.4 ***Specific requirements for fibreboard large packagings***

50G rigid fibreboard

6.6.4 4.1 Strong and good quality solid or double-faced corrugated fibreboard (single or multiwall) shall be used, appropriate to the capacity of the large packagings and to their intended use. The water resistance of the outer surface shall be such that the increase in mass, as determined in a test carried out over a period of 30 minutes by the Cobb method of determining water absorption, is not greater than 155 g/m^2 - see ISO 535:1991. It shall have

proper bending qualities. Fibreboard shall be cut, creased without scoring, and slotted so as to permit assembly without cracking, surface breaks or undue bending. The fluting or corrugated fibreboard shall be firmly glued to the facings.

6.6.4.4.2 The walls, including top and bottom, shall have a minimum puncture resistance of 15 J measured according to ISO 3036:1975.

6.6.4.4.3 Manufacturing joins in the outer packaging of large packagings shall be made with an appropriate overlap and shall be taped, glued, stitched with metal staples or fastened by other means at least equally effective. Where joins are effected by gluing or taping, a water resistant adhesive shall be used. Metal staples shall pass completely through all pieces to be fastened and be formed or protected so that any inner liner cannot be abraded or punctured by them.

6.6.4.4.4 Any integral pallet base forming part of a large packaging or any detachable pallet shall be suitable for mechanical handling with the large packaging filled to its maximum permissible gross mass.

6.6.4.4.5 The pallet or integral base shall be designed so as to avoid any protrusion of the base of the large packaging that might be liable to damage in handling.

6.6.4.4.6 The body shall be secured to any detachable pallet to ensure stability in handling and carriage. Where a detachable pallet is used, its top surface shall be free from sharp protrusions that might damage the large packaging.

6.6.4.4.7 Strengthening devices such as timber supports to increase stacking performance may be used but shall be external to the liner.

6.6.4.4.8 Where large packagings are intended for stacking, the bearing surface shall be such as to distribute the load in a safe manner.

6.6.4.5 ***Specific requirements for wooden large packagings***

50C natural wood
50D plywood
50F reconstituted wood

6.6.4.5.1 The strength of the materials used and the method of construction shall be appropriate to the capacity and intended use of the large packagings.

6.6.4.5.2 Natural wood shall be well seasoned, commercially dry and free from defects that would materially lessen the strength of any part of the large packagings. Each part of the large packagings shall consist of one piece or be equivalent thereto. Parts are considered equivalent to one piece when a suitable method of glued assembly is used as for instance Lindermann joint, tongue and groove joint, ship lap or rabbet joint; or butt joint with at least two corrugated metal fasteners at each joint, or when other methods at least equally effective are used.

6.6.4.5.3 Large packagings of plywood shall be at least 3-ply. They shall be made of well seasoned rotary cut, sliced or sawn veneer, commercially dry and free from defects that would materially lessen the strength of the large packaging. All adjacent plies shall be glued with water resistant adhesive. Other suitable materials may be used with plywood for the construction of the large packaging.

6.6.4.5.4 Large packagings of reconstituted wood shall be made of water resistant reconstituted wood such as hardboard, particle board or other suitable type.

6.6.4.5.5 Large packagings shall be firmly nailed or secured to corner posts or ends or be assembled by equally suitable devices.

6.6.4.5.6 Any integral pallet base forming part of a large packaging or any detachable pallet shall be suitable for mechanical handling with the large packaging filled to its maximum permissible gross mass.

6.6.4.5.7 The pallet or integral base shall be designed so as to avoid any protrusion of the base of the large packaging that might be liable to damage in handling.

6.6.4.5.8 The body shall be secured to any detachable pallet to ensure stability in handling and carriage. Where a detachable pallet is used, its top surface shall be free from sharp protrusions that might damage the large packaging.

6.6.4.5.9 Strengthening devices such as timber supports to increase stacking performance may be used but shall be external to the liner.

6.6.4.5.10 Where large packagings are intended for stacking, the bearing surface shall be such as to distribute the load in a safe manner.

6.6.5 Test requirements for large packagings

6.6.5.1 ***Performance and frequency of test***

6.6.5.1.1 The design type of each large packaging shall be tested as provided in 6.6.5.3 in accordance with procedures established and approved by the competent authority.

6.6.5.1.2 Tests shall be successfully performed on each large packaging design type before such a packaging is used. A large packaging design type is defined by the design, size, material and thickness, manner of construction and packing, but may include various surface treatments. It also includes large packagings which differ from the design type only in their lesser design height.

6.6.5.1.3 Tests shall be repeated on production samples at intervals established by the competent authority. For such tests on fibreboard large packagings, preparation at ambient conditions is considered equivalent to the provisions of 6.6.5.2.3.

6.6.5.1.4 Tests shall also be repeated after each modification which alters the design, material or manner of construction of large packagings.

6.6.5.1.5 The competent authority may permit the selective testing of large packagings that differ only in minor respects from a tested type, e.g. smaller sizes of inner packagings or inner packagings of lower net mass; and large packagings which are produced with small reductions in external dimension(s).

6.6.5.1.6 Where a large packaging has been successfully tested with different types of inner packagings, a variety of such different inner packagings may also be assembled in this large packaging. In addition, provided an equivalent level of performance is maintained, the following variations in inner packagings are allowed without further testing of the package:

(a) Inner packagings of equivalent or smaller size may be used provided:

(i) The inner packagings are of similar design to the tested inner packagings (e.g. shape - round, rectangular, etc);

(ii) The material of construction of the inner packagings (glass, plastics, metal, etc.) offers resistance to impact and stacking forces equal to or greater than that of the originally tested inner packaging;

(iii) The inner packagings have the same or smaller openings and the closure is of similar design (e.g. screw cap, friction lid, etc);

(iv) Sufficient additional cushioning material is used to take up void spaces and to prevent significant movement of the inner packagings; and

(v) Inner packagings are oriented within the large packagings in the same manner as in the tested package;

(b) A lesser number of the tested inner packagings, or of the alternative types of inner packagings identified in (a) above, may be used provided sufficient cushioning is added to fill the void space(s) and to prevent significant movement of the inner packagings.

6.6.5.1.7 The competent authority may at any time require proof, by tests in accordance with this section, that serially-produced large packagings meet the requirements of the design type tests.

6.6.5.1.8 Provided the validity of the test results is not affected and with the approval of the competent authority, several tests may be made on one sample.

6.6.5.2 ***Preparation for testing***

6.6.5.2.1 Tests shall be carried out on large packagings prepared as for carriage including the inner packagings or articles used. Inner packagings shall be filled to not less than 98% of their maximum capacity for liquids or 95% for solids. For large packagings where the inner packagings are designed to carry liquids and solids, separate testing is required for both liquid and solid contents. The substances in the inner packagings or the articles to be carried in the large packagings may be replaced by other material or articles except where this would invalidate the results of the tests. When other inner packagings or articles are used they shall have the same physical characteristics (mass, etc) as the inner packagings or articles to be carried. It is permissible to use additives, such as bags of lead shot, to achieve the requisite total package mass, so long as they are placed so that the test results are not affected.

6.6.5.2.2 Large packagings made of plastics materials and large packagings containing inner packagings of plastic materials - other than bags intended to contain solids or articles - shall be drop tested when the temperature of the test sample and its contents has been reduced to -18 °C or lower. This conditioning may be disregarded if the materials in question are of sufficient ductility and tensile strength at low temperatures. Where test sample are prepared in this way, the conditioning in 6.6.5.2.3 may be waived. Test liquids shall be kept in the liquid state by the addition of anti-freeze if necessary.

6.6.5.2.3 Large packagings of fibreboard shall be conditioned for at least 24 hours in an atmosphere having a controlled temperature and relative humidity (r.h.). There are three options, one of which shall be chosen.

The preferred atmosphere is 23 °C ± 2 °C and 50% ± 2% r.h. The two other options are: 20 °C ± 2 °C and 65% ± 2% r.h.; or 27 °C ± 2 °C and 65% ± 2% r.h.

NOTE: *Average values shall fall within these limits. Short term fluctuations and measurement limitations may cause individual measurements to vary by up to ± 5% relative humidity without significant impairment of test reproducibility.*

6.6.5.3 ***Test requirements***

6.6.5.3.1 *Bottom lift test*

6.6.5.3.1.1 Applicability

For all types of large packagings which are fitted with means of lifting from the base, as a design type test.

6.6.5.3.1.2 Preparation of large packagings for test

The large packagings shall be loaded to 1.25 times its maximum permissible gross mass, the load being evenly distributed.

6.6.5.3.1.3 Method of testing

The large packagings shall be raised and lowered twice by a lift truck with the forks centrally positioned and spaced at three quarters of the dimension of the side of entry (unless the points of entry are fixed). The forks shall penetrate to three quarters of the direction of entry. The test shall be repeated from each possible direction of entry.

6.6.5.3.1.4 Criteria for passing the test

No permanent deformation which renders the large packagings unsafe for carriage and no loss of contents.

6.6.5.3.2 *Top lift test*

6.6.5.3.2.1 Applicability

For types of large packagings which are intended to be lifted from the top and fitted with means of lifting, as a design type test.

6.6.5.3.2.2 Preparation of large packagings for test

The large packagings shall be loaded to twice its maximum permissible gross mass.

6.6.5.3.2.3 Method of testing

The large packagings shall be lifted in the manner for which it is designed until clear of the floor and maintained in that position for a period of five minutes.

6.6.5.3.2.4 Criteria for passing the test

No permanent deformation which renders the large packagings unsafe for carriage and no loss of contents.

6.6.5.3.3 *Stacking test*

6.6.5.3.3.1 Applicability

For all types of large packagings which are designed to be stacked on each other, as a design type test.

6.6.5.3.3.2 Preparation of large packagings for test

The large packagings shall be filled to its maximum permissible gross mass.

6.6.5.3.3.3 Method of testing

The large packagings shall be placed on its base on level hard ground and subjected to a uniformly distributed superimposed test load (see 6.6.5.3.3.4) for a period of at least five minutes, large packagings of wood, fibreboard and plastic materials for a period of 24 h.

6.6.5.3.3.4 Calculation of superimposed test load

The load to be placed on the large packagings shall be 1.8 times the combined maximum permissible gross mass of the number of similar large packagings that must be stacked on top of the large packagings during carriage.

6.6.5.3.3.5 Criteria for passing the test

No permanent deformation which renders the large packagings unsafe for carriage and no loss of contents.

6.6.5.3.4 *Drop test*

6.6.5.3.4.1 Applicability

For all types of large packagings as a design type test.

6.6.5.3.4.2 Preparation of large packagings for testing

The large packagings shall be filled in accordance with 6.6.5.2.1

6.6.5.3.4.3 Method of testing

The large packagings shall be dropped onto a rigid, non-resilient, smooth, flat and horizontal surface, in such a manner as to ensure that the point of impact is that part of the base of the large packagings considered to be the most vulnerable.

6.6.5.3.4.4 Drop height

Packing group I	**Packing group II**	**Packing group III**
1.8 m	1.2 m	0.8 m

***NOTE**: Large packagings for substances and articles of Class 1, self-reactive substances of Class 4.1 and organic peroxides of Class 5.2 shall be tested at the packing group II performance level.*

6.6.5.3.4.5 Criteria for passing the test

6.6.5.3.4.5.1 The large packagings shall not exhibit any damage liable to affect safety during carriage. There shall be no leakage of the filling substance from inner packaging(s) or article(s).

6.6.5.3.4.5.2 No rupture is permitted in large packagings for articles of Class 1 which would permit the spillage of loose explosive substances or articles from the large packagings.

6.6.5.3.4.5.3 Where a large packaging undergoes a drop test the sample passes the test if the entire contents are retained even if the closure is no longer sift-proof.

6.6.5.4 ***Certification and test report***

6.6.5.4.1 In respect of each design type of large packagings a certificate and mark (as in 6.6.3) shall be issued attesting that the design type including its equipment meets the test requirements.

6.6.5.4.2 A test report containing at least the following particulars shall be drawn up and shall be made available to the users of the large packagings:

1. Name and address of the test facility;
2. Name and address of applicant (where appropriate);
3. A unique test report identification;
4. Date of the test report;
5. Manufacturer of the large packagings;
6. Description of the large packagings design type (e.g. dimensions, materials, closures, thickness, etc) and/or photograph(s);
7. Maximum capacity/maximum permissible gross mass;
8. Characteristics of test contents, e.g. types and descriptions of inner packagings or articles used;
9. Test descriptions and results;
10. The test report shall be signed with the name and status of the signatory.

6.6.5.4.3 The test report shall contain statements that the large packagings prepared as for carriage was tested in accordance with the appropriate provisions of this Chapter and that the use of other packaging methods or components may render it invalid. A copy of the test report shall be available to the competent authority.

CHAPTER 6.7

REQUIREMENTS FOR THE DESIGN, CONSTRUCTION, INSPECTION AND TESTING OF PORTABLE TANKS

NOTE: *For fixed tanks (tank-vehicles), demountable tanks and tank-containers and tank swap bodies, with shells made of metallic materials, and battery-vehicles and multiple element gas containers (MEGCs), see Chapter 6.8; for fibre-reinforced plastics tanks, see Chapter 6.9; for vacuum operated waste tanks, see Chapter 6.10.*

6.7.1 Application and general requirements

6.7.1.1 The requirements of this Chapter apply to portable tanks intended for the carriage of dangerous goods of Classes 2, 3, 4.1, 4.2, 4.3, 5.1, 5.2, 6.1, 6.2, 7, 8 and 9, by all modes of carriage. In addition to the requirements of this Chapter, unless otherwise specified, the applicable requirements of the International Convention for Safe Containers (CSC) 1972, as amended, shall be fulfilled by any multimodal portable tank which meets the definition of a "container" within the terms of that Convention. Additional requirements may apply to offshore portable tanks that are handled in open seas.

6.7.1.2 In recognition of scientific and technological advances, the technical requirements of this Chapter may be varied by alternative arrangements. These alternative arrangements shall offer a level of safety not less than that given by the requirements of this Chapter with respect to the compatibility with substances carried and the ability of the portable tank to withstand impact, loading and fire conditions. For international carriage, alternative arrangement portable tanks shall be approved by the applicable competent authorities.

6.7.1.3 When a substance is not assigned a portable tank instruction (T1 to T23, T50 or T75) in Column (10) of Table A of in Chapter 3.2, interim approval for carriage may be issued by the competent authority of the country of origin. The approval shall be included in the documentation of the consignment and contain as a minimum the information normally provided in the portable tank instructions and the conditions under which the substance shall be carried.

6.7.2 Requirements for the design, construction, inspection and testing of portable tanks intended for the carriage of substances of Classes 3 to 9

6.7.2.1 *Definitions*

For the purposes of this section:

Portable tank means a multimodal tank having a capacity of more than 450 litres used for the carriage of substances of Classes 3 to 9. The portable tank includes a shell fitted with service equipment and structural equipment necessary for the carriage of dangerous substances. The portable tank shall be capable of being filled and discharged without the removal of its structural equipment. It shall possess stabilizing members external to the shell, and shall be capable of being lifted when full. It shall be designed primarily to be loaded onto a transport vehicle or ship and shall be equipped with skids, mountings or accessories to facilitate mechanical handling. Tank-vehicles, tank-wagons, non-metallic tanks and intermediate bulk containers (IBCs) are not considered to fall within the definition for portable tanks;

Shell means the part of the portable tank which retains the substance intended for carriage (tank proper), including openings and their closures, but does not include service equipment or external structural equipment;

Service equipment means measuring instruments and filling, discharge, venting, safety, heating, cooling and insulating devices;

Structural equipment means the reinforcing, fastening, protective and stabilizing members external to the shell;

Maximum allowable working pressure (MAWP) means a pressure that shall be not less than the highest of the following pressures measured at the top of the shell while in operating position:

(a) The maximum effective gauge pressure allowed in the shell during filling or discharge; or

(b) The maximum effective gauge pressure to which the shell is designed which shall be not less than the sum of:

(i) the absolute vapour pressure (in bar) of the substance at 65 °C, minus 1 bar; and

(ii) the partial pressure (in bar) of air or other gases in the ullage space being determined by a maximum ullage temperature of 65 °C and a liquid expansion due to an increase in mean bulk temperature of $t_r - t_f$ (t_f = filling temperature, usually 15 °C; t_r = maximum mean bulk temperature, 50 °C);

Design pressure means the pressure to be used in calculations required by a recognized pressure vessel code. The design pressure shall be not less than the highest of the following pressures:

(a) The maximum effective gauge pressure allowed in the shell during filling or discharge; or

(b) The sum of:

(i) the absolute vapour pressure (in bar) of the substance at 65 °C, minus 1 bar;

(ii) the partial pressure (in bar) of air or other gases in the ullage space being determined by a maximum ullage temperature of 65 °C and a liquid expansion due to an increase in mean bulk temperature of $t_r - t_f$ (t_f = filling temperature usually 15 °C; t_r = maximum mean bulk temperature, 50 °C); and

(iii) a head pressure determined on the basis of the dynamic forces specified in 6.7.2.2.12, but not less than 0.35 bar; or

(c) Two thirds of the minimum test pressure specified in the applicable portable tank instruction in 4.2.4.2.6;

Test pressure means the maximum gauge pressure at the top of the shell during the hydraulic pressure test equal to not less than 1.5 times the design pressure. The minimum test pressure for portable tanks intended for specific substances is specified in the applicable portable tank instruction in 4.2.4.2.6;

Leakproofness test means a test using gas subjecting the shell and its service equipment to an effective internal pressure of not less than 25% of the MAWP;

Maximum permissible gross mass (MPGM) means the sum of the tare mass of the portable tank and the heaviest load authorized for carriage;

Reference steel means a steel with a tensile strength of 370 N/mm^2 and an elongation at fracture of 27%;

Mild steel means a steel with a guaranteed minimum tensile strength of 360 N/mm^2 to 440 N/mm^2 and a guaranteed minimum elongation at fracture conforming to 6.7.2.3.3.3;

Design temperature range for the shell shall be -40 °C to 50 °C for substances carried under ambient conditions. For substances handled under elevated temperature conditions the design temperature shall be not less than the maximum temperature of the substance during filling, discharge or carriage. More severe design temperatures shall be considered for portable tanks subjected to severe climatic conditions.

6.7.2.2 ***General design and construction requirements***

6.7.2.2.1 Shells shall be designed and constructed in accordance with the requirements of a pressure vessel code recognized by the competent authority. Shells shall be made of metallic materials suitable for forming. The materials shall in principle conform to national or international material standards. For welded shells only a material whose weldability has been fully demonstrated shall be used. Welds shall be skilfully made and afford complete safety. When the manufacturing process or the materials make it necessary, the shells shall be suitably heat-treated to guarantee adequate toughness in the weld and in the heat affected zones. In choosing the material, the design temperature range shall be taken into account with respect to risk of brittle fracture, to stress corrosion cracking and to resistance to impact. When fine grain steel is used, the guaranteed value of the yield strength shall be not more than 460 N/mm^2 and the guaranteed value of the upper limit of the tensile strength shall be not more than 725 N/mm^2 according to the material specification. Aluminium may only be used as a construction material when indicated in a portable tank special provision assigned to a specific substance in Column (11) of Table A of Chapter 3.2 or when approved by the competent authority. When aluminium is authorized, it shall be insulated to prevent significant loss of physical properties when subjected to a heat load of 110 kW/m^2 for a period of not less than 30 minutes. The insulation shall remain effective at all temperatures less than 649 °C and shall be jacketed with a material with a melting point of not less than 700 °C. Portable tank materials shall be suitable for the external environment in which they may be carried.

6.7.2.2.2 Portable tank shells, fittings, and pipework shall be constructed from materials which are:

(a) Substantially immune to attack by the substance(s) intended to be carried; or

(b) Properly passivated or neutralized by chemical reaction; or

(c) Lined with corrosion-resistant material directly bonded to the shell or attached by equivalent means.

6.7.2.2.3 Gaskets shall be made of materials not subject to attack by the substance(s) intended to be carried.

6.7.2.2.4 When shells are lined, the lining shall be substantially immune to attack by the substance(s) intended to be carried, homogeneous, non porous, free from perforations, sufficiently elastic and compatible with the thermal expansion characteristics of the shell. The lining of every shell, shell fittings and piping shall be continuous, and shall extend around the face of any flange. Where external fittings are welded to the tank, the lining shall be continuous through the fitting and around the face of external flanges.

6.7.2.2.5 Joints and seams in the lining shall be made by fusing the material together or by other equally effective means.

6.7.2.2.6 Contact between dissimilar metals which could result in damage by galvanic action shall be avoided.

6.7.2.2.7 The materials of the portable tank, including any devices, gaskets, linings and accessories, shall not adversely affect the substance(s) intended to be carried in the portable tank.

6.7.2.2.8 Portable tanks shall be designed and constructed with supports to provide a secure base during carriage and with suitable lifting and tie-down attachments.

6.7.2.2.9 Portable tanks shall be designed to withstand, without loss of contents, at least the internal pressure due to the contents, and the static, dynamic and thermal loads during normal conditions of handling and carriage. The design shall demonstrate that the effects of fatigue, caused by repeated application of these loads through the expected life of the portable tank, have been taken into account.

6.7.2.2.10 A shell which is to be equipped with a vacuum-relief device shall be designed to withstand, without permanent deformation, an external pressure of not less than 0.21 bar above the internal pressure. The vacuum-relief device shall be set to relieve at a vacuum setting not greater than minus (-) 0.21 bar unless the shell is designed for a higher external over pressure, in which case the vacuum-relief pressure of the device to be fitted shall be not greater than the tank design vacuum pressure. A shell that is not to be fitted with a vacuum-relief device shall be designed to withstand, without permanent deformation an external pressure of not less than 0.4 bar above the internal pressure.

6.7.2.2.11 Vacuum-relief devices used on portable tanks intended for the carriage of substances meeting the flash-point criteria of Class 3, including elevated temperature substances carried at or above their flash-point, shall prevent the immediate passage of flame into the shell, or the portable tank shall have a shell capable of withstanding, without leakage an internal explosion resulting from the passage of flame into the shell.

6.7.2.2.12 Portable tanks and their fastenings shall, under the maximum permissible load, be capable of absorbing the following separately applied static forces:

(a) In the direction of travel: twice the MPGM multiplied by the acceleration due to gravity (g) [1];

(b) Horizontally at right angles to the direction of travel: the MPGM (when the direction of travel is not clearly determined, the forces shall be equal to twice the MPGM) multiplied by the acceleration due to gravity (g) [1];

(c) Vertically upwards: the MPGM multiplied by the acceleration due to gravity (g) [1]; and

(d) Vertically downwards: twice the MPGM (total loading including the effect of gravity) multiplied by the acceleration due to gravity (g) [1].

6.7.2.2.13 Under each of the forces in 6.7.2.2.12, the safety factor to be observed shall be as follows:

(a) For metals having a clearly defined yield point, a safety factor of 1.5 in relation to the guaranteed yield strength; or

[1] *For calculation purposes g = 9.81 m/s^2.*

[1] *For calculation purposes g = 9.81 m/s^2.*

(b) For metals with no clearly defined yield point, a safety factor of 1.5 in relation to the guaranteed 0.2% proof strength and, for austenitic steels, the 1% proof strength.

6.7.2.2.14 The values of yield strength or proof strength shall be the values according to national or international material standards. When austenitic steels are used, the specified minimum values of yield strength or proof strength according to the material standards may be increased by up to 15% when these greater values are attested in the material inspection certificate. When no material standard exists for the metal in question, the value of yield strength or proof strength used shall be approved by the competent authority.

6.7.2.2.15 Portable tanks shall be capable of being electrically earthed when intended for the carriage of substances meeting the flash-point criteria of Class 3 including elevated temperature substances carried at or above their flash-point. Measures shall be taken to prevent dangerous electrostatic discharge.

6.7.2.2.16 When required for certain substances by the applicable portable tank instruction indicated in Column (10) of Table A of Chapter 3.2 and described in 4.2.4.2.6 or by a portable tank special provision indicated in Column (11) of Table A of Chapter 3.2 and described in 4.2.4.3, portable tanks shall be provided with additional protection, which may take the form of additional shell thickness or a higher test pressure, the additional shell thickness or higher test pressure being determined in the light of the inherent risks associated with the carriage of the substances concerned.

6.7.2.3 ***Design criteria***

6.7.2.3.1 Shells shall be of a design capable of being stress-analysed mathematically or experimentally by resistance strain gauges, or by other methods approved by the competent authority.

6.7.2.3.2 Shells shall be designed and constructed to withstand a hydraulic test pressure not less than 1.5 times the design pressure. Specific requirements are laid down for certain substances in the applicable portable tank instruction indicated in Column (10) of Table A of Chapter 3.2 and described in 4.2.4.2.6 or by a portable tank special provision indicated in Column (11) of Table A of Chapter 3.2 and described in 4.2.4.3. Attention is drawn to the minimum shell thickness requirements specified in 6.7.2.4.1 to 6.7.2.4.10.

6.7.2.3.3 For metals exhibiting a clearly defined yield point or characterized by a guaranteed proof strength (0.2% proof strength, generally, or 1% proof strength for austenitic steels) the primary membrane stress σ (sigma) in the shell shall not exceed 0.75 Re or 0.50 Rm, whichever is lower, at the test pressure, where:

Re = yield strength in N/mm^2, or 0.2% proof strength or, for austenitic steels, 1% proof strength;

Rm = minimum tensile strength in N/mm^2.

6.7.2.3.3.1 The values of Re and Rm to be used shall be the specified minimum values according to national or international material standards. When austenitic steels are used, the specified minimum values for Re and Rm according to the material standards may be increased by up to 15% when greater values are attested in the material inspection certificate. When no material standard exists for the metal in question, the values of Re and Rm used shall be approved by the competent authority or its authorized body.

6.7.2.3.3.2 Steels which have a Re/Rm ratio of more than 0.85 are not allowed for the construction of welded shells. The values of Re and Rm to be used in determining this ratio shall be the values specified in the material inspection certificate.

6.7.2.3.3.3 Steels used in the construction of shells shall have an elongation at fracture, in %, of not less than 10 000/Rm with an absolute minimum of 16% for fine grain steels and 20% for other steels. Aluminium and aluminium alloys used in the construction of shells shall have an elongation at fracture, in %, of not less than 10 000/6Rm with an absolute minimum of 12%.

6.7.2.3.3.4 For the purpose of determining actual values for materials, it shall be noted that for sheet metal, the axis of the tensile test specimen shall be at right angles (transversely) to the direction of rolling. The permanent elongation at fracture shall be measured on test specimens of rectangular cross sections in accordance with ISO 6892:1998 using a 50 mm gauge length.

6.7.2.4 ***Minimum shell thickness***

6.7.2.4.1 The minimum shell thickness shall be the greater thickness based on:

(a) The minimum thickness determined in accordance with the requirements of 6.7.2.4.2 to 6.7.2.4.10;

(b) The minimum thickness determined in accordance with the recognized pressure vessel code including the requirements in 6.7.2.3; and

(c) The minimum thickness specified in the applicable portable tank instruction indicated in Column (10) of Table A of Chapter 3.2 and described in 4.2.4.2.6 or by a portable tank special provision indicated in Column (11) of Table A of Chapter 3.2 and described in 4.2.4.3.

6.7.2.4.2 The cylindrical portions, ends (heads) and manhole covers of shells not more than 1.80 m in diameter shall be not less than 5 mm thick in the reference steel or of equivalent thickness in the metal to be used. Shells more than 1.80 m in diameter shall be not less than 6 mm thick in the reference steel or of equivalent thickness in the metal to be used, except that for powdered or granular solid substances of packing group II or III the minimum thickness requirement may be reduced to not less than 5 mm thick in the reference steel or of equivalent thickness in the metal to be used.

6.7.2.4.3 When additional protection against shell damage is provided, portable tanks with test pressures less than 2.65 bar may have the minimum shell thickness reduced, in proportion to the protection provided, as approved by the competent authority. However, shells not more than 1.80 m in diameter shall be not less than 3 mm thick in the reference steel or of equivalent thickness in the metal to be used. Shells more than 1.80 m in diameter shall be not less than 4 mm thick in the reference steel or of equivalent thickness in the metal to be used.

6.7.2.4.4 The cylindrical portions, ends (heads) and manhole covers of all shells shall be not less than 3 mm thick regardless of the material of construction.

6.7.2.4.5 The additional protection referred to in 6.7.2.4.3 may be provided by overall external structural protection, such as suitable "sandwich" construction with the outer sheathing (jacket) secured to the shell, double wall construction or by enclosing the shell in a complete framework with longitudinal and transverse structural members.

6.7.2.4.6 The equivalent thickness of a metal other than the thickness prescribed for the reference steel in 6.7.2.4.2 shall be determined using the following formula:

$$e_1 = \frac{21{,}4e_o}{\sqrt[3]{Rm_1 \times A_1}}$$

where:

e_1 = required equivalent thickness (in mm) of the metal to be used;

e_0 = minimum thickness (in mm) of the reference steel specified in the applicable portable tank instruction indicated in Column (10) of Table A of Chapter 3.2 and described in 4.2.4.2.6 or by a portable tank special provision indicated in Column (11) of Table A of Chapter 3.2 and described in 4.2.4.3;

Rm_1 = guaranteed minimum tensile strength (in N/mm^2) of the metal to be used (see 6.7.2.3.3);

A_1 = guaranteed minimum elongation at fracture (in %) of the metal to be used according to national or international standards.

6.7.2.4.7 When in the applicable portable tank instruction in 4.2.4.2.6, a minimum thickness of 8 mm, 10 mm or 12 mm is specified, it shall be noted that these thicknesses are based on the properties of the reference steel and a shell diameter of 1.80 m. When a metal other than mild steel (see 6.7.2.1) is used or the shell has a diameter of more than 1.80 m, the thickness shall be determined using the following formula:

$$e_1 = \frac{21{,}4e_o\, d_1}{1{,}8\ \sqrt[3]{Rm_1 \times A_1}}$$

where:

e_1 = required equivalent thickness (in mm) of the metal to be used;

e_0 = minimum thickness (in mm) of the reference steel specified in the applicable portable tank instruction indicated in Column (10) of Table A of Chapter 3.2 and described in 4.2.4.2.6 or by a portable tank special provision indicated in Column (11) of Table A of Chapter 3.2 and described in 4.2.4.3;

d_1 = diameter of the shell (in m), but not less than 1.80 m;

Rm_1 = guaranteed minimum tensile strength (in N/mm^2) of the metal to be used (see 6.7.2.3.3);

A_1 = guaranteed minimum elongation at fracture (in %) of the metal to be used according to national or international standards.

6.7.2.4.8 In no case shall the wall thickness be less than that prescribed in 6.7.2.4.2, 6.7.2.4.3 and 6.7.2.4.4. All parts of the shell shall have a minimum thickness as determined by 6.7.2.4.2 to 6.7.2.4.4. This thickness shall be exclusive of any corrosion allowance.

6.7.2.4.9 When mild steel is used (see 6.7.2.1), calculation using the formula in 6.7.2.4.6 is not required.

6.7.2.4.10 There shall be no sudden change of plate thickness at the attachment of the ends (heads) to the cylindrical portion of the shell.

6.7.2.5 ***Service equipment***

6.7.2.5.1 Service equipment shall be so arranged as to be protected against the risk of being wrenched off or damaged during handling and carriage. When the connection between the frame and the shell allows relative movement between the sub-assemblies, the equipment shall be so fastened as to permit such movement without risk of damage to working parts. The external discharge fittings (pipe sockets, shut-off devices), the internal stop-valve and its seating shall be protected against the danger of being wrenched off by external forces (for example using shear sections). The filling and discharge devices (including flanges or threaded plugs) and any protective caps shall be capable of being secured against unintended opening.

6.7.2.5.2 All openings in the shell, intended for filling or discharging the portable tank shall be fitted with a manually operated stop-valve located as close to the shell as reasonably practicable. Other openings, except for openings leading to venting or pressure-relief devices, shall be equipped with either a stop-valve or another suitable means of closure located as close to the shell as reasonably practicable.

6.7.2.5.3 All portable tanks shall be fitted with a manhole or other inspection openings of a suitable size to allow for internal inspection and adequate access for maintenance and repair of the interior. Compartmented portable tanks shall have a manhole or other inspection openings for each compartment.

6.7.2.5.4 As far as reasonably practicable, external fittings shall be grouped together. For insulated portable tanks, top fittings shall be surrounded by a spill collection reservoir with suitable drains.

6.7.2.5.5 Each connection to a portable tank shall be clearly marked to indicate its function.

6.7.2.5.6 Each stop-valve or other means of closure shall be designed and constructed to a rated pressure not less than the MAWP of the shell taking into account the temperatures expected during carriage. All stop-valves with screwed spindles shall close by a clockwise motion of the handwheel. For other stop-valves the position (open and closed) and direction of closure shall be clearly indicated. All stop-valves shall be designed to prevent unintentional opening.

6.7.2.5.7 No moving parts, such as covers, components of closures, etc., shall be made of unprotected corrodible steel when they are liable to come into frictional or percussive contact with aluminium portable tanks intended for the carriage of substances meeting the flash-point criteria of Class 3 including elevated temperature substances carried at or above their flash-point.

6.7.2.5.8 Piping shall be designed, constructed and installed so as to avoid the risk of damage due to thermal expansion and contraction, mechanical shock and vibration. All piping shall be of a suitable metallic material. Welded pipe joints shall be used wherever possible.

6.7.2.5.9 Joints in copper tubing shall be brazed or have an equally strong metal union. The melting point of brazing materials shall be no lower than 525 °C. The joints shall not decrease the strength of the tubing as may happen when cutting threads.

6.7.2.5.10 The burst pressure of all piping and pipe fittings shall be not less than the highest of four times the MAWP of the shell or four times the pressure to which it may be subjected in service by the action of a pump or other device (except pressure-relief devices).

6.7.2.5.11 Ductile metals shall be used in the construction of valves and accessories.

6.7.2.6 ***Bottom openings***

6.7.2.6.1 Certain substances shall not be carried in portable tanks with bottom openings. When the applicable portable tank instruction identified in Column (10) of Table A of Chapter 3.2 and described in 4.2.4.2.6 indicates that bottom openings are prohibited there shall be no openings below the liquid level of the shell when it is filled to its maximum permissible filling limit. When an existing opening is closed it shall be accomplished by internally and externally welding one plate to the shell.

6.7.2.6.2 Bottom discharge outlets for portable tanks carrying certain solid, crystallizable or highly viscous substances shall be equipped with not less than two serially fitted and mutually independent shut-off devices. The design of the equipment shall be to the satisfaction of the competent authority or its authorized body and shall include:

(a) An external stop-valve fitted as close to the shell as reasonably practicable; and

(b) A liquid tight closure at the end of the discharge pipe, which may be a bolted blank flange or a screw cap.

6.7.2.6.3 Every bottom discharge outlet, except as provided in 6.7.2.6.2, shall be equipped with three serially fitted and mutually independent shut-off devices. The design of the equipment shall be to the satisfaction of the competent authority or its authorized body and include:

(a) A self-closing internal stop-valve, that is a stop-valve within the shell or within a welded flange or its companion flange, such that:

(i) The control devices for the operation of the valve are designed so as to prevent any unintended opening through impact or other inadvertent act;

(ii) The valve may be operable from above or below;

(iii) If possible, the setting of the valve (open or closed) shall be capable of being verified from the ground;

(iv) Except for portable tanks having a capacity of not more than 1 000 litres, it shall be possible to close the valve from an accessible position of the portable tank that is remote from the valve itself; and

(v) The valve shall continue to be effective in the event of damage to the external device for controlling the operation of the valve;

(b) An external stop-valve fitted as close to the shell as reasonably practicable; and

(c) A liquid tight closure at the end of the discharge pipe, which may be a bolted blank flange or a screw cap.

6.7.2.6.4 For a lined shell, the internal stop-valve required by 6.7.2.6.3 (a) may be replaced by an additional external stop-valve. The manufacturer shall satisfy the requirements of the competent authority or its authorized body.

6.7.2.7 ***Safety-relief devices***

6.7.2.7.1 All portable tanks shall be fitted with at least one pressure-relief device. All relief devices shall be designed, constructed and marked to the satisfaction of the competent authority or its authorized body.

6.7.2.8 ***Pressure-relief devices***

6.7.2.8.1 Every portable tank with a capacity not less than 1 900 litres and every independent compartment of a portable tank with a similar capacity, shall be provided with one or more

pressure-relief devices of the spring-loaded type and may in addition have a frangible disc or fusible element in parallel with the spring-loaded devices except when prohibited by reference to 6.7.2.8.3 in the applicable portable tank instruction in 4.2.4.2.6. The pressure-relief devices shall have sufficient capacity to prevent rupture of the shell due to over pressurization or vacuum resulting from filling, discharging, or from heating of the contents.

6.7.2.8.2 Pressure-relief devices shall be designed to prevent the entry of foreign matter, the leakage of liquid and the development of any dangerous excess pressure.

6.7.2.8.3 When required for certain substances by the applicable portable tank instruction indicated in Column (10) of Table A of Chapter 3.2 and described in 4.2.4.2.6, portable tanks shall have a pressure-relief device approved by the competent authority. Unless a portable tank in dedicated service is fitted with an approved relief device constructed of materials compatible with the substance carried, the relief device shall comprise a frangible disc preceding a spring-loaded pressure-relief device. When a frangible disc is inserted in series with the required pressure-relief device, the space between the frangible disc and the pressure-relief device shall be provided with a pressure gauge or suitable tell-tale indicator for the detection of disc rupture, pinholing, or leakage which could cause a malfunction of the pressure-relief system. The frangible disc shall rupture at a nominal pressure 10% above the start to discharge pressure of the relief device.

6.7.2.8.4 Every portable tank with a capacity less than 1 900 litres shall be fitted with a pressure-relief device which may be a frangible disc when this disc complies with the requirements of 6.7.2.11.1. When no spring-loaded pressure-relief device is used, the frangible disc shall be set to rupture at a nominal pressure equal to the test pressure.

6.7.2.8.5 When the shell is fitted for pressure discharge, the inlet line shall be provided with a suitable pressure-relief device set to operate at a pressure not higher than the MAWP of the shell, and a stop-valve shall be fitted as close to the shell as reasonably practicable.

6.7.2.9 ***Setting of pressure-relief devices***

6.7.2.9.1 It shall be noted that the pressure-relief devices shall operate only in conditions of excessive rise in temperature, since the shell shall not be subject to undue fluctuations of pressure during normal conditions of carriage (see 6.7.2.12.2).

6.7.2.9.2 The required pressure-relief device shall be set to start-to-discharge at a nominal pressure of five-sixths of the test pressure for shells having a test pressure of not more than 4.5 bar and 110% of two-thirds of the test pressure for shells having a test pressure of more than 4.5 bar. After discharge the device shall close at a pressure not more than 10% below the pressure at which the discharge starts. The device shall remain closed at all lower pressures. This requirement does not prevent the use of vacuum-relief or combination pressure-relief and vacuum-relief devices.

6.7.2.10 ***Fusible elements***

6.7.2.10.1 Fusible elements shall operate at a temperature between 110 °C and 149 °C on condition that the pressure in the shell at the fusing temperature will be not more than the test pressure. They shall be placed at the top of the shell with their inlets in the vapour space and in no case shall they be shielded from external heat. Fusible elements shall not be utilized on portable tanks with a test pressure which exceeds 2.65 bar. Fusible elements used on portable tanks intended for the carriage of elevated temperature substances shall be designed to operate at a temperature higher than the maximum temperature that will be experienced during carriage and shall be to the satisfaction of the competent authority or its authorized body.

6.7.2.11 ***Frangible discs***

6.7.2.11.1 Except as specified in 6.7.2.8.3, frangible discs shall be set to rupture at a nominal pressure equal to the test pressure throughout the design temperature range. Particular attention shall be given to the requirements of 6.7.2.5.1 and 6.7.2.8.3 if frangible discs are used.

6.7.2.11.2 Frangible discs shall be appropriate for the vacuum pressures which may be produced in the portable tank.

6.7.2.12 ***Capacity of pressure-relief devices***

6.7.2.12.1 The spring-loaded pressure-relief device required by 6.7.2.8.1 shall have a minimum cross sectional flow area equivalent to an orifice of 31.75 mm diameter. Vacuum-relief devices, when used, shall have a cross sectional flow area not less than 284 mm^2.

6.7.2.12.2 The combined delivery capacity of the relief devices in condition of complete fire engulfment of the portable tank shall be sufficient to limit the pressure in the shell to 20% above the start-to-discharge pressure of the pressure limiting device. Emergency pressure-relief devices may be used to achieve the full relief capacity prescribed. These devices may be fusible, spring loaded or frangible disc components, or a combination of spring-loaded and frangible disc devices. The total required capacity of the relief devices may be determined using the formula in 6.7.2.12.2.1 or the table in 6.7.2.12.2.3.

6.7.2.12.2.1 To determine the total required capacity of the relief devices, which shall be regarded as being the sum of the individual capacities of all the contributing devices, the following formula shall be used:

$$Q = 12.4 \frac{FA^{0.82}}{LC} \sqrt{\frac{ZT}{M}}$$

where:

Q = minimum required rate of discharge in cubic metres of air per second (m^3/s) at standard conditions: 1 bar and 0 °C (273 K);

F = is a coefficient with the following value:

for uninsulated shells: $F = 1$;

for insulated shells: $F = U(649 - t)/13.6$ but in no case is less than 0.25

where:

U = thermal conductance of the insulation, in $kW.m^{-2}.K^{-1}$, at 38 °C;

t = actual temperature of the substance during filling (in °C); when this temperature is unknown, let t = 15 °C;

The value of F given above for insulated shells may be taken provided that the insulation is in accordance with 6.7.2.12.2.4;

A = total external surface area of shell in m^2;

Z = the gas compressibility factor in the accumulating condition (when this factor is unknown, let Z =1.0);

T = absolute temperature in Kelvin (°C + 273) above the pressure-relief devices in the accumulating condition;

L = the latent heat of vaporization of the liquid, in kJ/kg, in the accumulating condition;

M = molecular mass of the discharged gas;

C = a constant which is derived from one of the following formulae as a function of the ratio k of specific heats:

$$k = \frac{c_p}{c_v}$$

where:

c_p is the specific heat at constant pressure; and
c_v is the specific heat at constant volume.

When $k>1$:

$$C = \sqrt{k\left(\frac{2}{k+1}\right)^{\frac{k+1}{k-1}}}$$

When $k = 1$ or k is unknown:

$$C = \frac{1}{\sqrt{e}} = 0.607$$

where e is the mathematical constant 2.7183

C may also be taken from the following table:

k	C	k	C	k	C
1.00	0.607	1.26	0.660	1.52	0.704
1.02	0.611	1.28	0.664	1.54	0.707
1.04	0.615	1.30	0.667	1.56	0.710
1.06	0.620	1.32	0.671	1.58	0.713
1.08	0.624	1.34	0.674	1.60	0.716
1.10	0.628	1.36	0.678	1.62	0.719
1.12	0.633	1.38	0.681	1.64	0.722
1.14	0.637	1.40	0.685	1.66	0.725
1.16	0.641	1.42	0.688	1.68	0.728
1.18	0.645	1.44	0.691	1.70	0.731
1.20	0.649	1.46	0.695	2.00	0.770
1.22	0.652	1.48	0.698	2.20	0.793
1.24	0.656	1.50	0.701		

6.7.2.12.2.2 As an alternative to the formula above, shells designed for the carriage of liquids may have their relief devices sized in accordance with the table in 6.7.2.12.2.3. This table assumes an insulation value of $F = 1$ and shall be adjusted accordingly when the shell is insulated. Other values used in determining this table are:

M	=	86.7	T	=	394 K
L	=	334.94 kJ/kg	C	=	0.607
Z	=	1			

6.7.2.12.2.3 Minimum required rate of discharge, Q, in cubic metres per air per second at 1 bar and 0 °C (273 K)

A **Exposed area (square metres)**	**Q** **(Cubic metres of air per second)**	**A** **Exposed area (square metres)**	**Q** **(Cubic metres of air per second)**
2	0.230	37.5	2.539
3	0.320	40	2.677
4	0.405	42.5	2.814
5	0.487	45	2.949
6	0.565	47.5	3.082
7	0.641	50	3.215
8	0.715	52.5	3.346
9	0.788	55	3.476
10	0.859	57.5	3.605
12	0.998	60	3.733
14	1.132	62.5	3.860
16	1.263	65	3.987
18	1.391	67.5	4.112
20	1.517	70	4.236
22.5	1.670	75	4.483
25	1.821	80	4.726
27.5	1.969	85	4.967
30	2.115	90	5.206
32.5	2.258	95	5.442
35	2.400	100	5.676

6.7.2.12.2.4 Insulation systems, used for the purpose of reducing venting capacity, shall be approved by the competent authority or its authorized body. In all cases, insulation systems approved for this purpose shall:

(a) Remain effective at all temperatures up to 649 °C; and

(b) Be jacketed with a material having a melting point of 700 °C or greater.

6.7.2.13 ***Marking of pressure-relief devices***

6.7.2.13.1 Every pressure-relief device shall be clearly and permanently marked with the following particulars:

(a) The pressure (in bar or kPa) or temperature (in °C) at which it is set to discharge;

(b) The allowable tolerance at the discharge pressure for spring-loaded devices;

(c) The reference temperature corresponding to the rated pressure for frangible discs;

(d) The allowable temperature tolerance for fusible elements; and

(e) The rated flow capacity of the device in standard cubic metres of air per second (m^3/s);

When practicable, the following information shall also be shown:

(f) The manufacturer's name and relevant catalogue number of the device.

6.7.2.13.2 The rated flow capacity marked on the pressure-relief devices shall be determined according to ISO 4126-1:1991.

6.7.2.14 ***Connections to pressure-relief devices***

6.7.2.14.1 Connections to pressure-relief devices shall be of sufficient size to enable the required discharge to pass unrestricted to the safety device. No stop-valve shall be installed between the shell and the pressure-relief devices except where duplicate devices are provided for maintenance or other reasons and the stop-valves serving the devices actually in use are locked open or the stop-valves are interlocked so that at least one of the duplicate devices is always in use. There shall be no obstruction in an opening leading to a vent or pressure-relief device which might restrict or cut-off the flow from the shell to that device. Vents or pipes from the pressure-relief device outlets, when used, shall deliver the relieved vapour or liquid to the atmosphere in conditions of minimum back-pressure on the relieving devices.

6.7.2.15 ***Siting of pressure-relief devices***

6.7.2.15.1 Each pressure-relief device inlet shall be situated on top of the shell in a position as near the longitudinal and transverse centre of the shell as reasonably practicable. All pressure-relief device inlets shall under maximum filling conditions be situated in the vapour space of the shell and the devices shall be so arranged as to ensure the escaping vapour is discharged unrestrictedly. For flammable substances, the escaping vapour shall be directed away from the shell in such a manner that it cannot impinge upon the shell. Protective devices which deflect the flow of vapour are permissible provided the required relief-device capacity is not reduced.

6.7.2.15.2 Arrangements shall be made to prevent access to the pressure-relief devices by unauthorized persons and to protect the devices from damage caused by the portable tank overturning.

6.7.2.16 ***Gauging devices***

6.7.2.16.1 Glass level-gauges and gauges made of other fragile material, which are in direct communication with the contents of the tank shall not be used.

6.7.2.17 ***Portable tank supports, frameworks, lifting and tie-down attachments***

6.7.2.17.1 Portable tanks shall be designed and constructed with a support structure to provide a secure base during carriage. The forces specified in 6.7.2.2.12 and the safety factor specified in 6.7.2.2.13 shall be considered in this aspect of the design. Skids, frameworks, cradles or other similar structures are acceptable.

6.7.2.17.2 The combined stresses caused by portable tank mountings (e.g. cradles, framework, etc.) and portable tank lifting and tie-down attachments shall not cause excessive stress in any portion of the shell. Permanent lifting and tie-down attachments shall be fitted to all portable tanks. Preferably they shall be fitted to the portable tank supports but may be secured to reinforcing plates located on the shell at the points of support.

6.7.2.17.3 In the design of supports and frameworks the effects of environmental corrosion shall be taken into account.

6.7.2.17.4 Forklift pockets shall be capable of being closed off. The means of closing forklift pockets shall be a permanent part of the framework or permanently attached to the framework. Single compartment portable tanks with a length less than 3.65 m need not have closed off forklift pockets provided that:

(a) The shell including all the fittings are well protected from being hit by the forklift blades; and

(b) The distance between the centres of the forklift pockets is at least half of the maximum length of the portable tank.

6.7.2.17.5 When portable tanks are not protected during carriage, according to 4.2.1.2, the shells and service equipment shall be protected against damage to the shell and service equipment resulting from lateral or longitudinal impact or overturning. External fittings shall be protected so as to preclude the release of the shell contents upon impact or overturning of the portable tank on its fittings. Examples of protection include:

(a) Protection against lateral impact which may consist of longitudinal bars protecting the shell on both sides at the level of the median line;

(b) Protection of the portable tank against overturning which may consist of reinforcement rings or bars fixed across the frame;

(c) Protection against rear impact which may consist of a bumper or frame;

(d) Protection of the shell against damage from impact or overturning by use of an ISO frame in accordance with ISO 1496-3:1995.

6.7.2.18 ***Design approval***

6.7.2.18.1 The competent authority or its authorized body shall issue a design approval certificate for any new design of a portable tank. This certificate shall attest that a portable tank has been surveyed by that authority, is suitable for its intended purpose and meets the requirements of this Chapter and where appropriate, the provisions for substances provided in Chapter 4.2 and in Table A of Chapter 3.2. When a series of portable tanks are manufactured without change in the design, the certificate shall be valid for the entire series. The certificate shall refer to the prototype test report, the substances or group of substances allowed to be carried, the materials of construction of the shell and lining (when applicable) and an approval number. The approval number shall consist of the distinguishing sign or mark of the State in whose territory the approval was granted, i.e. the distinguishing sign for use in international traffic as prescribed by the Convention on Road Traffic, Vienna 1968, and a registration number. Any alternative arrangements according to 6.7.1.2 shall be indicated on the certificate. A design approval may serve for the approval of smaller portable tanks made of materials of the same kind and thickness, by the same fabrication techniques and with identical supports, equivalent closures and other appurtenances.

6.7.2.18.2 The prototype test report for the design approval shall include at least the following:

(a) The results of the applicable framework test specified in ISO 1496-3:1995;

(b) The results of the initial inspection and test according to 6.7.2.19.3; and

(c) The results of the impact test in 6.7.2.19.1, when applicable.

6.7.2.19 ***Inspection and testing***

6.7.2.19.1 For portable tanks meeting the definition of container in the CSC, a prototype representing each design shall be subjected to an impact test. The prototype portable tank shall be shown to be capable of absorbing the forces resulting from an impact not less than 4 times (4 g) the MPGM of the fully loaded portable tank at a duration typical of the mechanical shocks experienced in rail transport. The following is a listing of standards describing methods acceptable for performing the impact test:

Association of American Railroads,
Manual of Standards and Recommended Practices,
Specifications for Acceptability of Tank Containers (AAR.600), 1992

Canadian Standards Association (CSA),
Highway Tanks and Portable Tanks for the Transportation of Dangerous Goods (B620-1987)

Deutsche Bahn AG
Zentralbereich Technik, Minden
Portable tanks, longitudinal dynamic impact test

Société Nationale des Chemins de Fer Français
C.N.E.S.T. 002-1966.
Tank containers, longitudinal external stresses and dynamic impact tests

Spoornet, South Africa
Engineering Development Centre (EDC)
Testing of ISO Tank Containers
Method EDC/TES/023/000/1991-06

6.7.2.19.2 The shell and items of equipment of each portable tank shall be inspected and tested before being put into service for the first time (initial inspection and test) and thereafter at not more than five-year intervals (5 year periodic inspection and test) with an intermediate periodic inspection and test (2.5 year periodic inspection and test) midway between the 5 year periodic inspections and tests. The 2.5 year inspection and test may be performed within 3 months of the specified date. An exceptional inspection and test shall be performed regardless of the date of the last periodic inspection and test when necessary according to 6.7.2.19.7.

6.7.2.19.3 The initial inspection and test of a portable tank shall include a check of the design characteristics, an internal and external examination of the portable tank and its fittings with due regard to the substances to be carried, and a pressure test. Before the portable tank is placed into service, a leakproofness test and a check of the satisfactory operation of all service equipment shall also be performed. When the shell and its fittings have been pressure-tested separately, they shall be subjected together after assembly to a leakproofness test.

6.7.2.19.4 The 5-year periodic inspection and test shall include an internal and external examination and, as a general rule, a hydraulic pressure test. Sheathing, thermal insulation and the like shall be removed only to the extent required for reliable appraisal of the condition of the portable tank. When the shell and equipment have been pressure-tested separately, they shall be subjected together after assembly to a leakproofness test.

6.7.2.19.5 The intermediate 2.5 year periodic inspection and test shall at least include an internal and external examination of the portable tank and its fittings with due regard to the substances intended to be carried, a leakproofness test and a check of the satisfactory operation of all service equipment. Sheathing, thermal insulation and the like shall be removed only to the extent required for reliable appraisal of the condition of the portable tank. For portable tanks intended for the carriage of a single substance, the 2.5 year internal examination may be waived or substituted by other test methods or inspection procedures specified by the competent authority or its authorized body.

6.7.2.19.6 A portable tank may not be filled and offered for carriage after the date of expiry of the last 5 year or 2.5 year periodic inspection and test as required by 6.7.2.19.2. However, a portable tank filled prior to the date of expiry of the last periodic inspection and test may be carried for a period not to exceed three months beyond the date of expiry of the last periodic test or inspection. In addition, a portable tank may be carried after the date of expiry of the last periodic test and inspection:

(a) After emptying but before cleaning, for purposes of performing the next required test or inspection prior to refilling; and

(b) Unless otherwise approved by the competent authority, for a period not to exceed six months beyond the date of expiry of the last periodic test or inspection, in order to allow the return of dangerous goods for proper disposal or recycling. Reference to this exemption shall be mentioned in the transport document.

6.7.2.19.7 The exceptional inspection and test is necessary when the portable tank shows evidence of damaged or corroded areas, or leakage, or other conditions that indicate a deficiency that could affect the integrity of the portable tank. The extent of the exceptional inspection and test shall depend on the amount of damage or deterioration of the portable tank. It shall include at least the 2.5 year inspection and test according to 6.7.2.19.5.

6.7.2.19.8 The internal and external examinations shall ensure that:

(a) The shell is inspected for pitting, corrosion, or abrasions, dents, distortions, defects in welds or any other conditions, including leakage, that might render the portable tank unsafe for carriage;

(b) The piping, valves, heating/cooling system, and gaskets are inspected for corroded areas, defects, or any other conditions, including leakage, that might render the portable tank unsafe for filling, discharge or carriage;

(c) Devices for tightening manhole covers are operative and there is no leakage at manhole covers or gaskets;

(d) Missing or loose bolts or nuts on any flanged connection or blank flange are replaced or tightened;

(e) All emergency devices and valves are free from corrosion, distortion and any damage or defect that could prevent their normal operation. Remote closure devices and self-closing stop-valves shall be operated to demonstrate proper operation;

(f) Linings, if any, are inspected in accordance with criteria outlined by the lining manufacturer;

(g) Required markings on the portable tank are legible and in accordance with the applicable requirements; and

(h) The framework, supports and arrangements for lifting the portable tank are in a satisfactory condition.

6.7.2.19.9 The inspections and tests in 6.7.2.19.1, 6.7.2.19.3, 6.7.2.19.4, 6.7.2.19.5 and 6.7.2.19.7 shall be performed or witnessed by an expert approved by the competent authority or its authorized body. When the pressure test is a part of the inspection and test, the test pressure shall be the one indicated on the data plate of the portable tank. While under pressure, the portable tank shall be inspected for any leaks in the shell, piping or equipment.

6.7.2.19.10 In all cases when cutting, burning or welding operations on the shell have been effected, that work shall be to the approval of the competent authority or its authorized body taking into account the pressure vessel code used for the construction of the shell. A pressure test to the original test pressure shall be performed after the work is completed.

6.7.2.19.11 When evidence of any unsafe condition is discovered, the portable tank shall not be returned to service until it has been corrected and the test is repeated and passed.

6.7.2.20 ***Marking***

6.7.2.20.1 Every portable tank shall be fitted with a corrosion resistant metal plate permanently attached to the portable tank in a conspicuous place readily accessible for inspection. When for reasons of portable tank arrangements the plate cannot be permanently attached to the shell, the shell shall be marked with at least the information required by the pressure vessel code. As a minimum at least the following information shall be marked on the plate by stamping or by any other similar method.

Country of manufacture
U Approval Approval For Alternative Arrangements (see 6.7.1.2)
N Country Number "AA"
Manufacturer's name or mark
Manufacturer's serial number
Authorized body for the design approval
Owner's registration number
Year of manufacture
Pressure vessel code to which the shell is designed
Test pressure _____bar/kPa (gauge pressure) [2]
MAWP_____ bar/kPa (gauge pressure) [2]
External design pressure [3] _____ bar/kPa (gauge pressure) [2]
Design temperature range_____ °C to_____°C
Water capacity at 20 °C _____litres
Water capacity of each compartment at 20 °C _____ litres
Initial pressure test date and witness identification
MAWP for heating/cooling system _____ bar/kPa (gauge pressure) [2]
Shell material(s) and material standard reference(s)
Equivalent thickness in reference steel _____mm
Lining material (when applicable)
Date and type of most recent periodic test(s)
Month_____ Year_____ Test pressure_____bar/kPa (gauge pressure) [2]
Stamp of expert who performed or witnessed the most recent test

6.7.2.20.2 The following particulars shall be marked either on the portable tank itself or on a metal plate firmly secured to the portable tank:

Name of the operator
Name of substance(s) being carried and maximum mean bulk temperature when higher than 50 °C
Maximum permissible gross mass (MPGM) _____ kg
Unladen (tare) mass _____ kg

NOTE*: For the identification of the substances being carried, see also Part 5.*

[2] *The unit used shall be marked.*

[3] *See 6.7.2.2.10.*

6.7.2.20.3 If a portable tank is designed and approved for handling in open seas, the words "OFFSHORE PORTABLE TANK" shall be marked on the identification plate.

6.7.3 Requirements for the design, construction, inspection and testing of portable tanks intended for the carriage of non-refrigerated liquefied gases

6.7.3.1 *Definitions*

For the purposes of this section:

Portable tank means a multimodal tank having a capacity of more than 450 litres used for the carriage of non-refrigerated liquefied gases of Class 2. The portable tank includes a shell fitted with service equipment and structural equipment necessary for the carriage of gases. The portable tank shall be capable of being filled and discharged without the removal of its structural equipment. It shall possess stabilizing members external to the shell, and shall be capable of being lifted when full. It shall be designed primarily to be loaded onto a transport vehicle or ship and shall be equipped with skids, mountings or accessories to facilitate mechanical handling. Tank-vehicles, tank-wagons, non-metallic tanks, intermediate bulk containers (IBCs), gas cylinders and large receptacles are not considered to fall within the definition for portable tanks;

Shell means the part of the portable tank which retains the non-refrigerated liquefied gas intended for carriage (tank proper), including openings and their closures, but does not include service equipment or external structural equipment;

Service equipment means measuring instruments and filling, discharge, venting, safety and insulating devices;

Structural equipment means the reinforcing, fastening, protective and stabilizing members external to the shell;

Maximum allowable working pressure (MAWP) means a pressure that shall be not less than the highest of the following pressures measured at the top of the shell while in operating position, but in no case less than 7 bar:

(a) The maximum effective gauge pressure allowed in the shell during filling or discharge; or

(b) The maximum effective gauge pressure to which the shell is designed, which shall be:

(i) for a non-refrigerated liquefied gas listed in the portable tank instruction T50 in 4.2.4.2.6, the MAWP (in bar) given in T50 portable tank instruction for that gas;

(ii) for other non-refrigerated liquefied gases, not less than the sum of:

- the absolute vapour pressure (in bar) of the non-refrigerated liquefied gas at the design reference temperature minus 1 bar; and

- the partial pressure (in bar) of air or other gases in the ullage space being determined by the design reference temperature and the liquid phase expansion due to an increase of the mean bulk temperature of $t_r - t_f$ (t_f = filling temperature, usually 15 °C, t_r = maximum mean bulk temperature, 50 °C);

Design pressure means the pressure to be used in calculations required by a recognized pressure vessel code. The design pressure shall be not less than the highest of the following pressures:

(a) The maximum effective gauge pressure allowed in the shell during filling or discharge; or

(b) The sum of:

(i) the maximum effective gauge pressure to which the shell is designed as defined in (b) of the MAWP definition (see above); and

(ii) a head pressure determined on the basis of the dynamic forces specified in 6.7.3.2.9, but not less than 0.35 bar;

Test pressure means the maximum gauge pressure at the top of the shell during the pressure test;

Leakproofness test means a test using gas subjecting the shell and its service equipment to an effective internal pressure of not less than 25% of the MAWP;

Maximum permissible gross mass (MPGM) means the sum of the tare mass of the portable tank and the heaviest load authorized for carriage;

Reference steel means a steel with a tensile strength of 370 N/mm^2 and an elongation at fracture of 27%;

Mild steel means a steel with a guaranteed minimum tensile strength of 360 N/mm^2 to 440 N/mm^2 and a guaranteed minimum elongation at fracture conforming to 6.7.3.3.3.3;

Design temperature range for the shell shall be -40 °C to 50 °C for non-refrigerated liquefied gases carried under ambient conditions. More severe design temperatures shall be considered for portable tanks subjected to severe climatic conditions;

Design reference temperature means the temperature at which the vapour pressure of the contents is determined for the purpose of calculating the MAWP. The design reference temperature shall be less than the critical temperature of the non-refrigerated liquefied gas intended to be carried to ensure that the gas at all times is liquefied. This value for each portable tank type is as follows:

(a) Shell with a diameter of 1.5 metres or less: 65 °C;

(b) Shell with a diameter of more than 1.5 metres:

(i) without insulation or sun shield: 60 °C;

(ii) with sun shield (see 6.7.3.2.12): 55 °C; and

(iii) with insulation (see 6.7.3.2.12) : 50 °C;

Filling density means the average mass of non-refrigerated liquefied gas per litre of shell capacity (kg/l). The filling density is given in portable tank instruction T50 in 4.2.4.2.6.

6.7.3.2 ***General design and construction requirements***

6.7.3.2.1 Shells shall be designed and constructed in accordance with the requirements of a pressure vessel code recognized by the competent authority. Shells shall be made of steel suitable for forming. The materials shall in principle conform to national or international material standards. For welded shells, only a material whose weldability has been fully demonstrated shall be used. Welds shall be skilfully made and afford complete safety. When the manufacturing process or the materials make it necessary, the shells shall be suitability heat-treated to guarantee adequate toughness in the weld and in the heat affected zones. In choosing the material the design temperature range shall be taken into account with respect to risk of brittle fracture, to stress corrosion cracking and to resistance to impact. When fine grain steel is used, the guaranteed value of the yield strength shall be not more than 460 N/mm^2 and the guaranteed value of the upper limit of the tensile strength shall be not more than 725 N/mm^2 according to the material specification. Portable tank materials shall be suitable for the external environment in which they may be carried.

6.7.3.2.2 Portable tank shells, fittings and pipework shall be constructed of materials which are:

(a) Substantially immune to attack by the non-refrigerated liquefied gas(es) intended to be carried; or

(b) Properly passivated or neutralized by chemical reaction.

6.7.3.2.3 Gaskets shall be made of materials compatible with the non-refrigerated liquefied gas(es) intended to be carried.

6.7.3.2.4 Contact between dissimilar metals which could result in damage by galvanic action shall be avoided.

6.7.3.2.5 The materials of the portable tank, including any devices, gaskets, and accessories, shall not adversely affect the non-refrigerated liquefied gas(es) intended for carriage in the portable tank.

6.7.3.2.6 Portable tanks shall be designed and constructed with supports to provide a secure base during carriage and with suitable lifting and tie-down attachments.

6.7.3.2.7 Portable tanks shall be designed to withstand, without loss of contents, at least the internal pressure due to the contents, and the static, dynamic and thermal loads during normal conditions of handling and carriage. The design shall demonstrate that the effects of fatigue, caused by repeated application of these loads through the expected life of the portable tank, have been taken into account.

6.7.3.2.8 Shells shall be designed to withstand an external pressure of at least 0.4 bar (gauge pressure) above the internal pressure without permanent deformation. When the shell is to be subjected to a significant vacuum before filling or during discharge it shall be designed to withstand an external pressure of at least 0.9 bar (gauge pressure) above the internal pressure and shall be proven at that pressure.

6.7.3.2.9 Portable tanks and their fastenings shall, under the maximum permissible load, be capable of absorbing the following separately applied static forces:

(a) In the direction of travel: twice the MPGM multiplied by the acceleration due to gravity (g) [4] ;

[4] *For calculation purposes g = 9.81 m/s^2.*

(b) Horizontally at right angles to the direction of travel: the MPGM (when the direction of travel is not clearly determined, the forces shall be equal to twice the MPGM) multiplied by the acceleration due to gravity (g) [4];

(c) Vertically upwards: the MPGM multiplied by the acceleration due to gravity (g) [4]; and

(d) Vertically downwards: twice the MPGM (total loading including the effect of gravity) multiplied by the acceleration due to gravity (g) [4].

6.7.3.2.10 Under each of the forces in 6.7.3.2.9, the safety factor to be observed shall be as follows:

(a) For steels having a clearly defined yield point, a safety factor of 1.5 in relation to the guaranteed yield strength; or

(b) For steels with no clearly defined yield point, a safety factor of 1.5 in relation to the guaranteed 0.2% proof strength and, for austenitic steels, the 1% proof strength.

6.7.3.2.11 The values of yield strength or proof strength shall be the values according to national or international material standards. When austenitic steels are used, the specified minimum values of yield strength and proof strength according to the material standards may be increased by up to 15% when these greater values are attested in the material inspection certificate. When no material standard exists for the steel in question, the value of yield strength or proof strength used shall be approved by the competent authority.

6.7.3.2.12 When the shells intended for the carriage of non-refrigerated liquefied gases are equipped with thermal insulation, the thermal insulation systems shall satisfy the following requirements:

(a) It shall consist of a shield covering not less than the upper third but not more than the upper half of the surface of the shell and separated from the shell by an air space about 40 mm across;

(b) It shall consist of a complete cladding of adequate thickness of insulating materials protected so as to prevent the ingress of moisture and damage under normal conditions of carriage and so as to provide a thermal conductance of not more than 0.67 ($W.m^{-2}.K^{-1}$);

(c) When the protective covering is so closed as to be gas-tight, a device shall be provided to prevent any dangerous pressure from developing in the insulating layer in the event of inadequate gas tightness of the shell or of its items of equipment; and

(d) The thermal insulation shall not inhibit access to the fittings and discharge devices.

6.7.3.2.13 Portable tanks intended for the carriage of flammable non-refrigerated liquefied gases shall be capable of being electrically earthed.

6.7.3.3 ***Design criteria***

6.7.3.3.1 Shells shall be of a circular cross-section.

6.7.3.3.2 Shells shall be designed and constructed to withstand a test pressure not less than 1.3 times the design pressure. The shell design shall take into account the minimum MAWP values provided in portable tank instruction T50 in 4.2.4.2.6 for each non-refrigerated liquefied gas intended for carriage. Attention is drawn to the minimum shell thickness requirements for these shells specified in 6.7.3.4.

6.7.3.3.3 For steels exhibiting a clearly defined yield point or characterized by a guaranteed proof strength (0.2% proof strength, generally, or 1% proof strength for austenitic steels) the primary membrane stress σ (sigma) in the shell shall not exceed 0.75 Re or 0.50 Rm, whichever is lower, at the test pressure, where:

Re = yield strength in N/mm^2, or 0.2% proof strength or, for austenitic steels, 1% proof stress;

Rm = minimum tensile strength in N/mm^2.

6.7.3.3.3.1 The values of Re and Rm to be used shall be the specified minimum values according to national or international material standards. When austenitic steels are used, the specified minimum values for Re and Rm according to the material standards may be increased by up to 15% when these greater values are attested in the material inspection certificate. When no material standard exists for the steel in question, the values of Re and Rm used shall be approved by the competent authority or its authorized body.

6.7.3.3.3.2 Steels which have a Re/Rm ratio of more than 0.85 are not allowed for the construction of welded shells. The values of Re and Rm to be used in determining this ratio shall be the values specified in the material inspection certificate.

6.7.3.3.3.3 Steels used in the construction of shells shall have an elongation at fracture, in %, of not less than 10 000/Rm with an absolute minimum of 16% for fine grain steels and 20% for other steels.

6.7.3.3.3.4 For the purpose of determining actual values for materials, it shall be noted that for sheet metal, the axis of the tensile test specimen shall be at right angles (transversely) to the direction of rolling. The permanent elongation at fracture shall be measured on test specimens of rectangular cross sections in accordance with ISO 6892:1998 using a 50 mm gauge length.

6.7.3.4 ***Minimum shell thickness***

6.7.3.4.1 The minimum shell thickness shall be the greater thickness based on:

(a) The minimum thickness determined in accordance with the requirements in 6.7.3.4; and

(b) The minimum thickness determined in accordance with the recognized pressure vessel code including the requirements in 6.7.3.3.

6.7.3.4.2 The cylindrical portions, ends (heads) and manhole covers of shells of not more than 1.80 m in diameter shall be not less than 5 mm thick in the reference steel or of equivalent thickness in the steel to be used. Shells of more than 1.80 m in diameter shall be not less than 6 mm thick in the reference steel or of equivalent thickness in the steel to be used.

6.7.3.4.3 The cylindrical portions, ends (heads) and manhole covers of all shells shall be not less than 4 mm thick regardless of the material of construction.

6.7.3.4.4 The equivalent thickness of a steel other than the thickness prescribed for the reference steel in 6.7.3.4.2 shall be determined using the following formula:

$$e_1 = \frac{21{,}4 e_o}{\sqrt[3]{Rm_1 \times A_1}}$$

where:

e_1 = required equivalent thickness (in mm) of the steel to be used;

e_0 = minimum thickness (in mm) for the reference steel specified in 6.7.3.4.2;

Rm_1 = guaranteed minimum tensile strength (in N/mm^2) of the steel to be used (see 6.7.3.3.3);

A_1 = guaranteed minimum elongation at fracture (in %) of the steel to be used according to national or international standards.

6.7.3.4.5 In no case shall the wall thickness be less than that prescribed in 6.7.3.4.1 to 6.7.3.4.3. All parts of the shell shall have a minimum thickness as determined by 6.7.3.4.1 to 6.7.3.4.3. This thickness shall be exclusive of any corrosion allowance.

6.7.3.4.6 When mild steel is used (see 6.7.3.1), calculation using the formula in 6.7.3.4.4 is not required.

6.7.3.4.7 There shall be no sudden change of plate thickness at the attachment of the ends (heads) to the cylindrical portion of the shell.

6.7.3.5 ***Service equipment***

6.7.3.5.1 Service equipment shall be so arranged as to be protected against the risk of being wrenched off or damaged during handling and carriage. When the connection between the frame and the shell allows relative movement between the sub-assemblies, the equipment shall be so fastened as to permit such movement without risk of damage to working parts. The external discharge fittings (pipe sockets, shut-off devices), the internal stop-valve and its seating shall be protected against the danger of being wrenched off by external forces (for example using shear sections). The filling and discharge devices (including flanges or threaded plugs) and any protective caps shall be capable of being secured against unintended opening.

6.7.3.5.2 All openings with a diameter of more than 1.5 mm in shells of portable tanks, except openings for pressure-relief devices, inspection openings and closed bleed holes, shall be fitted with at least three mutually independent shut-off devices in series, the first being an internal stop-valve, excess flow valve or equivalent device, the second being an external stop-valve and the third being a blank flange or equivalent device.

6.7.3.5.2.1 When a portable tank is fitted with an excess flow valve, the excess flow valve shall be so fitted that its seating is inside the shell or inside a welded flange or, when fitted externally, its mountings shall be designed so that in the event of impact its effectiveness shall be maintained. The excess flow valves shall be selected and fitted so as to close automatically when the rated flow specified by the manufacturer is reached. Connections and accessories leading to or from such a valve shall have a capacity for a flow more than the rated flow of the excess flow valve.

6.7.3.5.3 For filling and discharge openings, the first shut-off device shall be an internal stop-valve and the second shall be a stop-valve placed in an accessible position on each discharge and filling pipe.

6.7.3.5.4 For filling and discharge bottom openings of portable tanks intended for the carriage of flammable and/or toxic non-refrigerated liquefied gases the internal stop-valve shall be a quick closing safety device which closes automatically in the event of unintended movement of the portable tank during filling or discharge or fire engulfment. Except for portable tanks having a capacity of not more than 1 000 litres, it shall be possible to operate this device by remote control.

6.7.3.5.5 In addition to filling, discharge and gas pressure equalizing orifices, shells may have openings in which gauges, thermometers and manometers can be fitted. Connections for such instruments shall be made by suitable welded nozzles or pockets and not be screwed connections through the shell.

6.7.3.5.6 All portable tanks shall be fitted with manholes or other inspection openings of suitable size to allow for internal inspection and adequate access for maintenance and repair of the interior.

6.7.3.5.7 External fittings shall be grouped together so far as reasonably practicable.

6.7.3.5.8 Each connection on a portable tank shall be clearly marked to indicate its function.

6.7.3.5.9 Each stop-valve or other means of closure shall be designed and constructed to a rated pressure not less than the MAWP of the shell taking into account the temperatures expected during carriage. All stop-valves with a screwed spindle shall close by a clockwise motion of the handwheel. For other stop-valves the position (open and closed) and direction of closure shall be clearly indicated. All stop-valves shall be designed to prevent unintentional opening.

6.7.3.5.10 Piping shall be designed, constructed and installed so as to avoid the risk of damage due to thermal expansion and contraction, mechanical shock and vibration. All piping shall be of suitable metallic material. Welded pipe joints shall be used wherever possible.

6.7.3.5.11 Joints in copper tubing shall be brazed or have an equally strong metal union. The melting point of brazing materials shall be no lower than 525 °C. The joints shall not decrease the strength of tubing as may happen when cutting threads.

6.7.3.5.12 The burst pressure of all piping and pipe fittings shall be not less than the highest of four times the MAWP of the shell or four times the pressure to which it may be subjected in service by the action of a pump or other device (except pressure-relief devices).

6.7.3.5.13 Ductile metals shall be used in the construction of valves and accessories.

6.7.3.6 ***Bottom openings***

6.7.3.6.1 Certain non-refrigerated liquefied gases shall not be carried in portable tanks with bottom openings when portable tank instruction T50 in 4.2.4.2.6 indicates that bottom openings are not allowed. There shall be no openings below the liquid level of the shell when it is filled to its maximum permissible filling limit.

6.7.3.7 ***Pressure-relief devices***

6.7.3.7.1 Portable tanks shall be provided with one or more spring-loaded pressure-relief devices. The pressure-relief devices shall open automatically at a pressure not less than the MAWP and be fully open at a pressure equal to 110% of the MAWP. These devices shall, after discharge, close at a pressure not lower than 10% below the pressure at which discharge starts and shall remain closed at all lower pressures. The pressure-relief devices shall be of a type that will resist dynamic forces including liquid surge. Frangible discs not in series with a spring-loaded pressure-relief device are not permitted.

6.7.3.7.2 Pressure-relief devices shall be designed to prevent the entry of foreign matter, the leakage of gas and the development of any dangerous excess pressure.

6.7.3.7.3 Portable tanks intended for the carriage of certain non-refrigerated liquefied gases identified in portable tank instruction T50 in 4.2.4.2.6 shall have a pressure-relief device approved by the competent authority. Unless a portable tank in dedicated service is fitted with an

approved relief device constructed of materials compatible with the load, such device shall comprise a frangible disc preceding a spring-loaded device. The space between the frangible disc and the device shall be provided with a pressure gauge or a suitable tell-tale indicator. This arrangement permits the detection of disc rupture, pinholing or leakage which could cause a malfunction of the pressure-relief device. The frangible discs shall rupture at a nominal pressure 10% above the start-to-discharge pressure of the relief device.

6.7.3.7.4 In the case of multi-purpose portable tanks, the pressure-relief devices shall open at a pressure indicated in 6.7.3.7.1 for the gas having the highest maximum allowable pressure of the gases allowed to be carried in the portable tank.

6.7.3.8 ***Capacity of relief devices***

6.7.3.8.1 The combined delivery capacity of the relief devices shall be sufficient that, in the event of total fire engulfment, the pressure (including accumulation) inside the shell does not exceed 120% of the MAWP. Spring-loaded relief devices shall be used to achieve the full relief capacity prescribed. In the case of multi-purpose tanks, the combined delivery capacity of the pressure-relief devices shall be taken for the gas which requires the highest delivery capacity of the gases allowed to be carried in portable tanks.

6.7.3.8.1.1 To determine the total required capacity of the relief devices, which shall be regarded as being the sum of the individual capacities of the several devices, the following formulae [5] shall be used:

$$Q = 12.4 \frac{FA^{0.82}}{LC}\sqrt{\frac{ZT}{M}}$$

where:

Q = minimum required rate of discharge in cubic metres of air per second (m^3/s) at standard conditions: 1 bar and 0 °C (273 K);

F = is a coefficient with the following value:

for uninsulated shells: F = 1;

for insulated shells: F = U(649-t)/13.6 but in no case is less than 0.25 where:

U = thermal conductance of the insulation, in $Kw.m^{-2}.K^{-1}$, at 38 °C;

t = actual temperature of the non-refrigerated liquefied gas during filling (°C); when this temperature is unknown, let t=15 °C;

The value of F given above for insulated shells may be taken provided that the insulation is in accordance with 6.7.3.8.1.2;

where:

A = total external surface area of shell in square metres;

Z = the gas compressibility factor in the accumulating condition (when this

[5] *This formula applies only to non-refrigerated liquefied gases which have critical temperatures well above the temperature at the accumulating condition. For gases which have critical temperatures near or below the temperature at the accumulating condition, the calculation of the pressure-relief device delivery capacity shall consider further thermodynamic properties of the gas (see for example CGA S-1.2-1995).*

T = absolute temperature in Kelvin (°C + 273) above the pressure-relief devices in the accumulating condition;

L = the latent heat of vaporization of the liquid, in kJ/kg, in the accumulating condition;

M = molecular mass of the discharged gas;

C = a constant which is derived from one of the following formulae as a function of the ratio k of specific heats

$$k = \frac{c_p}{c_v}$$

where

c_p is the specific heat at constant pressure; and

c_v is the specific heat at constant volume.

<u>when k > 1</u>:

$$C = \sqrt{k\left(\frac{2}{k+1}\right)^{\frac{k+1}{k-1}}}$$

<u>when k = 1</u> or <u>K is unknown</u>:

$$C = \frac{1}{\sqrt{e}} = 0.607$$

where e is the mathematical constant 2.7183

C may also be taken from the following table:

k	C	k	C	k	C
1.00	0.607	1.26	0.660	1.52	0.704
1.02	0.611	1.28	0.664	1.54	0.707
1.04	0.615	1.30	0.667	1.56	0.710
1.06	0.620	1.32	0.671	1.58	0.713
1.08	0.624	1.34	0.674	1.60	0.716
1.10	0.628	1.36	0.678	1.62	0.719
1.12	0.633	1.38	0.681	1.64	0.722
1.14	0.637	1.40	0.685	1.66	0.725
1.16	0.641	1.42	0.688	1.68	0.728
1.18	0.645	1.44	0.691	1.70	0.731
1.20	0.649	1.46	0.695	2.00	0.770
1.22	0.652	1.48	0.698	2.20	0.793
1.24	0.656	1.50	0.701		

6.7.3.8.1.2 Insulation systems, used for the purpose of reducing the venting capacity, shall be approved by the competent authority or its authorized body. In all cases, insulation systems approved for this purpose shall:

(a) Remain effective at all temperatures up to 649 °C; and
(b) Be jacketed with a material having a melting point of 700 °C or greater.

6.7.3.9 ***Marking of pressure-relief devices***

6.7.3.9.1 Every pressure-relief device shall be plainly and permanently marked with the following particulars:

(a) The pressure (in bar or kPa) at which it is set to discharge;

(b) The allowable tolerance at the discharge pressure for spring-loaded devices;

(c) The reference temperature corresponding to the rated pressure for frangible discs; and

(d) The rated flow capacity of the device in standard cubic metres of air per second (m^3/s).

When practicable, the following information shall also be shown:

(e) The manufacturer's name and relevant catalogue number of the device.

6.7.3.9.2 The rated flow capacity marked on the pressure-relief devices shall be determined according to ISO 4126-1:1991.

6.7.3.10 ***Connections to pressure-relief devices***

6.7.3.10.1 Connections to pressure-relief devices shall be of sufficient size to enable the required discharge to pass unrestricted to the safety device. No stop-valve shall be installed between the shell and the pressure-relief devices except when duplicate devices are provided for maintenance or other reasons and the stop-valves serving the devices actually in use are locked open or the stop-valves are interlocked so that at least one of the duplicate devices is always operable and capable of meeting the requirements of 6.7.3.8. There shall be no obstruction in an opening leading to a vent or pressure-relief device which might restrict or cut-off the flow from the shell to that device. Vents from the pressure-relief devices, when used, shall deliver the relieved vapour or liquid to the atmosphere in conditions of minimum back-pressure on the relieving device.

6.7.3.11 ***Siting of pressure-relief devices***

6.7.3.11.1 Each pressure-relief device inlet shall be situated on top of the shell in a position as near the longitudinal and transverse centre of the shell as reasonably practicable. All pressure relief device inlets shall under maximum filling conditions be situated in the vapour space of the shell and the devices shall be so arranged as to ensure that the escaping vapour is discharged unrestrictedly. For flammable non-refrigerated liquefied gases, the escaping vapour shall be directed away from the shell in such a manner that it cannot impinge upon the shell. Protective devices which deflect the flow of vapour are permissible provided the required relief-device capacity is not reduced.

6.7.3.11.2 Arrangements shall be made to prevent access to the pressure-relief devices by unauthorized persons and to protect the devices from damage caused by the portable tank overturning.

6.7.3.12 ***Gauging devices***

6.7.3.12.1 Unless a portable tank is intended to be filled by weight it shall be equipped with one or more gauging devices. Glass level-gauges and gauges made of other fragile material, which are in direct communication with the contents of the shell shall not be used.

6.7.3.13 ***Portable tank supports, frameworks, lifting and tie-down attachments***

6.7.3.13.1 Portable tanks shall be designed and constructed with a support structure to provide a secure base during carriage. The forces specified in 6.7.3.2.9 and the safety factor specified in 6.7.3.2.10 shall be considered in this aspect of the design. Skids, frameworks, cradles or other similar structures are acceptable.

6.7.3.13.2 The combined stresses caused by portable tank mountings (e.g. cradles, frameworks, etc.) and portable tank lifting and tie-down attachments shall not cause excessive stress in any portion of the shell. Permanent lifting and tie-down attachments shall be fitted to all portable tanks. Preferably they shall be fitted to the portable tank supports but may be secured to reinforcing plates located on the shell at the points of support.

6.7.3.13.3 In the design of supports and frameworks the effects of environmental corrosion shall be taken into account.

6.7.3.13.4 Forklift pockets shall be capable of being closed off. The means of closing forklift pockets shall be a permanent part of the framework or permanently attached to the framework. Single compartment portable tanks with a length less than 3.65 m need not have closed off forklift pockets provided that:

(a) The shell and all the fittings are well protected from being hit by the forklift blades; and

(b) The distance between the centres of the forklift pockets is at least half of the maximum length of the portable tank.

6.7.3.13.5 When portable tanks are not protected during carriage, according to 4.2.2.3, the shells and service equipment shall be protected against damage to the shell and service equipment resulting from lateral or longitudinal impact or overturning. External fittings shall be protected so as to preclude the release of the shell contents upon impact or overturning of the portable tank on its fittings. Examples of protection include:

(a) Protection against lateral impact which may consist of longitudinal bars protecting the shell on both sides at the level of the median line;

(b) Protection of the portable tank against overturning which may consist of reinforcement rings or bars fixed across the frame;

(c) Protection against rear impact which may consist of a bumper or frame;

(d) Protection of the shell against damage from impact or overturning by use of an ISO frame in accordance with ISO 1496-3:1995.

6.7.3.14 ***Design approval***

6.7.3.14.1 The competent authority or its authorized body shall issue a design approval certificate for any new design of a portable tank. This certificate shall attest that a portable tank has been surveyed by that authority, is suitable for its intended purpose and meets the requirements of this Chapter and where appropriate the provisions for gases provided in portable tank

instruction T50 in 4.2.4.2.6. When a series of portable tanks are manufactured without change in the design, the certificate shall be valid for the entire series. The certificate shall refer to the prototype test report, the gases allowed to be carried, the materials of construction of the shell and an approval number. The approval number shall consist of the distinguishing sign or mark of the State in whose territory the approval was granted, i.e. the distinguishing sign for use in international traffic, as prescribed by the Convention on Road Traffic, Vienna 1968, and a registration number. Any alternative arrangements according to 6.7.1.2 shall be indicated on the certificate. A design approval may serve for the approval of smaller portable tanks made of materials of the same kind and thickness, by the same fabrication techniques and with identical supports, equivalent closures and other appurtenances.

6.7.3.14.2 The prototype test report for the design approval shall include at least the following:

(a) The results of the applicable framework test specified in ISO 1496-3:1995;

(b) The results of the initial inspection and test in 6.7.3.15.3; and

(c) The results of the impact test in 6.7.3.15.1, when applicable.

6.7.3.15 ***Inspection and testing***

6.7.3.15.1 For portable tanks meeting the definition of container in the CSC, a prototype representing each design shall be subjected to an impact test. The prototype portable tank shall be shown to be capable of absorbing the forces resulting from an impact not less than 4 times (4 g) the MPGM of the fully loaded portable tank at a duration typical of the mechanical shocks experienced in rail transport. The following is a listing of standards describing methods acceptable for performing the impact test:

Association of American Railroads,
Manual of Standards and Recommended Practices,
Specifications for Acceptability of Tank Containers (AAR.600), 1992

Canadian Standards Association (CSA),
Highway Tanks and Portable Tanks for the Transportation of Dangerous Goods
(B620-1987)

Deutsche Bahn AG
Zentralbereich Technik, Minden
Portable tanks, longitudinal dynamic impact test

Société Nationale des Chemins de Fer Français
C.N.E.S.T. 002-1966.
Tank containers, longitudinal external stresses and dynamic impact tests

Spoornet, South Africa
Engineering Development Centre (EDC)
Testing of ISO Tank Containers
Method EDC/TES/023/000/1991-06

6.7.3.15.2 The shell and items of equipment of each portable tank shall be inspected and tested before being put into service for the first time (initial inspection and test) and thereafter at not more than five-year intervals (5 year periodic inspection and test) with an intermediate periodic inspection and test (2.5 year periodic inspection and test) midway between the 5 year periodic inspections and tests. The 2.5 year inspection and test may be performed within 3

months of the specified date. An exceptional inspection and test shall be performed regardless of the last periodic inspection and test when necessary according to 6.7.3.15.7.

6.7.3.15.3 The initial inspection and test of a portable tank shall include a check of the design characteristics, an internal and external examination of the portable tank and its fittings with due regard to the non-refrigerated liquefied gases to be carried, and a pressure test referring to the test pressures according to 6.7.3.3.2. The pressure test may be performed as a hydraulic test or by using another liquid or gas with the agreement of the competent authority or its authorized body. Before the portable tank is placed into service, a leakproofness test and a test of the satisfactory operation of all service equipment shall also be performed. When the shell and its fittings have been pressure-tested separately, they shall be subjected together after assembly to a leakproofness test. All welds subject to full stress level in the shell shall be inspected during the initial test by radiographic, ultrasonic, or another suitable non-destructive test method. This does not apply to the jacket.

6.7.3.15.4 The 5 year periodic inspection and test shall include an internal and external examination and, as a general rule, a hydraulic pressure test. Sheathing, thermal insulation and the like shall be removed only to the extent required for reliable appraisal of the condition of the portable tank. When the shell and equipment have been pressure-tested separately, they shall be subjected together after assembly to a leakproofness test.

6.7.3.15.5 The intermediate 2.5 year periodic inspection and test shall at least include an internal and external examination of the portable tank and its fittings with due regard to the non-refrigerated liquefied gases intended to be carried, a leakproofness test and a check of the satisfactory operation of all service equipment. Sheathing thermal insulation and the like shall be removed only to the extent required for reliable appraisal of the condition of the portable tank. For portable tanks intended for the carriage of a single non-refrigerated liquefied gas, the 2.5 year internal examination may be waived or substituted by other test methods or inspection procedures specified by the competent authority or its authorized body.

6.7.3.15.6 A portable tank may not be filled and offered for carriage after the date of expiry of the last 5 year or 2.5 year periodic inspection and test as required by 6.7.3.15.2. However a portable tank filled prior to the date of expiry of the last periodic inspection and test may be carried for a period not to exceed three months beyond the date of expiry of the last periodic test or inspection. In addition, a portable tank may be carried after the date of expiry of the last periodic test and inspection:

(a) After emptying but before cleaning, for purposes of performing the next required test or inspection prior to refilling; and

(b) Unless otherwise approved by the competent authority, for a period not to exceed six months beyond the date of expiry of the last periodic test or inspection, in order to allow the return of dangerous goods for proper disposal or recycling. Reference to this exemption shall be mentioned in the transport document.

6.7.3.15.7 The exceptional inspection and test is necessary when the portable tank shows evidence of damaged or corroded areas, or leakage, or other conditions that indicate a deficiency that could affect the integrity of the portable tank. The extent of the exceptional inspection and test shall depend on the amount of damage or deterioration of the portable tank. It shall include at least the 2.5 year inspection and test according to 6.7.3.15.5.

6.7.3.15.8 The internal and external examinations shall ensure that:

(a) The shell is inspected for pitting, corrosion, or abrasions, dents, distortions, defects in welds or any other conditions, including leakage, that might render the portable tank unsafe for carriage;

(b) The piping, valves, and gaskets are inspected for corroded areas, defects, or any other conditions, including leakage, that might render the portable tank unsafe for filling, discharge or carriage;

(c) Devices for tightening manhole covers are operative and there is no leakage at manhole covers or gaskets;

(d) Missing or loose bolts or nuts on any flanged connection or blank flange are replaced or tightened;

(e) All emergency devices and valves are free from corrosion, distortion and any damage or defect that could prevent their normal operation. Remote closure devices and self-closing stop-valves shall be operated to demonstrate proper operation;

(f) Required markings on the portable tank are legible and in accordance with the applicable requirements; and

(g) The framework, the supports and the arrangements for lifting the portable tank are in satisfactory condition.

6.7.3.15.9 The inspections and tests in 6.7.3.15.1, 6.7.3.15.3, 6.7.3.15.4, 6.7.3.15.5 and 6.7.3.15.7 shall be performed or witnessed by an expert approved by the competent authority or its authorized body. When the pressure test is a part of the inspection and test, the test pressure shall be the one indicated on the data plate of the portable tank. While under pressure, the portable tank shall be inspected for any leaks in the shell, piping or equipment.

6.7.3.15.10 In all cases when cutting, burning or welding operations on the shell have been effected, that work shall be to the approval of the competent authority or its authorized body taking into account the pressure vessel code used for the construction of the shell. A pressure test to the original test pressure shall be performed after the work is completed.

6.7.3.15.11 When evidence of any unsafe condition is discovered, the portable tank shall not be returned to service until it has been corrected and the pressure test is repeated and passed.

6.7.3.16 ***Marking***

6.7.3.16.1 Every portable tank shall be fitted with a corrosion resistant metal plate permanently attached to the portable tank in a conspicuous place readily accessible for inspection. When for reasons of portable tank arrangements, the plate cannot be permanently attached to the shell, the shell shall be marked with at least the information required by the pressure vessel code. As a minimum at least the following information shall be marked on the plate by stamping or by any other similar method:

Country of manufacture
U Approval Approval For Alternative Arrangements (see 6.7.1.2)
N Country Number "AA"
Manufacturer's name or mark
Manufacturer's serial number
Authorized body for the design approval
Owner's registration number

Year of manufacture
Pressure vessel code to which the shell is designed
Test pressure _____bar/kPa (gauge pressure) [6]
MAWP_____ bar/kPa (gauge pressure) [6]
External design pressure [7] _____ bar/kPa (gauge pressure) [6]
Design temperature range_____ °C to_____°C
Design reference temperature_____ °C
Water capacity at 20°C _____litres
Initial pressure test date and witness identification
Shell material(s) and material standard reference(s)
Equivalent thickness in reference steel _____mm
Date and type of most recent periodic test(s)
Month_____ Year_____ Test pressure_____bar/kPa (gauge pressure) [6]
Stamp of expert who performed or witnessed the most recent test

6.7.3.16.2 The following information shall be marked either on the portable tank itself or on a metal plate firmly secured to the portable tank:

Name of the operator
Name of non-refrigerated liquefied gas(es) permitted for carriage
Maximum permissible load mass for each non-refrigerated liquefied gas permitted _____kg
Maximum permissible gross mass (MPGM)_____kg
Unladen (tare) mass_____kg

***NOTE**: For the identification of the non-refrigerated liquefied gases being carried, see also Part 5.*

6.7.3.16.3 If a portable tank is designed and approved for handling in open seas, the words "OFFSHORE PORTABLE TANK" shall be marked on the identification plate.

6.7.4 Requirements for the design, construction, inspection and testing of portable tanks intended for the carriage of refrigerated liquefied gases

6.7.4.1 *Definitions*

For the purposes of this section:

Portable tank means a thermally insulated multimodal tank having a capacity of more than 450 litres fitted with service equipment and structural equipment necessary for the carriage of refrigerated liquefied gases. The portable tank shall be capable of being filled and discharged without the removal of its structural equipment. It shall possess stabilizing members external to the tank, and shall be capable of being lifted when full. It shall be designed primarily to be loaded onto a transport vehicle or ship and shall be equipped with skids, mountings or accessories to facilitate mechanical handling. Tank-vehicles, tank-wagons, non-metallic tanks, intermediate bulk containers (IBCs), gas cylinders and large receptacles are not considered to fall within the definition for portable tanks;

Tank means a construction which normally consists of either :

[6] *The unit used shall be marked.*

[7] *See 6.7.3.2.8.*

(a) A jacket and one or more inner shells where the space between the shell(s) and the jacket is exhausted of air (vacuum insulation) and may incorporate a thermal insulation system; or

(b) A jacket and an inner shell with an intermediate layer of solid thermally insulating material (e.g. solid foam);

Shell means the part of the portable tank which retains the refrigerated liquefied gas intended for carriage, including openings and their closures, but does not include service equipment or external structural equipment;

Jacket means the outer insulation cover or cladding which may be part of the insulation system;

Service equipment means measuring instruments and filling, discharge, venting, safety, pressurizing, cooling and thermal insulation devices;

Structural equipment means the reinforcing, fastening, protective and stabilizing members external to the shell;

Maximum allowable working pressure (MAWP) means the maximum effective gauge pressure permissible at the top of the shell of a loaded portable tank in its operating position including the highest effective pressure during filling and discharge;

Test pressure means the maximum gauge pressure at the top of the shell during the pressure test;

Leakproofness test means a test using gas subjecting the shell and its service equipment, to an effective internal pressure not less than 90% of the MAWP;

Maximum permissible gross mass (MPGM) means the sum of the tare mass of the portable tank and the heaviest load authorized for carriage;

Holding time means the time that will elapse from the establishment of the initial filling condition until the pressure has risen due to heat influx to the lowest set pressure of the pressure limiting device(s);

Reference steel means a steel with a tensile strength of 370 N/mm^2 and an elongation at fracture of 27%;

*Minimum design temperature m*eans the temperature which is used for the design and construction of the shell not higher than the lowest (coldest) temperature (service temperature) of the contents during normal conditions of filling, discharge and carriage.

6.7.4.2 ***General design and construction requirements***

6.7.4.2.1 Shells shall be designed and constructed in accordance with the requirements of a pressure vessel code recognized by the competent authority. Shells and jackets shall be made of metallic materials suitable for forming. Jackets shall be made of steel. Non-metallic materials may be used for the attachments and supports between the shell and jacket, provided their material properties at the minimum design temperature are proven to be sufficient. The materials shall in principle conform to national or international material standards. For welded shells and jackets only materials whose weldability has been fully demonstrated shall be used. Welds shall be skilfully made and afford complete safety. When the manufacturing process or the materials make it necessary, the shell shall be suitably heat treated to guarantee adequate toughness in the weld and in the heat affected zones. In

choosing the material, the minimum design temperature shall be taken into account with respect to risk of brittle fracture, to hydrogen embrittlement, to stress corrosion cracking and to resistance to impact. When fine grain steel is used, the guaranteed value of the yield strength shall be not more than 460 N/mm^2 and the guaranteed value of the upper limit of the tensile strength shall be not more than 725 N/mm^2 in accordance with the material specifications. Portable tank materials shall be suitable for the external environment in which they may be carried.

6.7.4.2.2 Any part of a portable tank, including fittings, gaskets and pipe-work, which can be expected normally to come into contact with the refrigerated liquefied gas carried shall be compatible with that refrigerated liquefied gas.

6.7.4.2.3 Contact between dissimilar metals which could result in damage by galvanic action shall be avoided.

6.7.4.2.4 The thermal insulation system shall include a complete covering of the shell(s) with effective insulating materials. External insulation shall be protected by a jacket so as to prevent the ingress of moisture and other damage under normal carriage conditions.

6.7.4.2.5 When a jacket is so closed as to be gas-tight, a device shall be provided to prevent any dangerous pressure from developing in the insulation space.

6.7.4.2.6 Portable tanks intended for the carriage of refrigerated liquefied gases having a boiling point below minus (-) 182 °C at atmospheric pressure shall not include materials which may react with oxygen or oxygen enriched atmospheres in a dangerous manner, when located in parts of the thermal insulation when there is a risk of contact with oxygen or with oxygen enriched fluid.

6.7.4.2.7 Insulating materials shall not deteriorate unduly in service.

6.7.4.2.8 A reference holding time shall be determined for each refrigerated liquefied gas intended for carriage in a portable tank.

6.7.4.2.8.1 The reference holding time shall be determined by a method recognized by the competent authority on the basis of the following:

(a) The effectiveness of the insulation system, determined in accordance with 6.7.4.2.8.2;

(b) The lowest set pressure of the pressure limiting device(s);

(c) The initial filling conditions;

(d) An assumed ambient temperature of 30 °C;

(e) The physical properties of the individual refrigerated liquefied gas intended to be carried.

6.7.4.2.8.2 The effectiveness of the insulation system (heat influx in watts) shall be determined by type testing the portable tank in accordance with a procedure recognized by the competent authority. This test shall consist of either:

(a) A constant pressure test (for example at atmospheric pressure) when the loss of refrigerated liquefied gas is measured over a period of time; or

(b) A closed system test when the rise in pressure in the shell is measured over a period of time.

When performing the constant pressure test, variations in atmospheric pressure shall be taken into account. When performing either tests corrections shall be made for any variation of the ambient temperature from the assumed ambient temperature reference value of 30 °C.

***NOTE**: For the determination of the actual holding time before each journey, refer to 4.2.3.7.*

6.7.4.2.9 The jacket of a vacuum-insulated double-wall tank shall have either an external design pressure not less than 100 kPa (1 bar) (gauge pressure) calculated in accordance with a recognized technical code or a calculated critical collapsing pressure of not less than 200 kPa (2 bar) (gauge pressure). Internal and external reinforcements may be included in calculating the ability of the jacket to resist the external pressure.

6.7.4.2.10 Portable tanks shall be designed and constructed with supports to provide a secure base during carriage and with suitable lifting and tie-down attachments.

6.7.4.2.11 Portable tanks shall be designed to withstand, without loss of contents, at least the internal pressure due to the contents, and the static, dynamic and thermal loads during normal conditions of handling and carriage. The design shall demonstrate that the effects of fatigue, caused by repeated application of these loads through the expected life of the portable tank, have been taken into account.

6.7.4.2.12 Portable tanks and their fastenings under the maximum permissible load shall be capable of absorbing the following separately applied static forces:

(a) In the direction of travel: twice the MPGM multiplied by the acceleration due to gravity (g) [8];

(b) Horizontally at right angles to the direction of travel: the MPGM (when the direction of travel is not clearly determined, the forces shall be equal to twice the MPGM) multiplied by the acceleration due to gravity (g) [8];

(c) Vertically upwards: the MPGM multiplied by the acceleration due to gravity (g) [8]; and

(d) Vertically downwards: twice the MPGM (total loading including the effect of gravity) multiplied by the acceleration due to gravity (g) [8].

6.7.4.2.13 Under each of the forces in 6.7.4.2.12, the safety factor to be observed shall be as follows:

(a) For materials having a clearly defined yield point, a safety factor of 1.5 in relation to the guaranteed yield strength; and

(b) For materials with no clearly defined yield point, a safety factor of 1.5 in relation to the guaranteed 0.2% proof strength or, in case of austenitic steels, the 1% proof strength.

6.7.4.2.14 The values of yield strength or proof strength shall be the values according to national or international material standards. When austenitic steels are used, the specified minimum values according to the material standards may be increased by up to 15% when greater values are attested in the material inspection certificate. When no material standard exists for the metal in question, or when non-metallic materials are used the values of yield strength or proof strength shall be approved by the competent authority.

[8] *For calculation purposes $g = 9.81\ m/s^2$.*

6.7.4.2.15 Portable tanks intended for the carriage of flammable refrigerated liquefied gases shall be capable of being electrically earthed.

6.7.4.3 ***Design criteria***

6.7.4.3.1 Shells shall be of a circular cross section.

6.7.4.3.2 Shells shall be designed and constructed to withstand a test pressure not less than 1.3 times the MAWP. For shells with vacuum insulation the test pressure shall not be less than 1.3 times the sum of the MAWP and 100 kPa (1 bar). In no case shall the test pressure be less than 300 kPa (3 bar) (gauge pressure). Attention is drawn to the minimum shell thickness requirements, specified in 6.7.4.4.2 to 6.7.4.4.7.

6.7.4.3.3 For metals exhibiting a clearly defined yield point or characterized by a guaranteed proof strength (0.2% proof strength, generally, or 1% proof strength for austenitic steels) the primary membrane stress σ (sigma) in the shell shall not exceed 0.75 Re or 0.50 Rm, whichever is lower, at the test pressure, where:

Re = yield strength in N/mm^2, or 0.2% proof strength or, for austenitic steels, 1% proof strength;

Rm = minimum tensile strength in N/mm^2.

6.7.4.3.3.1 The values of Re and Rm to be used shall be the specified minimum values according to national or international material standards. When austenitic steels are used, the specified minimum values for Re and Rm according to the material standards may be increased by up to 15% when greater values are attested in the material inspection certificate. When no material standard exists for the metal in question, the values of Re and Rm used shall be approved by the competent authority or its authorized body.

6.7.4.3.3.2 Steels which have a Re/Rm ratio of more than 0.85 are not allowed for the construction of welded shells. The values of Re and Rm to be used in determining this ratio shall be the values specified in the material inspection certificate.

6.7.4.3.3.3 Steels used in the construction of shells shall have an elongation at fracture, in %, of not less than 10 000/Rm with an absolute minimum of 16% for fine grain steels and 20% for other steels. Aluminium and aluminium alloys used in the construction of shells shall have an elongation at fracture, in %, of not less than 10 000/6Rm with an absolute minimum of 12%.

6.7.4.3.3.4 For the purpose of determining actual values for materials, it shall be noted that for sheet metal, the axis of the tensile test specimen shall be at right angles (transversely) to the direction of rolling. The permanent elongation at fracture shall be measured on test specimens of rectangular cross sections in accordance with ISO 6892:1988 using a 50 mm gauge length.

6.7.4.4 ***Minimum shell thickness***

6.7.4.4.1 The minimum shell thickness shall be the greater thickness based on:

(a) The minimum thickness determined in accordance with the requirements in 6.7.4.4.2 to 6.7.4.4.7; or

(b) The minimum thickness determined in accordance with the recognized pressure vessel code including the requirements in 6.7.4.3.

6.7.4.4.2 Shells of not more than 1.80 m in diameter shall be not less than 5 mm thick in the reference steel or of equivalent thickness in the metal to be used. Shells of more than 1.80 m in diameter shall be not less than 6 mm thick in the reference steel or of equivalent thickness in the metal to be used.

6.7.4.4.3 Shells of vacuum-insulated tanks of not more than 1.80 m in diameter shall be not less than 3 mm thick in the reference steel or of equivalent thickness in the metal to be used. Such shells of more than 1.80 m in diameter shall be not less than 4 mm thick in the reference steel or of equivalent thickness in the metal to be used.

6.7.4.4.4 For vacuum-insulated tanks, the aggregate thickness of the jacket and the shell shall correspond to the minimum thickness prescribed in 6.7.4.4.2, the thickness of the shell itself being not less than the minimum thickness prescribed in 6.7.4.4.3.

6.7.4.4.5 Shells shall be not less than 3 mm thick regardless of the material of construction.

6.7.4.4.6 The equivalent thickness of a metal other than the thickness prescribed for the reference steel in 6.7.4.4.2 and 6.7.4.4.3 shall be determined using the following formula:

$$e_1 = \frac{21.4 e_o}{\sqrt[3]{Rm_1 \times A_1}}$$

where:

e_1 = required equivalent thickness (in mm) of the metal to be used;

e_0 = minimum thickness (in mm) of the reference steel specified in 6.7.4.4.2 and 6.7.4.4.3;

Rm_1 = guaranteed minimum tensile strength (in N/mm^2) of the metal to be used (see 6.7.4.3.3);

A_1 = guaranteed minimum elongation at fracture (in %) of the metal to be used according to national or international standards.

6.7.4.4.7 In no case shall the wall thickness be less than that prescribed in 6.7.4.4.1 to 6.7.4.4.5. All parts of the shell shall have a minimum thickness as determined by 6.7.4.4.1 to 6.7.4.4.6. This thickness shall be exclusive of any corrosion allowance.

6.7.4.4.8 There shall be no sudden change of plate thickness at the attachment of the ends (heads) to the cylindrical portion of the shell.

6.7.4.5 ***Service equipment***

6.7.4.5.1 Service equipment shall be so arranged as to be protected against the risk of being wrenched off or damaged during handling and carriage. When the connection between the frame and the tank or the jacket and the shell allows relative movement, the equipment shall be so fastened as to permit such movement without risk of damage to working parts. The external discharge fittings (pipe sockets, shut-off devices), the stop-valve and its seating shall be protected against the danger of being wrenched off by external forces (for example using shear sections). The filling and discharge devices (including flanges or threaded plugs) and any protective caps shall be capable of being secured against unintended opening.

6.7.4.5.2 Each filling and discharge opening in portable tanks used for the carriage of flammable refrigerated liquefied gases shall be fitted with at least three mutually independent shut-off devices in series, the first being a stop-valve situated as close as reasonably practicable to the jacket, the second being a stop-valve and the third being a blank flange or equivalent device.

The shut-off device closest to the jacket shall be a quick closing device, which closes automatically in the event of unintended movement of the portable tank during filling or discharge or fire engulfment. This device shall also be possible to operate by remote control.

6.7.4.5.3 Each filling and discharge opening in portable tanks used for the carriage of non-flammable refrigerated liquefied gases shall be fitted with at least two mutually independent shut-off devices in series, the first being a stop-valve situated as close as reasonably practicable to the jacket, the second a blank flange or equivalent device.

6.7.4.5.4 For sections of piping which can be closed at both ends and where liquid product can be trapped, a method of automatic pressure relief shall be provided to prevent excess pressure build-up within the piping.

6.7.4.5.5 Vacuum insulated tanks need not have an opening for inspection.

6.7.4.5.6 External fittings shall be grouped together so far as reasonably practicable.

6.7.4.5.7 Each connection on a portable tank shall be clearly marked to indicate its function.

6.7.4.5.8 Each stop-valve or other means of closure shall be designed and constructed to a rated pressure not less than the MAWP of the shell taking into account the temperature expected during carriage. All stop-valves with a screwed spindle shall be closed by a clockwise motion of the handwheel. In the case of other stop-valves the position (open and closed) and direction of closure shall be clearly indicated. All stop-valves shall be designed to prevent unintentional opening.

6.7.4.5.9 When pressure-building units are used, the liquid and vapour connections to that unit shall be provided with a valve as close to the jacket as reasonably practicable to prevent the loss of contents in case of damage to the pressure-building unit.

6.7.4.5.10 Piping shall be designed, constructed and installed so as to avoid the risk of damage due to thermal expansion and contraction, mechanical shock and vibration. All piping shall be of a suitable material. To prevent leakage due to fire, only steel piping and welded joints shall be used between the jacket and the connection to the first closure of any outlet. The method of attaching the closure to this connection shall be to the satisfaction of the competent authority or its authorized body. Elsewhere pipe joints shall be welded when necessary.

6.7.4.5.11 Joints in copper tubing shall be brazed or have an equally strong metal union. The melting point of brazing materials shall be no lower than 525 °C. The joints shall not decrease the strength of the tubing as may happen when cutting threads.

6.7.4.5.12 The materials of construction of valves and accessories shall have satisfactory properties at the lowest operating temperature of the portable tank.

6.7.4.5.13 The burst pressure of all piping and pipe fittings shall be not less than the highest of four times the MAWP of the shell or four times the pressure to which it may be subjected in service by the action of a pump or other device (except pressure-relief devices).

6.7.4.6 ***Pressure-relief devices***

6.7.4.6.1 Every shell shall be provided with not less than two independent spring-loaded pressure-relief devices. The pressure-relief devices shall open automatically at a pressure not less than the MAWP and be fully open a pressure equal to 110% of the MAWP. These devices shall, after discharge, close at a pressure not lower than 10% below the pressure at which discharge starts and shall remain closed at all lower pressures. The pressure-relief devices shall be of the type that will resist dynamic forces including surge.

6.7.4.6.2 Shells for non-flammable refrigerated liquefied gases and hydrogen may in addition have frangible discs in parallel with the spring-loaded devices as specified in 6.7.4.7.2 and 6.7.4.7.3.

6.7.4.6.3 Pressure-relief devices shall be designed to prevent the entry of foreign matter, the leakage of gas and the development of any dangerous excess pressure.

6.7.4.6.4 Pressure-relief devices shall be approved by the competent authority or its authorized body.

6.7.4.7 ***Capacity and setting of pressure-relief devices***

6.7.4.7.1 In the case of the loss of vacuum in a vacuum-insulated tank or of loss of 20% of the insulation of a tank insulated with solid materials, the combined capacity of all pressure-relief devices installed shall be sufficient so that the pressure (including accumulation) inside the shell does not exceed 120% of the MAWP.

6.7.4.7.2 For non-flammable refrigerated liquefied gases (except oxygen) and hydrogen, this capacity may be achieved by the use of frangible discs in parallel with the required safety-relief devices. Frangible discs shall rupture at nominal pressure equal to the test pressure of the shell.

6.7.4.7.3 Under the circumstances described in 6.7.4.7.1 and 6.7.4.7.2 together with complete fire engulfment the combined capacity of all pressure-relief devices installed shall be sufficient to limit the pressure in the shell to the test pressure.

6.7.4.7.4 The required capacity of the relief devices shall be calculated in accordance with a well-established technical code recognized by the competent authority [9].

6.7.4.8 ***Marking of pressure-relief devices***

6.7.4.8.1 Every pressure-relief device shall be plainly and permanently marked with the following particulars:

(a) The pressure (in bar or kPa) at which it is set to discharge;

(b) The allowable tolerance at the discharge pressure for spring-loaded devices;

(c) The reference temperature corresponding to the rated pressure for frangible discs; and

(d) The rated flow capacity of the device in standard cubic meters of air per second (m^3/s).

When practicable, the following information shall also be shown:

(e) The manufacturer's name and relevant catalogue number of the device.

6.7.4.8.2 The rated flow capacity marked on the pressure-relief devices shall be determined according to ISO 4126-1:1991.

6.7.4.9 ***Connections to pressure-relief devices***

6.7.4.9.1 Connections to pressure-relief devices shall be of sufficient size to enable the required discharge to pass unrestricted to the safety device. No stop-valve shall be installed between the shell and the pressure-relief devices except when duplicate devices are provided for maintenance or other reasons and the stop-valves serving the devices actually in use are

[9] *See for example CGA Pamphlet S-1.2-1995*.

locked open or the stop-valves are interlocked so that the requirements of 6.7.4.7 are always fulfilled. There shall be no obstruction in an opening leading to a vent or pressure-relief device which might restrict or cut-off the flow from the shell to that device. Pipework to vent the vapour or liquid from the outlet of the pressure-relief devices, when used, shall deliver the relieved vapour or liquid to the atmosphere in conditions of minimum back-pressure on the relieving device.

6.7.4.10 ***Siting of pressure-relief devices***

6.7.4.10.1 Each pressure-relief device inlet shall be situated on top of the shell in a position as near the longitudinal and transverse centre of the shell as reasonably practicable. All pressure-relief device inlets shall under maximum filling conditions be situated in the vapour space of the shell and the devices shall be so arranged as to ensure that the escaping vapour is discharged unrestrictedly. For refrigerated liquefied gases, the escaping vapour shall be directed away from the tank and in such a manner that it cannot impinge upon the tank. Protective devices which deflect the flow of vapour are permissible provided the required relief-device capacity is not reduced.

6.7.4.10.2 Arrangements shall be made to prevent access to the devices by unauthorized persons and to protect the devices from damage caused by the portable tank overturning.

6.7.4.11 ***Gauging devices***

6.7.4.11.1 Unless a portable tank is intended to be filled by weight, it shall be equipped with one or more gauging devices. Glass level-gauges and gauges made of other fragile material, which are in direct communication with the contents of the shell shall not be used.

6.7.4.11.2 A connection for a vacuum gauge shall be provided in the jacket of a vacuum-insulated portable tank.

6.7.4.12 ***Portable tank supports, frameworks, lifting and tie-down attachments***

6.7.4.12.1 Portable tanks shall be designed and constructed with a support structure to provide a secure base during carriage. The forces specified in 6.7.4.2.12 and the safety factor specified in 6.7.4.2.13 shall be considered in this aspect of the design. Skids, frameworks, cradles or other similar structures are acceptable.

6.7.4.12.2 The combined stresses caused by portable tank mountings (e.g. cradles, frameworks, etc.) and portable tank lifting and tie-down attachments shall not cause excessive stress in any portion of the tank. Permanent lifting and tie-down attachments shall be fitted to all portable tanks. Preferably they shall be fitted to the portable tank supports but may be secured to reinforcing plates located on the tank at the points of support.

6.7.4.12.3 In the design of supports and frameworks the effects of environmental corrosion shall be taken into account.

6.7.4.12.4 Forklift pockets shall be capable of being closed off. The means of closing forklift pockets shall be a permanent part of the framework or permanently attached to the framework. Single compartment portable tanks with a length less than 3.65 m need not have closed off forklift pockets provided that:

(a) The tank and all the fittings are well protected from being hit by the forklift blades; and

(b) The distance between the centres of the forklift pockets is at least half of the maximum length of the portable tank.

6.7.4.12.5 When portable tanks are not protected during carriage, according to 4.2.3.3, the shells and service equipment shall be protected against damage to the shell and service equipment resulting from lateral or longitudinal impact or overturning. External fittings shall be protected so as to preclude the release of the shell contents upon impact or overturning of the portable tank on its fittings. Examples of protection include:

(a) Protection against lateral impact which may consist of longitudinal bars protecting the shell on both sides at the level of the median line;

(b) Protection of the portable tank against overturning which may consist of reinforcement rings or bars fixed across the frame;

(c) Protection against rear impact which may consist of a bumper or frame;

(d) Protection of the shell against damage from impact or overturning by use of an ISO frame in accordance with ISO 1496-3:1995;

(e) Protection of the portable tank from impact or overturning by a vacuum insulation jacket.

6.7.4.13 ***Design approval***

6.7.4.13.1 The competent authority or its authorized body shall issue a design approval certificate for any new design of a portable tank. This certificate shall attest that a portable tank has been surveyed by that authority, is suitable for its intended purpose and meets the requirements of this Chapter. When a series of portable tanks are manufactured without change in the design, the certificate shall be valid for the entire series. The certificate shall refer to the prototype test report, the refrigerated liquefied gases allowed to be carried, the materials of construction of the shell and jacket and an approval number. The approval number shall consist of the distinguishing sign or mark of the State in whose territory the approval was granted, i.e. the distinguishing sign for use in international traffic, as prescribed by the Convention on Road Traffic, Vienna 1968, and a registration number. Any alternative arrangements according to 6.7.1.2 shall be indicated on the certificate. A design approval may serve for the approval of smaller portable tanks made of materials of the same kind and thickness, by the same fabrication techniques and with identical supports, equivalent closures and other appurtenances.

6.7.4.13.2 The prototype test report for the design approval shall include at least the following:

(a) The results of the applicable frame-work test specified in ISO 1496-3:1995;

(b) The results of the initial inspection and test in 6.7.4.14.3; and

(c) The results of the impact test in 6.7.4.14.1, when applicable.

6.7.4.14 ***Inspection and testing***

6.7.4.14.1 For portable tanks meeting the definition of container in the CSC, a prototype representing each design shall be subjected to an impact test. The prototype portable tank shall be shown to be capable of absorbing the forces resulting from an impact not less than 4 times (4 g) the MPGM of the fully loaded portable tank at a duration typical of the mechanical shocks experienced in rail transport. The following is a listing of standards describing methods acceptable for performing the impact test:

Association of American Railroads,

Manual of Standards and Recommended Practices,
Specifications for Acceptability of Tank Containers (AAR.600), 1992

Canadian Standards Association (CSA),
Highway Tanks and Portable Tanks for the Transportation of Dangerous Goods (B620-1987)

Deutsche Bahn AG
Zentralbereich Technik, Minden
Portable tanks, longitudinal dynamic impact test

Société Nationale des Chemins de Fer Français
C.N.E.S.T. 002-1966.
Tank containers, longitudinal external stresses and dynamic impact tests

Spoornet, South Africa
Engineering Development Centre (EDC)
Testing of ISO Tank Containers
Method EDC/EST/023/000/1991-06

6.7.4.14.2 The tank and items of equipment of each portable tank shall be inspected and tested before being put into service for the first time (initial inspection and test) and thereafter at not more than five-year intervals (5 year periodic inspection and test) with an intermediate periodic inspection and test (2.5 year periodic inspection and test) midway between the 5 year periodic inspections and tests. The 2.5 year inspection and test may be performed within 3 months of the specified date. An exceptional inspection and test shall be performed regardless of the last periodic inspection and test when necessary according to 6.7.4.14.7.

6.7.4.14.3 The initial inspection and test of a portable tank shall include a check of the design characteristics, an internal and external examination of the portable tank shell and its fittings with due regard to the refrigerated liquefied gases to be carried, and a pressure test referring to the test pressures according to 6.7.4.3.2. The pressure test may be performed as a hydraulic test or by using another liquid or gas with the agreement of the competent authority or its authorized body. Before the portable tank is placed into service, a leakproofness test and a check of the satisfactory operation of all service equipment shall also be performed. When the shell and its fittings have been pressure-tested separately, they shall be subjected together after assembly to a leakproofness test. All welds subject to full stress level shall be inspected during the initial test by radiographic, ultrasonic, or another suitable non-destructive test method. This does not apply to the jacket.

6.7.4.14.4 The 5 and 2.5 year periodic inspection and test shall include an external examination of the portable tank and its fittings with due regard to the refrigerated liquefied gases carried, a leakproofness test, a check of the satisfactory operation of all service equipment and a vacuum reading, when applicable. In the case of non-vacuum insulated tanks, the jacket and insulation shall be removed during a 2.5 year and a 5 year periodic inspection but only to the extent necessary for a reliable appraisal.

6.7.4.14.5 In addition, at the 5 year periodic inspection and test of non-vacuum insulated tanks the jacket and insulation shall be removed, but only to the extent necessary for a reliable appraisal.

6.7.4.14.6 A portable tank may not be filled and offered for carriage after the date of expiry of the last 5 year or 2.5 year periodic inspection and test as required by 6.7.4.14.2. However a portable tank filled prior to the date of expiry of the last periodic inspection and test may be carried for a period not to exceed three months beyond the date of expiry of the last periodic test or inspection. In addition, a portable tank may be carried after the date of expiry of the last periodic test and inspection:

(a) After emptying but before cleaning, for purposes of performing the next required test or inspection prior to refilling; and

(b) Unless otherwise approved by the competent authority, for a period not to exceed six months beyond the date of expiry of the last periodic test or inspection, in order to allow the return of dangerous goods for proper disposal or recycling. Reference to this exemption shall be mentioned in the transport document.

6.7.4.14.7 The exceptional inspection and test is necessary when the portable tank shows evidence of damaged or corroded areas, leakage, or any other conditions that indicate a deficiency that could affect the integrity of the portable tank. The extent of the exceptional inspection and test shall depend on the amount of damage or deterioration of the portable tank. It shall include at least the 2.5 year inspection and test according to 6.7.4.14.4.

6.7.4.14.8 The internal examination during the initial inspection and test shall ensure that the shell is inspected for pitting, corrosion, or abrasions, dents, distortions, defects in welds or any other conditions, that might render the portable tank unsafe for carriage.

6.7.4.14.9 The external examination shall ensure that:

(a) The external piping, valves, pressurizing/cooling systems when applicable and gaskets are inspected for corroded areas, defects, or any other conditions, including leakage, that might render the portable tank unsafe for filling, discharge or carriage;

(b) There is no leakage at any manhole covers or gaskets;

(c) Missing or loose bolts or nuts on any flanged connection or blank flange are replaced or tightened;

(d) All emergency devices and valves are free from corrosion, distortion and any damage or defect that could prevent their normal operation. Remote closure devices and self-closing stop-valves shall be operated to demonstrate proper operation;

(e) Required markings on the portable tank are legible and in accordance with the applicable requirements; and

(f) The framework, the supports and the arrangements for lifting the portable tank are in satisfactory condition.

6.7.4.14.10 The inspections and tests in 6.7.4.14.1, 6.7.4.14.3, 6.7.4.14.4, 6.7.4.14.5 and 6.7.4.14.7 shall be performed or witnessed by an expert approved by the competent authority or its authorized body. When the pressure test is a part of the inspection and test, the test pressure shall be the one indicated on the data plate of the portable tank. While under pressure, the portable tank shall be inspected for any leaks in the shell, piping or equipment.

6.7.4.14.11 In all cases when cutting, burning or welding operations on the shell of a portable tank have been effected, that work shall be to the approval of the competent authority or its authorized body taking into account the pressure vessel code used for the construction of the shell. A pressure test to the original test pressure shall be performed after the work is completed.

6.7.4.14.12 When evidence of any unsafe condition is discovered, the portable tank shall not be returned to service until it has been corrected and the test is repeated and passed.

6.7.4.15 ***Marking***

6.7.4.15.1 Every portable tank shall be fitted with a corrosion resistant metal plate permanently attached to the portable tank in a conspicuous place readily accessible for inspection. When for reasons of portable tank arrangements, the plate cannot be permanently attached to the shell, the shell shall be marked with at least the information required by the pressure vessel code. As a minimum at least the following information shall be marked on the plate by stamping or by any other similar method:

Country of manufacture
U Approval Approval In case of Alternative Arrangements (see 6.7.1.2)
N Country Number "AA"
Manufacturer's name or mark
Manufacturer's serial number
Authorized body for the design approval
Owner's registration number
Year of manufacture
Pressure vessel code to which the tank is designed
Test pressure _____bar/kPa (gauge pressure) [10]
MAWP_____ bar/kPa (gauge pressure) [10]
Minimum design temperature _____°C
Water capacity at 20 °C _____litres
Initial pressure test date and witness identification
Shell material(s) and material standard reference(s)
Equivalent thickness in reference steel _____mm
Date and type of most recent periodic test(s)
Month_____ Year_____ Test pressure_____bar/kPa (gauge pressure) [10]
Stamp of expert who performed or witnessed the most recent test
The name, in full, of the gas(es) for whose carriage the portable tank is approved
Either "thermally insulated" or "vacuum insulated"_____
Effectiveness of the insulation system (heat influx)_____Watts (W)
Reference holding time_____days (or hours) and initial pressure_____bar/kPa (gauge pressure) [10] and degree of filling_____ in kg for each refrigerated liquefied gas permitted for carriage.

6.7.4.15.2 The following particulars shall be durably marked either on the portable tank itself or on a metal plate firmly secured to the portable tank.

Name of the owner and the operator
Name of the refrigerated liquefied gas being carried (and minimum mean bulk temperature)
Maximum permissible gross mass (MPGM)_____kg
Unladen (tare) mass_____kg
Actual holding time for gas being carried _____days (or hours)

NOTE*: For the identification of the refrigerated liquefied gas(es) being carried, see also Part 5.*

6.7.4.15.3 If a portable tank is designed and approved for handling in open seas, the words "OFFSHORE PORTABLE TANK" shall be marked on the identification plate.

[10] *The unit used shall be marked*.

CHAPTER 6.8

REQUIREMENTS FOR THE CONSTRUCTION, EQUIPMENT, TYPE APPROVAL, INSPECTIONS AND TESTS, AND MARKING OF FIXED TANKS (TANK-VEHICLES), DEMOUNTABLE TANKS AND TANK-CONTAINERS AND TANK SWAP BODIES, WITH SHELLS MADE OF METALLIC MATERIALS, AND BATTERY-VEHICLES AND MULTIPLE ELEMENT GAS CONTAINERS (MEGCs)

NOTE: *For portable tanks see Chapter 6.7, for fibre-reinforced plastics tanks see Chapter 6.9, for vacuum operated waste tanks see Chapter 6.10.*

6.8.1 Scope

6.8.1.1 The requirements across the whole width of the page apply both to fixed tanks (tank-vehicles), to demountable tanks and battery-vehicles, and to tank-containers, tank swap bodies and MEGCs. Those contained in a single column apply only:

- to fixed tanks (tank-vehicles), to demountable tanks and battery-vehicles (left hand column);
- to tank-containers, tank swap bodies and MEGCs (right hand column).

6.8.1.2 These requirements shall apply to

fixed tanks (tank-vehicles), demountable tanks and battery-vehicles	tank-containers, tank swap bodies and MEGCs

used for the carriage of gaseous, liquid, powdery or granular substances.

6.8.1.3 Section 6.8.2 sets out the requirements applicable to fixed tanks (tank-vehicles), to demountable tanks, tank-containers, tank swap bodies intended for the carriage of substances of all classes and battery-vehicles and MEGCs for gases of Class 2. Sections 6.8.3 to 6.8.5 contain special requirements supplementing or modifying the requirements of section 6.8.2.

6.8.1.4 For provisions concerning use of these tanks, see Chapter 4.3.

6.8.2 Requirements applicable to all classes

6.8.2.1 *Construction*

Basic principles

6.8.2.1.1 Shells, their attachments and their service and structural equipment shall be designed to withstand without loss of contents (other than quantities of gas escaping through any degassing vents):

- static and dynamic stresses in normal conditions of carriage as defined in 6.8.2.1.2 and 6.8.2.1.13;
- prescribed minimum stresses as defined in 6.8.2.1.15.

6.8.2.1.2	The tanks and their fastenings shall be capable of absorbing, under the maximum permissible load, the forces exerted by: - in the direction of travel: twice the total mass; - at right angles to the direction of travel: the total mass; - vertically upwards: the total mass; - vertically downwards: twice the total mass.	Tank-containers and their fastenings shall, under the maximum permissible load be capable of absorbing the forces equal to those exerted by: - in the direction of travel: twice the total mass; - horizontally at right angles to the direction of travel: the total mass; (where the direction of travel is not clearly determined, twice the total mass in each direction); - vertically upwards: the total mass; - vertically downwards: twice the total mass.

6.8.2.1.3 The walls of the shells shall have at least the thickness specified in

6.8.2.1.17 to 6.8.2.1.21 | 6.8.2.1.17 to 6.8.2.1.20.

6.8.2.1.4 Shells shall be designed and constructed in accordance with the requirements of a technical code recognized by the competent authority, in which the material is chosen and the shell thickness determined taking into account maximum and minimum filling and working temperatures, but the following minimum requirements of 6.8.2.1.6 to 6.8.2.1.26 shall be met.

6.8.2.1.5 Tanks intended to contain certain dangerous substances shall be provided with additional protection. This may take the form of additional thickness of the shell (increased calculation pressure) determined in the light of the dangers inherent in the substances concerned or of a protective device (see the special provisions of 6.8.4).

6.8.2.1.6 Welds shall be skilfully made and shall afford the fullest safety. The execution and checking of welds shall comply with the requirements of 6.8.2.1.23.

6.8.2.1.7 Measures shall be taken to protect shells against the risk of deformation as a result of a negative internal pressure.

Materials for shells

6.8.2.1.8 Shells shall be made of suitable metallic materials which, unless other temperature ranges are prescribed in the various classes, shall be resistant to brittle fracture and to stress corrosion cracking between -20 °C and +50 °C.

6.8.2.1.9 The materials of shells or of their protective linings which are in contact with the contents shall not contain substances liable to react dangerously (see "Dangerous reaction" in 1.2.1) with the contents, to form dangerous compounds, or substantially to weaken the material.

If contact between the substance carried and the material used for the construction of the shell entails a progressive decrease in the shell thickness, this thickness shall be increased at manufacture by an appropriate amount. This additional thickness to allow for corrosion shall not be taken into consideration in calculating the shell thickness.

6.8.2.1.10 For welded shells only materials of faultless weldability whose adequate impact strength at an ambient temperature of –20 ºC can be guaranteed, particularly in the weld seams and the zones adjacent thereto, shall be used.

If fine-grained steel is used, the guaranteed value of the yield strength Re shall not exceed 460 N/mm^2 and the guaranteed value of the upper limit of tensile strength Rm shall not exceed 725 N/mm^2, in accordance with the specifications of the material.

6.8.2.1.11 Ratios of Re/Rm exceeding 0.85 are not allowed for steels used in the construction of welded tanks.

Re = apparent yield strength for steels having a clearly-defined yield point or

guaranteed 0.2% proof strength for steels with no clearly-defined yield point (1% for austenitic steels)

Rm = tensile strength.

The values specified in the inspection certificate for the material shall be taken as a basis in determining this ratio in each case.

6.8.2.1.12 For steel, the elongation at fracture, in % shall be not less than

$$\frac{10\,000}{\text{determined tensile strength in } N/mm^2}$$

but in any case for fine-grained steels it shall be not less than 16% and not less than 20% for other steels.

For aluminium alloys the elongation at fracture shall be not less than 12% [1].

Calculation of the shell thickness

6.8.2.1.13 The pressure on which the shell thickness is based shall not be less than the calculation pressure, but the stresses referred to in 6.8.2.1.1 shall also be taken into account, and, if necessary, the following stresses:

In the case of vehicles in which the tank constitutes a stressed self-supporting member, the shell shall be designed to withstand the stresses thus imposed in addition to stresses from other sources.

[1] *In the case of sheet metal the axis of the tensile test-piece shall be at right angles to the direction of rolling. The permanent elongation at fracture shall be measured on test-pieces of circular cross-section in which the gauge length l is equal to five times the diameter d (l = 5d); if test-pieces of rectangular section are used, the gauge length shall be calculated by the formula*

$$l = 5{,}65\sqrt{F_o},$$

where F_o indicates the initial cross-section area of the test-piece.

Under these stresses, the stress at the most severely stressed point of the shell and its fastenings shall not exceed the value σ defined in 6.8.2.1.16.	Under each of these stresses the safety factors to be observed shall be the following: - for metals having a clearly-defined yield point: a safety factor of 1.5 in relation to the apparent yield strength; or - for metals with no clearly-defined yield point: a safety factor of 1.5 in relation to the guaranteed 0.2% proof strength (1% maximum elongation for austenitic steels).

6.8.2.1.14 The calculation pressure is in the second part of the code (see 4.3.4.1) according to Column (12) of Table A of Chapter 3.2.

When "G" appears, the following requirements shall apply:

(a) Gravity-discharge shells intended for the carriage of substances having a vapour pressure not exceeding 110 kPa (1.1 bar) (absolute pressure) at 50 ºC shall be designed for a calculation pressure of twice the static pressure of the substance to be carried but not less than twice the static pressure of water.

(b) Pressure-filled or pressure-discharge shells intended for the carriage of substances having a vapour pressure not exceeding 110 kPa (1.1 bar) (absolute pressure) at 50 ºC shall be designed for a calculation pressure equal to 1.3 times the filling or discharge pressure.

When the numerical value of the minimum calculation pressure is given (gauge pressure) the shell shall be designed for this pressure which shall not be less than 1.3 times the filling or discharge pressure. The following minimum requirements shall apply in these cases:

(c) Shells intended for the carriage of substances having a vapour pressure of more than 110 kPa (1.1 bar) but not more than 175 kPa (1.75 bar) (absolute pressure) at 50 °C shall, whatever their filling or discharge system, be designed for a calculation pressure of not less than 150 kPa (1.5 bar) gauge pressure or 1.3 times the filling or discharge pressure, whichever is the higher.

(d) Shells intended for the carriage of substances having a vapour pressure of more than 175 kPa (1.75 bar) (absolute pressure) at 50 °C shall, whatever their filling or discharge system, be designed for a calculation pressure equal to 1.3 times the filling or discharge pressure but not less than 0.4 MPa (4 bar) (gauge pressure).

6.8.2.1.15 At the test pressure, the stress σ at the most severely stressed point of the shell shall not exceed the material-dependent limits prescribed below. Allowance shall be made for any weakening due to the welds.

6.8.2.1.16 For all metals and alloys, the stress σ at the test pressure shall be lower than the smaller of the values given by the following formulae:

$$\sigma \leq 0.75 \text{ Re or } \sigma \leq 0.5 \text{ Rm}$$

where

Re = apparent yield strength for steels having a clearly-defined yield point or

guaranteed 0.2% proof strength for steels with no clearly-defined yield point (1% for austenitic steels)

Rm = tensile strength.

The values of Re and Rm to be used shall be specified minimum values according to material standards. If no material standard exists for the metal or alloy in question, the values of Re and Rm used shall be approved by the competent authority or by a body designated by that authority.

When austenitic steels are used, the specified minimum values according to the material standards may be exceeded by up to 15% if these higher values are attested in the inspection certificate.

Minimum shell thickness

6.8.2.1.17 The shell thickness shell shall not be less than the greater of the values determined by the following formulae:

$$e = \frac{P_T D}{2 s l} \qquad \left| \qquad e = \frac{P_C D}{2 s} \right.$$

where:

e = minimum shell thickness in mm

P_T = test pressure in MPa

P_C = calculation pressure in MPa as specified in 6.8.2.1.14

D = internal diameter of shell in mm

σ = permissible stress, as defined in 6.8.2.1.16, in N/mm^2

λ = a coefficient not exceeding or equal to 1, allowing for any weakening due to welds, and linked to the inspection methods defined in 6.8.2.1.23.

The thickness shall in no case be less than that defined in

6.8.2.1.18 to 6.8.2.1.21. | 6.8.2.1.18 to 6.8.2.1.20.

6.8.2.1.18	Shells of circular cross-section [2] not more than 1.80 m in diameter other than those referred to in 6.8.2.1.21, shall not be less than 5 mm thick if of mild steel [3], or of equivalent thickness if of another metal. Where the diameter is more than 1.80 m, this thickness shall be increased to 6mm except in the case of shells intended for the carriage of powdery or granular substances, if the shell is of mild steel, or to an equivalent thickness if of another metal.	Shells shall be not less than 5 mm thick if of mild steel [3] (in conformity with the requirements of 6.8.2.1.11 and 6.8.2.1.12) or of equivalent thickness if of another metal. Where the diameter is more than 1.80 m, this thickness shall be increased to 6mm except in the case of tanks intended for the carriage of powdery or granular substances, if the shell is of mild steel [3] or to an equivalent thickness if of another metal. Whatever the metal used, the shell thickness shall in no case be less than 3 mm.

"Equivalent thickness" means the thickness obtained by the following formula [4]:

$$e_1 = \frac{464\, e_0}{\sqrt[3]{(R_{m1}A_1)^2}} \qquad \left| \qquad e_1 = \frac{21.4\, e_0}{\sqrt[3]{R_{m1}A_1}} \right.$$

6.8.2.1.19	Where protection of the tank against damage through lateral impact or overturning is provided according to 6.8.2.1.20, the competent authority may allow the aforesaid minimum thicknesses to be reduced in proportion to the protection provided; however, the said thicknesses shall not be less	Where protection of the tank against damage is provided according to 6.8.2.1.20, the competent authority may allow the aforesaid minimum thicknesses to be reduced in proportion to the protection provided; however, the said thicknesses shall be not less than 3 mm in the case of mild steel [3], or than

---

[2] *For shells not of a circular cross-section, for example box-shaped or elliptical shells, the indicated diameters shall correspond to those calculated on the basis of a circular cross-section of the same area. For such shapes of cross-section the radius of convexity of the shell wall shall not exceed 2 000 mm at the sides or 3 000 mm at the top and bottom.*

[3] *For the definitions of "mild steel" and "reference steel" see 1.2.1.*

[4] *This formula is derived from the general formula:*

$$e_1 = e_0 \sqrt[3]{\left(\frac{R_{m0}A_0}{R_{m1}A_1}\right)^2} \qquad \left| \qquad e_1 = e_0 \sqrt[3]{\frac{R_{m0}A_0}{R_{m1}A_1}} \right.$$

where

e_1 = *minimum shell thickness for the metal chosen, in mm;*

e_o = *minimum shell thickness for mild steel, in mm, according to 6.8.2.1.18 and 6.8.2.1.19;*

Rm_o = *370 (tensile strength for reference steel, see definition 1.2.1, in N/mm^2);*

A_o = *27 (elongation at fracture for reference steel, in %);*

Rm_1 = *minimum tensile strength of the metal chosen, in N/mm^2; and*

A_1 = *minimum elongation at fracture of the metal chosen under tensile stress, in %.*

than 3 mm in the case of mild steel [3], or than an equivalent thickness in the case of other materials, for shells not more than 1.80 m in diameter. For shells with a diameter exceeding 1.80 m the aforesaid minimum thickness shall be increased to 4mm in the case of mild steel [3] and to an equivalent thickness in the case of other metals.

Equivalent thickness means the thickness given by the formula in 6.8.2.1.18.

Except in cases for which 6.8.2.1.21 provide, the thickness of shells with protection against damage in accordance with 6.8.2.1.20 (a) or (b) shall not be less than the values given in the table below.

an equivalent thickness in the case of other materials, for shells not more than 1.80 m in diameter. For shells of a diameter exceeding 1.80 m this minimum thickness shall be increased to 4 mm in the case of mild steel [3], and to an equivalent thickness in the case of other metals.

Equivalent thickness means the thickness given by the formula in 6.8.2.1.18.

	Diameter of shell	≤ 1.80 m	> 1.80 m
Minimum thickness of shells	Stainless austenitic steels	2.5 mm	3 mm
	Other steels	3 mm	4 mm
	Aluminium alloys	4 mm	5 mm
	Pure aluminium of 99.80%	6 mm	8 mm

6.8.2.1.20 For tanks built after 1 January 1990, there is protection against damage as referred to in 6.8.2.1.19 when the following measures or equivalent measures are adopted:

(a) For tanks intended for the carriage of powdery or granular substances, the protection against damage shall satisfy the competent authority.

(b) For tanks intended for the carriage of other substances, there is protection against damage when:

The protection referred to in 6.8.2.1.19 may consist of:

- overall external structural protection as in "sandwich" construction where the sheathing is secured to the shell; or

- a structure in which the shell is supported by a complete skeleton including longitudinal and transverse structural members; or

- double-wall construction.

Where the tanks are made with double walls, the space between being evacuated of air, the aggregate thickness of the outer metal wall and the shell wall shall correspond to the minimum wall thickness prescribed in

[3] *For the definitions of "mild steel" and "reference steel" see 1.2.1.*

1. For shells with a circular or elliptical cross-section having a maximum radius of curvature of 2 m, the shell is equipped with strengthening members comprising partitions, surge-plates or external or internal rings, so placed that at least one of the following conditions is met:

   - Distance between two adjacent strengthening elements of not more than 1.75 m.

   - Volume contained between two partitions or surge-plates of not more than 7 500 l.

   The vertical cross-section of a ring, with the associated coupling, shall have a section modulus of at least 10 cm^3.

   External rings shall not have projecting edges with a radius of less than 2.5 mm.

   Partitions and surge-plates shall conform to the requirements of 6.8.2.1.22.

   The thickness of the partitions and surge-plates shall in no case be less than that of the shell.

2. For tanks made with double walls, the space between being evacuated of air, the aggregate thickness of the outer metal wall and the shell wall corresponds to the wall thickness prescribed in 6.8.2.1.18, and the thickness of the wall of the shell itself is not less than the minimum thickness prescribed in 6.8.2.1.19.

minimum wall thickness prescribed in 6.8.2.1.18, the thickness of the wall of the shell itself being not less than the minimum thickness prescribed in 6.8.2.1.19.

Where tanks are made with double walls with an intermediate layer of solid materials at least 50 mm thick, the outer wall shall have a thickness of not less than 0.5 mm if it is made of mild steel [3] or at least 2 mm if it is made of a plastics material reinforced with glass fibre. Solid foam with an impact absorption capacity such as that, for example, of polyurethane foam, may be used as the intermediate layer of solid material.

[3] *For the definitions of "mild steel" and "reference steel" see 1.2.1.*

3. For tanks made with double walls having an intermediate layer of solid materials at least 50 mm thick, the outer wall has a thickness of at least 0.5 mm of mild steel [3] or at least 2 mm of a plastics material reinforced with glass fibre. Solid foam (with an impact absorption capacity like that, for example, of polyurethane foam) may be used as the intermediate layer of solid material.

4. Shells of forms other than in 1, especially box-shaped shells, are provided, all round the mid-point of their vertical height and over at least 30% of their height with a protection designed in such a way as to offer specific resilience at least equal to that of a shell constructed in mild steel [3] of a thickness of 5 mm (for a shell diameter not exceeding 1.80 m) or 6 mm (for a shell diameter exceeding 1.80 m). The protection shall be applied in a durable manner to the outside of the shell.

   This requirement shall be considered to have been met without further proof of the specific resilience when the protection involves the welding of a plate of the same material as the shell to the area to be strengthened, so that the minimum wall thickness is in accordance with 6.8.2.1.18.

   This protection is dependent upon the possible stresses exerted on mild steel [3] shells in the event of an accident, where the ends and walls have a thickness of at least 5 mm for a diameter not exceeding 1.80 m or at least 6 mm for a diameter exceeding 1.80 m. If another metal is used, the equivalent thickness shall be obtained in accordance with the formula in 6.8.2.1.18.

For demountable tanks this protection is not required when they are protected on all sides by the drop sides of the carrying vehicle.

[3] *For the definitions of "mild steel" and "reference steel" see 1.2.1.*

6.8.2.1.21 The thickness of shells designed in accordance with 6.8.2.1.14 (a) which either are of not more than 5 000 litres capacity or are divided into leakproof compartments of not more than 5 000 litres unit capacity may be adjusted to a level which, unless prescribed otherwise in 6.8.3 or 6.8.4, shall however not be less than the appropriate value shown in the following table:

Maximum radius of curvature of shell (m)	Capacity of shell or shell compartment (m^3)	Minimum thickness (mm) Mild steel
≤ 2	≤ 5.0	3
2 - 3	≤ 3.5	3
	> 3.5 but ≤ 5.0	4

Where a metal other than mild steel [3] is used, the thickness shall be determined by the equivalence formula given in 6.8.2.1.18. The thickness of the partitions and surge-plates shall in no case be less than that of the shell.

6.8.2.1.22 Surge-plates and partitions shall be dished, with a depth of dish of not less than 10 cm, or shall be corrugated, profiled or otherwise reinforced to give equivalent strength. The area of the surge plate shall be at least 70% of the cross-sectional area of the tank in which the surge-plate is fitted.

Welding and inspection of welds

6.8.2.1.23 The manufacturer's qualification for performing welding operations shall be one recognized by the competent authority. Welding shall be performed by skilled welders using a welding process whose effectiveness (including any heat treatments required) has been demonstrated by test. Non-destructive tests shall be carried out by radiography or by ultrasound and must confirm that the quality of the welding is appropriate to the stresses.

The following checks shall be carried out in accordance with the value of the coefficient λ used in determining the thickness of the shell in 6.8.2.1.17:

$\lambda = 0.8$: the weld beads shall so far as possible be inspected visually on both faces and shall be subjected to a non-destructive spot check with particular attention to connections;

[3] *For the definitions of "mild steel" and "reference steel" see 1.2.1.*

$\lambda = 0.9$: all longitudinal beads throughout their length, all connections, 25% of circular beads, and welds for the assembly of large-diameter items of equipment shall be subjected to non-destructive checks. Beads shall be checked visually on both sides as far as possible;

$\lambda = 1$: all beads shall be subjected to non-destructive checks and are so far as possible inspected visually on both sides. A weld test-piece shall be taken.

Where the competent authority has doubts regarding the quality of weld beads, it may require additional checks.

Other construction requirements

6.8.2.1.24 The protective lining shall be so designed that its leakproofness remains intact, whatever the deformation liable to occur in normal conditions of carriage (see 6.8.2.1.2).

6.8.2.1.25 The thermal insulation shall be so designed as not to hinder access to, or the operation of, filling and discharge devices and safety valves.

6.8.2.1.26 If shells intended for the carriage of flammable liquids having a flash-point of not more than 61ºC are fitted with non-metallic protective linings (inner layers), the shells and the protective linings shall be so designed that no danger of ignition from electrostatic charges can occur.

6.8.2.1.27 Shells intended for the carriage of liquids having a flash-point of not more than 61 °C or for the carriage of flammable gases, or of UN No.1361 carbon or UN No.1361 carbon black, packing group II, shall be linked to the chassis by means of at least one good electrical connection. Any metal contact capable of causing electrochemical corrosion shall be avoided. Shells shall be provided with at least one earth fitting clearly marked with the symbol " ⏚ ", capable of being electrically connected.

All parts of a tank-container intended for the carriage of liquids having a flash-point of not more than 61° C, flammable gases, or UN No.1361 carbon or UN No.1361 carbon black, packing group II, shall be capable of being electrically earthed. Any metal contact capable of causing electrochemical corrosion shall be avoided.

6.8.2.1.28 *Protection of fittings mounted on the upper part of the tank*

The fittings and accessories mounted on the upper part of the tank shall be protected against damage caused by overturning. This protection may take the form of strengthening rings, protective canopies or transverse or longitudinal members so shaped that effective protection is given.

6.8.2.2 ***Items of equipment***

6.8.2.2.1 Suitable non-metallic materials may be used to manufacture service and structural equipment.

The items of equipment shall be so arranged as to be protected against the risk of being wrenched off or damaged during carriage or handling. They shall exhibit a suitable degree of safety comparable to that of the shells themselves, and shall in particular:

- be compatible with the substances carried; and

- meet the requirements of 6.8.2.1.1.

As many operating parts as possible shall be served by the smallest possible number of openings in the shell. The leakproofness of the service equipment including the closure (cover) of the inspection openings shall be ensured even in the event of overturning of the tank, taking into account the forces generated by an impact (such as acceleration and dynamic pressure). Limited release of the tank contents due to a pressure peak during the impact is however allowed.

The leakproofness of the service equipment shall be ensured even in the event of the overturning of the tank-container.

The gaskets shall be made of a material compatible with the substance carried and shall be replaced as soon as their effectiveness is impaired, for example as a result of ageing.

Gaskets ensuring the leakproofness of fittings requiring manipulation during normal use of tanks shall be so designed and arranged that manipulation of the fittings incorporating them does not damage them.

6.8.2.2.2 Each bottom-filling or bottom-discharge opening in tanks which are referred to, in Column (12) of Table A of Chapter 3.2, with a tank code including the letter "A" in its third part (see 4.3.4.1.1) shall be equipped with at least two mutually independent closures, mounted in series, comprising

- an external stop-valve with piping made of a malleable metal material and

- a closing device at the end of each pipe which may be a screw-threaded plug, a blank flange or an equivalent device.

Each bottom-filling or bottom-discharge opening in tanks which are referred to, in Column (12) of Table A of Chapter 3.2, with a tank code including the letter "B" in its third part (see 4.3.3.1.1 or 4.3.4.1.1) shall be equipped with at least three mutually independent closures, mounted in series, comprising

- an internal stop-valve, i.e. a stop-valve mounted inside the shell or in a welded flange or companion flange;

- an external stop-valve or an equivalent device [5]

  one at the end of each pipe | as near as possible to the shell

and

- a closing device at the end of each pipe, which may be a screw-threaded plug, a blank flange or an equivalent device.

However, in the case of tanks intended for the carriage of certain crystallizable or highly viscous substances and shells fitted with an ebonite or thermoplastic coating, the internal stop-valve may be replaced by an external stop-valve provided with additional protection.

[5] *In the case of tank-containers of less than 1 m³ capacity, the external stop-valve or other equivalent device may be replaced by a blank flange.*

The internal stop-valve shall be operable either from above or from below. Its setting - open or closed - shall so far as possible in each case be capable of being verified from the ground. Internal stop-valve control devices shall be so designed as to prevent any unintended opening through impact or an inadvertent act.

The internal shut-off device shall continue to be effective in the event of damage to the external control device.

In order to avoid any loss of contents in the event of damage to the external fittings (pipes, lateral shut-off devices), the internal stop-valve and its seating shall be protected against the danger of being wrenched off by external stresses or shall be so designed as to resist them. The filling and discharge devices (including flanges or threaded plugs) and protective caps (if any) shall be capable of being secured against any unintended opening.
The position and/or direction of closure of shut-off devices shall be clearly apparent.

All openings of tanks which are referred to in Column (12) of Table A of Chapter 3.2, by a tank code including letter "C" or "D" in its third part (see 4.3.3.1.1 and 4.3.4.1.1) shall be situated above the surface level of the liquid. These tanks shall have no pipes or pipe connections below the surface level of the liquid. The cleaning openings (fist-holes) are, however, permitted in the lower part of the shell for tanks referred to by a tank code including letter "C" in its third part. This opening shall be capable of being sealed by a flange so closed as to be leakproof and whose design shall be approved by the competent authority or by a body designated by that authority.

6.8.2.2.3 Unless otherwise prescribed in the provisions of 6.8.4, tanks may have valves to avoid an unacceptable negative internal pressure, without intervening bursting discs.

6.8.2.2.4 The shell or each of its compartments shall be provided with an opening large enough to permit inspection.

6.8.2.2.5 *(Reserved)*

6.8.2.2.6 Tanks intended for the carriage of liquids having a vapour pressure of not more than 110 kPa (1.1 bar) (absolute) at 50 °C shall have a venting system and a safety device to prevent the contents from spilling out if the tank overturns; otherwise they shall conform to 6.8.2.2.7 or 6.8.2.2.8.

6.8.2.2.7 Tanks intended for the carriage of liquids having a vapour pressure of more than 110 kPa (1.1 bar) but not exceeding 175 kPa (1.75 bar) (absolute) at 50 °C shall have a safety valve set at not less than 150 kPa (1.5 bar) (gauge pressure) and which shall be fully open at a pressure not exceeding the test pressure; otherwise they shall conform to 6.8.2.2.8.

6.8.2.2.8 Tanks intended for the carriage of liquids having a vapour pressure of more than 175 kPa (1.75 bar) but not exceeding 300 kPa (3 bar) (absolute) at 50° C shall have a safety valve set at not less than 300 kPa (3 bar) gauge pressure and which shall be fully open at a pressure not exceeding the test pressure; otherwise they shall be hermetically closed [6].

6.8.2.2.9 Movable parts such as covers, closures, etc., which are liable to come into frictional or percussive contact with aluminium shells intended for the carriage of flammable liquids having a flash-point of not more than 61 °C or for the carriage of flammable gases shall not be made of unprotected corrodible steel.

[6] *For the definition of "hermetically closed tank" see 1.2.1.*

6.8.2.3 ***Type approval***

6.8.2.3.1 The competent authority or a body designated by that authority shall issue in respect of each new type of tank-vehicle, demountable tank, tank-container, tank swap body, battery-vehicle or MEGC a certificate attesting that the type, including fastenings, which it has inspected is suitable for the purpose for which it is intended and meets the construction requirements of 6.8.2.1, the equipment requirements of 6.8.2.2 and the special conditions for the classes of substances carried.

The certificate shall show:

- the results of the test;

- an approval number for the type;

  The approval number shall consist of the distinguishing sign [7] of the State in whose territory the approval was granted and a registration number.

- the tank code in accordance with 4.3.3.1.1 or 4.3.4.1.1;

- special construction (TC) and equipment (TE) requirements applicable to the type;

- if required, the substances and/or group of substances for the carriage of which the tank has been approved. These shall be shown with their chemical name or the corresponding collective entry (see 2.1.1.2), together with their classification (Class, classification code and packing group). With the exception of substances of Class 2 and those listed in 4.3.4.1.3, the listing of approved substances may be dispensed with. In such cases, groups of substances permitted on the basis of the tank code shown in the rationalised approach in 4.3.4.1.2 shall be accepted for carriage taking into account any relevant special provision.

The substances referred to in the certificate or the groups of substances approved according to the rationalised approach shall, in general, be compatible with the characteristics of the tank. A reservation shall be included in the certificate if it was not possible to investigate this compatibility exhaustively when the type approval was issued.

6.8.2.3.2 If the tanks, battery-vehicles or MECGs are manufactured in series without modification this approval shall be valid for the tanks, battery-vehicles or MECGs manufactured in series or according to the prototype.

A type approval may however serve for the approval of tanks with limited variations of the design that either reduce the loads and stresses on the tanks (e.g. reduced pressure, reduced mass, reduced volume) or increase the safety of the structure (e.g. increased shell thickness, more surge-plates, decreased diameter of openings). The limited variations shall be clearly described in the type approval certificate.

[7] *Distinguishing sign for use in international traffic prescribed by the Convention on Road Traffic (Vienna, 1968).*

6.8.2.4 ***Inspections and tests***

6.8.2.4.1 Shells and their equipment shall either together or separately undergo an initial inspection before being put into service. This inspection shall include:

- a check of conformity to the approved type;
- a check of the design characteristics [8];
- an examination of the internal and external conditions;
- a hydraulic pressure test [9] at the test pressure indicated on the plate prescribed in 6.8.2.5.1; and
- a check of satisfactory operation of the equipment.

The hydraulic pressure test shall be carried out on the shell as a whole at the test pressure, specified in the Note of 6.8.4 (d), and separately on each compartment of compartmented shells at a pressure of not less than 1.3 times the maximum working pressure.

The hydraulic pressure test shall be carried out before the installation of such thermal equipment as may be necessary. If the shells and their equipment are tested separately, they shall be jointly subjected to a leakproofness test after assembly in accordance with 6.8.2.4.3.

The leakproofness test shall be carried out separately on each compartment of compartmented shells.

6.8.2.4.2 Shells and their equipment shall undergo periodic inspections at fixed intervals. The periodic inspections shall include: an external and internal examination and, as a general rule, a hydraulic pressure test [9]. Sheathing for thermal or other insulation shall be removed only to the extent required for reliable appraisal of the characteristics of the shell.

The hydraulic pressure test shall be carried out on the shell as a whole at the test pressure, specified in the Note of 6.8.4 (d), and separately on each compartment of compartmented shells at a pressure of not less than 1.3 times the maximum working pressure.

---

[8] *The check of the design characteristics shall also include, for shells requiring a test pressure of 1 MPa (10 bar) or higher, the taking of weld test-pieces (work samples) in accordance with 6.8.2.1.23 and the tests prescribed in 6.8.5.*

[9] *In special cases and with the agreement of the expert approved by the competent authority, the hydraulic pressure test may be replaced by a pressure test using another liquid or gas, where such an operation does not present any danger.*

In the case of tanks intended for the carriage of powdery or granular substances, and with the agreement of the expert approved by the competent authority, the periodic hydraulic pressure tests may be omitted and replaced by leakproofness tests in accordance with 6.8.2.4.3.

The maximum intervals for inspection shall be six years.	The maximum intervals for inspections shall be five years.

6.8.2.4.3 In addition, a leakproofness test of the shell with its equipment and a check of the satisfactory operation of all the equipment shall be carried out

at least every three years.	at least every two and a half years.

For this purpose the tank shall be subjected to an effective internal pressure equal to the maximum working pressure, but not less than 20 kPa (0.2 bar) (gauge pressure).

For tanks equipped with venting systems and a safety device to prevent the contents spilling out if the tank overturns, the pressure test shall be equal to the static pressure of the filling substance.

The leakproofness test shall be carried out separately on each compartment of compartmented shells.

6.8.2.4.4 When the safety of the tank or of its equipment may have been impaired as a result of repairs, alterations or accident, an exceptional check shall be carried out.

6.8.2.4.5 The tests, inspections and checks in accordance with 6.8.2.4.1 to 6.8.2.4.4 shall be carried out by the expert approved by the competent authority. Certificates shall be issued showing the results of these operations. These certificates shall refer to the list of the substances permitted for carriage in this tank or to the tank code in accordance with 6.8.2.3.

6.8.2.5 ***Marking***

6.8.2.5.1 Every tank shall be fitted with a corrosion-resistant metal plate permanently attached to the tank in a place readily accessible for inspection. The following particulars at least shall be marked on the plate by stamping or by any other similar method. These particulars may be engraved directly on the walls of the shell itself, if the walls are so reinforced that the strength of the shell is not impaired [10]:

- approval number;
- manufacturer's name or mark;
- manufacturer's serial number;
- year of manufacture;
- test pressure (gauge pressure);
- capacity - in the case of multiple-element shells, the capacity of each element;
- design temperature (only if above +50 ºC or below -20 ºC);

[10] *Add the units of measurement after the numerical values.*

- date (month and year) of initial test and most recent periodic test in accordance with 6.8.2.4.1 and 6.8.2.4.2;

- stamp of the expert who carried out the tests;

- material of the shell and reference to materials standards, if available and, where appropriate, the protective lining;

- test pressure on the shell as a whole and test pressure by compartment in MPa or bar (gauge pressure) where the pressure by compartment is less than the pressure on the shell.

In addition, the maximum working pressure allowed shall be inscribed on pressure-filled or pressure-discharge tanks.

6.8.2.5.2

The following particulars shall be inscribed on the tank-vehicle itself or on a plate [10]:

- name of owner or operator;

- unladen mass; and

- maximum permissible mass.

These particulars shall not be required in the case of a vehicle carrying demountable tanks.

The following particulars shall be inscribed either on the tank-container itself or on a plate [10]:

- names of owner and of operator;

- capacity of the shell;

- tare;

- maximum permissible laden mass;

- proper shipping name of substance carried"

- tank code according to 4.3.4.1.1.

6.8.2.6 ***Requirements for tanks which are designed, constructed and tested according to standards***

(Reserved)

6.8.2.7 ***Requirements for tanks which are not designed, constructed and tested according to standards***

Tanks which are not designed, constructed and tested in accordance with the standards set out in 6.8.2.6 shall be designed, constructed and tested in accordance with the requirements of a technical code recognized by the competent authority. They shall, however, comply with the minimum requirements of 6.8.2.

[10] *Add the units of measurement after the numerical values.*

[11] *A collective description covering a group of substances of a similar nature and equally compatible with the characteristics of the tank may be given instead of the name.*

6.8.3 Special requirements applicable to Class 2

6.8.3.1 *Construction of shells*

6.8.3.1.1 Shells intended for the carriage of compressed or liquefied gases or gases dissolved under pressure shall be made of steel. In the case of weldless shells, by derogation from 6.8.2.1.12 a minimum elongation at fracture of 14% and also a stress σ lower than or equal to limits hereafter given according to the material may be accepted:

(a) When the ratio Re/Rm (of the minimum guaranteed characteristics after heat treatment) is higher than 0.66 without exceeding 0.85:

$$\sigma \leq 0.75 \text{ Re};$$

(b) When the ratio Re/Rm (of the minimum guaranteed characteristics after heat treatment) is higher than 0.85:

$$\sigma \leq 0.5 \text{ Rm}.$$

6.8.3.1.2 The requirements of 6.8.5 apply to the materials and construction of welded shells.

6.8.3.1.3 *(Reserved)*

Construction of battery-vehicles and MEGCs

6.8.3.1.4 Cylinders, tubes, pressure drums and bundles of cylinders, as elements of a battery-vehicle or MEGC, shall be constructed in accordance with Chapter 6.2.

NOTE 1: *Bundles of cylinders which are not elements of a battery-vehicle or of a MEGC shall be subject to the requirements of Chapter 6.2.*

NOTE 2: *Tanks as elements of battery-vehicles and MEGCs shall be constructed in accordance with 6.8.2.1 and 6.8.3.1.*

NOTE 3: *Demountable tanks [12] are not to be considered elements of battery-vehicles or MEGCs.*

6.8.3.1.5 Elements and their fastenings shall be capable of absorbing under the maximum permissible load the forces defined in 6.8.2.1.2. Under each force the stress at the most severely stressed point of the element and its fastenings shall not exceed the value defined in 6.2.3.1 for cylinders, tubes, pressure drums and bundles of cylinders and for tanks the value of σ defined in 6.8.2.1.16.

6.8.3.2 *Items of equipment*

6.8.3.2.1 The discharge pipes of tanks shall be capable of being closed by blank flanges or some other equally reliable device. For tanks intended for the carriage of refrigerated liquefied gases, these blank flanges or other equally reliable devices may be fitted with pressure-release openings of a maximum diameter of 1.5 mm.

6.8.3.2.2 Shells intended for the carriage of liquefied gases may be provided with, in addition to the openings prescribed in 6.8.2.2.2 and 6.8.2.2.4, openings for the fitting of gauges, thermometers, manometers and with bleed holes, as required for their operation and safety.

---

[12] *For the definition of "demountable tank" see 1.2.1.*

6.8.3.2.3 Filling and discharge openings of tanks

| with a capacity greater than 1 m^3

intended for the carriage of liquefied flammable and/or toxic gases shall be equipped with an instant-closing internal safety device which closes automatically in the event of an unintended movement of the shell or of fire. It shall also be possible to operate the closing device by remote control.

6.8.3.2.4 All openings, other than those accommodating safety valves and closed bleed holes, of tanks intended for the carriage of liquefied flammable and/or toxic gases shall, if their nominal diameter is more than 1.5 mm, shall be equipped with an internal shut-off device.

6.8.3.2.5 Notwithstanding the requirements of 6.8.2.2.2, 6.8.3.2.3 and 6.8.3.2.4, tanks intended for the carriage of refrigerated liquefied gases may be equipped with external devices in place of internal devices if the external devices afford protection against external damage at least equivalent to that afforded by the wall of the shell.

6.8.3.2.6 If the tanks are equipped with gauges in direct contact with the substance carried, the gauges shall not be made of a transparent material. If there are thermometers, they shall not project directly into the gas or liquid through the shell.

6.8.3.2.7 Filling and discharge openings situated in the upper part of tanks shall be equipped with, in addition to what is prescribed in 6.8.3.2.3, a second, external, closing device. This device shall be capable of being closed by a blank flange or some other equally reliable device.

6.8.3.2.8 Safety valves shall meet the requirements of 6.8.3.2.9 to 6.8.3.2.12 below:

6.8.3.2.9 Tanks intended for the carriage of compressed or liquefied gases or gases dissolved under pressure, may be fitted with not more than two safety valves whose aggregate clear cross-sectional area of passage at the seating or seatings shall be not less than 20 cm^2 per 30 m^3 or part thereof of the shell's capacity. These valves shall be capable of opening automatically under a pressure between 0.9 and 1.0 times the test pressure of the tank to which they are fitted. They shall be of such a type as to resist dynamic stresses, including liquid surge. The use of dead weight or counter weight valves is prohibited.

6.8.3.2.10 Where tanks are intended for carriage by sea, the requirements of 6.8.3.2.9 shall not prohibit the fitting of safety valves conforming to the IMDG Code.

6.8.3.2.11 Tanks intended for the carriage of refrigerated liquefied gases shall be equipped with two independent safety valves, each so designed as to allow the gases formed by evaporation during normal operation to escape from the tank in such a way that the pressure does not at any time exceed by more than 10% the working pressure indicated on the tank.

One of the two safety valves may be replaced by a bursting disc which shall be such as to burst at the test pressure.

In the event of loss of the vacuum in a double-walled tank, or of destruction of 20% of the insulation of a single-walled tank, the safety valve and the bursting disc shall permit an outflow such that the pressure in the shell cannot exceed the test pressure.

6.8.3.2.12 The safety valves of tanks intended for the carriage of refrigerated liquefied gases shall be capable of opening at the working pressure indicated on the tank. They shall be so designed as to function faultlessly even at their lowest working temperature. The reliability of their operation at that temperature shall be established and checked either by testing each valve or by testing a specimen valve of each design-type.

6.8.3.2.13 The valves of demountable tanks that can be rolled shall be provided with protective caps.

Thermal insulation

6.8.3.2.14 If tanks intended for the carriage of liquefied gases are equipped with thermal insulation, such insulation shall consist of either:

- a sun shield covering not less than the upper third but not more than the upper half of the tank surface and separated from the shell by an air space at least 4 cm across; or

- a complete cladding, of adequate thickness, of insulating materials.

6.8.3.2.15 Tanks intended for the carriage of refrigerated liquefied gases shall be thermally insulated. Thermal insulation shall be ensured by means of a continuous sheathing. If the space between the shell and the sheathing is under vacuum (vacuum insulation), the protective sheathing shall be so designed as to withstand without deformation an external pressure of at least 100 kPa (1 bar) (gauge pressure). By derogation from the definition of "calculation pressure" in 1.2.1, external and internal reinforcing devices may be taken into account in the calculations. If the sheathing is so closed as to be gas-tight, a device shall be provided to prevent any dangerous pressure from developing in the insulating layer in the event of inadequate gas-tightness of the shell or of its items of equipment. The device shall prevent the infiltration of moisture into the heat-insulating sheath.

6.8.3.2.16 Tanks intended for the carriage of liquefied gases having a boiling point below -182° C at atmospheric pressure shall not include any combustible material either in the thermal insulation or in the means of attachment.

The means of attachment for vacuum insulated tanks may, with the approval of the competent authority, contain plastics substances between the shell and the sheathing.

6.8.3.2.17 By derogation from the requirements of 6.8.2.2.4 shells intended for the carriage of refrigerated liquefied gases need not have an inspection opening.

Items of equipment for battery-vehicles and MEGCs

6.8.3.2.18 The manifold shall be designed for service in a temperature range of -20° C to +50° C.

The manifold shall be designed, constructed and installed so as to avoid the risk of damage due to thermal expansion and contraction, mechanical shock and vibration. All piping shall be of suitable metallic material. Welded pipe joints shall be used wherever possible.

Joints in copper tubing shall be brazed or have an equally strong metal union. The melting point of brazing materials shall be no lower than 525ºC. The joints shall not decrease the strength of tubing as may happen when cutting threads.

6.8.3.2.19 Except for UN No.1001 acetylene, dissolved, the permissible maximum stress σ of the manifolding arrangement at the test pressure of the receptacles shall not exceed 75% of the guaranteed yield strength of the material.

The necessary wall thickness of the manifolding arrangement for the carriage of UN No.1001 acetylene, dissolved shall be calculated according to an approved code of practice.

NOTE: *For the yield strength, see 6.8.2.1.11.*

The basic requirements of this paragraph shall be deemed to have been complied with if the following standards are applied: *(Reserved)*.

6.8.3.2.20 By derogation from the requirements of 6.8.3.2.3, 6.8.3.2.4 and 6.8.3.2.7, for cylinders, tubes, pressure drums and bundles of cylinders (frames) forming a battery-vehicle or MEGC, the required closing devices may be provided for within the manifolding arrangement.

6.8.3.2.21 If one of the elements is equipped with a safety valve and shut-off devices are provided between the elements, every element shall be so equipped.

6.8.3.2.22 The filling and discharge devices may be affixed to a manifold.

6.8.3.2.23 Each element, including each individual cylinder of a bundle, intended for the carriage of toxic gases, shall be capable of being isolated by a shut-off valve.

6.8.3.2.24 Battery-vehicles or MEGCs intended for the carriage of toxic gases shall not have safety valves, unless the safety valves are preceded by a bursting disc. In the latter case, the arrangement of the bursting disc and safety valve shall be satisfactory to the competent authority.

6.8.3.2.25 When battery-vehicles or MEGCs are intended for carriage by sea, the requirements of 6.8.3.2.24 shall not prohibit the fitting of safety valves conforming to the IMDG Code.

6.8.3.2.26 Receptacles which are elements of a battery-vehicle or MEGC intended for the carriage of flammable gases shall be combined in groups of not more than 5 000 litres which are capable of being isolated by a shut-off valve.

Each element of a battery-vehicle or MEGC intended for the carriage of flammable gases, when consisting of tanks conforming to this Chapter, shall be capable of being isolated by a shut-off valve.

6.8.3.3 ***Type approval***

No special requirements.

6.8.3.4 ***Inspections and tests***

6.8.3.4.1 The materials of every welded shell with the exception of cylinders, tubes, pressure drums and cylinders as part of bundles of cylinders which are elements of a battery-vehicle or of a MEGC shall be tested according to the method described in 6.8.5.

6.8.3.4.2 The basic requirements for the test pressure are given in 4.3.3.2.1 to 4.3.3.2.4 and the minimum test pressures are given in the table of gases and gas mixtures in 4.3.3.2.5.

6.8.3.4.3 The first hydraulic pressure test shall be carried out before thermal insulation is placed in position.

6.8.3.4.4 The capacity of each shell intended for the carriage of compressed gases filled by mass, liquefied gases or gases dissolved under pressure shall be determined, under the supervision of an expert approved by the competent authority, by weighing or volumetric measurement of the quantity of water which fills the shell; the measurement of shell capacity shall be accurate to within 1%. Determination by a calculation based on the dimensions of the shell is not permitted. The maximum filling masses allowed in accordance with packing instruction P200 or P203 in 4.1.4.1 as well as 4.3.3.2.2 and 4.3.3.2.3 shall be prescribed by an approved expert.

6.8.3.4.5 Checking of the welds shall be carried out in accordance with the λ=1 requirements of 6.8.2.1.23.

6.8.3.4.6 By derogation from the requirements of 6.8.2.4, the periodic inspections, including the hydraulic pressure test, shall take place:

a) Every 3 years | Every 2½ years

in the case of tanks intended for the carriage of UN No.1008 boron trifluoride, UN No. 1017 chlorine, UN No. 1048 hydrogen bromide, anhydrous, UN No. 1050 hydrogen chloride, anhydrous, UN No. 1053 hydrogen sulphide, UN No. 1067 dinitrogen tetroxide (nitrogen dioxide), UN No. 1076 phosgene or UN No. 1079 sulphur dioxide;

b) After 6 years | After 8 years

of service and thereafter every 12 years in the case of tanks intended for the carriage of refrigerated liquefied gases.

A leakproofness test shall be performed by an approved expert 6 years after each periodic inspection. | A leakproofness test may be performed, at the request of the competent authority, between any two successive inspections.

6.8.3.4.7 In the case of vacuum-insulated tanks, the hydraulic-pressure test and the check of the internal condition may, with the consent of the approved expert, be replaced by a leakproofness test and measurement of the vacuum.

6.8.3.4.8 If, at the time of periodic inspections, openings have been made in shells intended for the carriage of refrigerated liquefied gases, the method by which they are hermetically closed before the shells are returned to service shall be approved by the approved expert and shall ensure the integrity of the shell.

6.8.3.4.9 Leakproofness tests of tanks intended for the carriage of compressed, liquefied gases or gases dissolved under pressure shall be performed at a pressure of not less than 0.4 MPa (4 bar) and not more than 0.8 MPa (8 bar) (gauge pressure).

Inspections and tests for battery-vehicles and MEGCs

6.8.3.4.10 The elements and items of equipment of each battery-vehicle or MEGC shall be inspected and tested either together or separately before being put into service for the first time (initial inspection and test). Thereafter battery-vehicles or MEGCs the elements of which are receptacles shall be inspected at not more than five-year intervals. Battery-vehicles and MEGCs the elements of which are tanks shall be inspected according to 6.8.3.4.6. An exceptional inspection and test shall be performed regardless of the last periodic inspection and test when necessary according to 6.8.3.4.14.

6.8.3.4.11 The initial inspection shall include:

- a check of conformity to the approved type;
- a check of the design characteristics;
- an examination of the internal and external conditions;

- a hydraulic pressure test [13] at the test pressure indicated on the plate prescribed in 6.8.3.5.10

- a leakproofness test at the maximum working pressure; and

- a check of satisfactory operation of the equipment.

When the elements and their fittings have been pressure-tested separately, they shall be subjected together after assembly to a leakproofness test.

6.8.3.4.12 Cylinders, tubes and pressure drums and cylinders as part of bundles of cylinders shall be tested according to packing instruction P200 or P203 in 4.1.4.1.

The test pressure of the manifold of the battery-vehicle or MEGC shall be the same as that of the elements of the battery-vehicle or MEGC. The pressure test of the manifold may be performed as a hydraulic test or by using another liquid or gas with the agreement of the competent authority or its authorised body. By derogation from this requirement, the test pressure for the manifold of battery-vehicle or MEGC shall not be less than 300 bar for UN No. 1001 acetylene, dissolved.

6.8.3.4.13 The periodic inspection shall include a leakproofness test at the maximum working pressure and an external examination of the structure, the elements and the service equipment without disassembling. The elements and the piping shall be tested at the periodicity defined in packing instruction P200 of 4.1.4.1 and in accordance with the requirements of 6.2.1.5. When the elements and equipment have been pressure-tested separately, they shall be subjected together after assembly to a leakproofness test.

6.8.3.4.14 An exceptional inspection and test is necessary when the battery-vehicle or MEGC shows evidence of damaged or corroded areas, or leakage, or any other conditions, that indicate a deficiency that could affect the integrity of the battery-vehicle or MEGC. The extent of the exceptional inspection and test and, if deemed necessary, the disassembling of elements shall depend on the amount of damage or deterioration of the battery-vehicle or MEGC. It shall include at least the examinations required under 6.8.3.4.15

6.8.3.4.15 The examinations shall ensure that:

(a) the elements are inspected externally for pitting, corrosion, or abrasions, dents, distortions, defects in welds or any other conditions, including leakage, that might render the battery-vehicles or MEGCs unsafe for transport;

(b) the piping, valves, and gaskets are inspected for corroded areas, defects, and other conditions, including leakage, that might render battery-vehicles or MEGCs unsafe for filling, discharge or transport;

(c) missing or loose bolts or nuts on any flanged connection or blank flange are replaced or tightened;

(d) all emergency devices and valves are free from corrosion, distortion and any damage or defect that could prevent their normal operation. Remote closure devices and self-closing stop-valves shall be operated to demonstrate proper operation;

---

[13] *In special cases and with the agreement of the expert approved by the competent authority, the hydraulic pressure test may be replaced by a pressure test using another liquid or gas, where such an operation does not present any danger.*

(e) required markings on the battery-vehicles or MEGCs are legible and in accordance with the applicable requirements; and

(f) any framework, supports and arrangements for lifting the battery-vehicles or MEGCs are in satisfactory condition.

6.8.3.4.16 The tests, inspections and checks in accordance with 6.8.3.4.10 to 6.8.3.4.15 shall be carried out by the expert approved by the competent authority. Certificates shall be issued showing the results of these operations.

These certificates shall refer to the list of the substances permitted for carriage in this battery-vehicle or MEGC in accordance with 6.8.2.3.1.

6.8.3.5 ***Marking***

6.8.3.5.1 The following additional particulars shall be marked by stamping or by any other similar method on the plate prescribed in 6.8.2.5.1, or directly on the walls of the shell itself if the walls are so reinforced that the strength of the tank is not impaired.

6.8.3.5.2 On tanks intended for the carriage of only one substance:

- the proper shipping name of the gas and, in addition for gases classified under an n.o.s. entry, the technical name [14].

This indication shall be supplemented:

- in the case of tanks intended for the carriage of compressed gases filled by volume (pressure), by an indication of the maximum filling pressure at 15 °C permitted for the tank; and

- in the case of tanks intended for the carriage of compressed gases filled by mass, and of liquefied gases, refrigerated liquefied gases or gases dissolved under pressure by an indication of the maximum permissible load mass in kg and of the filling temperature if below -20 °C.

---

[14] *Instead of the proper shipping name of the n.o.s. entry followed by the technical name, the use of one of the following names is permitted:*

- *for UN No. 1078 refrigerant gas, n.o.s: mixture F1, mixture F2, mixture F3;*

- *for UN No. 1060 methylacetylene and propadiene mixtures, stabilized: mixture P1, mixture P2;*

- *for UN No. 1965 hydrocarbon gas mixture, liquefied, n.o.s: mixture A, mixture A01, mixture A02, mixture A0, mixture A1, mixture B1, mixture B2, mixture B, mixture C. The names customary in the trade and mentioned in 2.2.2.3, Classification code 2F, UN No. 1965, Note 1 may be used only as a complement.*

6.8.3.5.3 On multipurpose tanks:

- the proper shipping names of the gases and, in addition for gases classified under an n.o.s. entry, the technical name of the gases [14] for whose carriage the tank is approved.

These particulars shall be supplemented by an indication of the maximum permissible load mass in kg for each gas.

6.8.3.5.4 On tanks intended for the carriage of refrigerated liquefied gases:

- the maximum working pressure allowed.

6.8.3.5.5 On tanks equipped with thermal insulation:

- the inscription "thermally insulated" or "thermally insulated by vacuum".

6.8.3.5.6 In addition to the particulars prescribed in 6.8.2.5.2, the following shall be inscribed on

the tank itself or on a plate:	the tank-container itself or on a plate:
(a) - the tank code according to the certificate (see 6.8.2.3.1) with the actual test pressure of the tank;	
- the inscription: "minimum filling temperature allowed :…";	
(b) where the tank is intended for the carriage of one substance only:	
- the proper shipping name of the gas and, in addition for gases classified under an n.o.s. entry, the technical name [14];	
	- for compressed gases which are filled by mass, and for liquefied gases, refrigerated liquefied gases or gases dissolved under pressure, the maximum permissible load mass in kg;

[14] *Instead of the proper shipping name of the n.o.s. entry followed by the technical name, the use of one of the following names is permitted:*

- *for UN No. 1078 refrigerant gas, n.o.s: mixture F1, mixture F2, mixture F3;*
- *for UN No. 1060 methylacetylene and propadiene mixtures, stabilized: mixture P1, mixture P2;*
- *for UN No. 1965 hydrocarbon gas mixture, liquefied, n.o.s: mixture A, mixture A01, mixture A02, mixture A0, mixture A1, mixture B1, mixture B2, mixture B, mixture C. The names customary in the trade and mentioned in 2.2.2.3, Classification code 2F, UN No. 1965, Note 1 may be used only as a complement.*

(c) where the tank is a multipurpose tank:

- the proper shipping name of the gas and, for gases classified under an n.o.s. entry, the technical name [14] of all gases to whose carriage the tank is assigned

  with an indication of the maximum permissible load mass in kg for each of them;

(d) where the shell is equipped with thermal insulation:

- the inscription "thermally insulated" (or "thermally insulated by vacuum"), in an official language of the country of registration and also, if that language is not English, French or German, in English, French or German, unless any agreements concluded between the countries concerned in the transport operation provide otherwise.

6.8.3.5.7 *(Reserved)*

6.8.3.5.8 These particulars shall not be required in the case of a vehicle carrying demountable tanks.

6.8.3.5.9 *(Reserved)*

Marking of battery-vehicles and MEGCs

6.8.3.5.10 Every battery-vehicle and every MEGC shall be fitted with a corrosion-resistant metal plate permanently attached in a place readily accessible for inspection. The following particulars at least shall be marked on the plate by stamping or by any other similar method [15]:

- approval number;
- manufacturer's name or mark;
- manufacturer's serial number;
- year of manufacture;
- test pressure (gauge pressure)
- design temperature (only if above +50 °C or below -20 °C);
- date (month and year) of initial test and most recent periodic test in accordance with 6.8.3.4.10 to 6.8.3.4.13;

---

[14] *Instead of the proper shipping name of the n.o.s. entry followed by the technical name, the use of one of the following names is permitted:*

- *for UN No. 1078 refrigerant gas, n.o.s: mixture F1, mixture F2, mixture F3;*
- *for UN No. 1060 methylacetylene and propadiene mixtures, stabilized: mixture P1, mixture P2;*
- *for UN No. 1965 hydrocarbon gas mixture, liquefied, n.o.s: mixture A, mixture A01, mixture A02, mixture A0, mixture A1, mixture B1, mixture B2, mixture B, mixture C. The names customary in the trade and mentioned in 2.2.2.3, Classification code 2F, UN No. 1965, Note 1 may be used only as a complement.*

[15] *Add the units of measurements after the numerical values.*

- stamp of the expert who carried out the tests.

6.8.3.5.11	The following particulars shall be inscribed on the battery-vehicle itself or on a plate [15]: - names of owner or of operator; - number of elements; - total capacity of the elements; and for battery-vehicles filled by mass: - unladen mass**;** - maximum permissible mass.	The following particulars shall be inscribed either on the MEGC itself or on a plate [15]: - names of owner and of operator; - number of elements; - total capacity of the elements; - maximum permissible laden mass; - proper shipping name of substance carried [16]; and for MEGCs filled by mass: - tare.

6.8.3.5.12 The frame of a battery-vehicle or MEGC shall bear near the filling point a plate specifying:

- the maximum filling pressure [15] at 15 °C allowed for elements intended for compressed gases;

---

[15] *Add the units of measurements after the numerical values.*

[16] *A collective description covering a group of substances of a similar nature and equally compatible with the characteristics of the tank may be given instead of the name.*

- the proper shipping name of the gas in accordance with Chapter 3.2 and, in addition for gases classified under an n.o.s. entry, the technical name [17];

and, in addition, in the case of liquefied gases:

- the permissible maximum load per element [15].

6.8.3.5.13 Cylinders, tubes and pressure drums, and cylinders as part of bundles of cylinders, shall be marked according to 6.2.1.7. These receptacles need not be labelled individually with the danger labels as required in Chapter 5.2.

Battery-vehicles and MEGCs shall be placarded and marked according to Chapter 5.3.

6.8.3.6 ***Requirements for battery-vehicles and MEGCs which are designed, constructed and tested according to standards***

(Reserved)

6.8.3.7 ***Requirements for battery-vehicles and MEGCs which are not designed, constructed and tested according to standards***

Battery-vehicles and MEGCs which are not designed, constructed and tested in accordance with the standards set out in 6.8.3.6 shall be designed, constructed and tested in accordance with the requirements of a technical code recognized by the competent authority. They shall, however, comply with the minimum requirements of 6.8.3.

6.8.4 **Special provisions**

NOTE 1: *For liquids having a flash-point of not more than 61 °C and for flammable gases, see also 6.8.2.1.26, 6.8.2.1.27 and 6.8.2.2.9.*

NOTE 2: *For requirements for tanks subjected to a pressure test of not less than 1 MPa (10 bar) or for tanks intended for the carriage of refrigerated liquefied gases, see 6.8.5.*

When they are shown under an entry in Column (13) of Table A of Chapter 3.2, the following special provisions apply:

(a) **Construction (TC)**

TC1 The requirements of 6.8.5 are applicable to the materials and construction of these shells.

---

[17] *Instead of the proper shipping name of the n.o.s. entry followed by the technical name, the use of one of the following names is permitted:*

- *for UN No. 1078 refrigerant gas, n.o.s: mixture F1, mixture F2, mixture F3;*
- *for UN No. 1060 methylacetylene and propadiene mixtures, stabilized: mixture P1, mixture P2;*
- *for UN No. 1965 hydrocarbon gas mixture, liquefied, n.o.s: mixture A, mixture A01, mixture A02, mixture A0, mixture A1, mixture B1, mixture B2, mixture B, mixture C. The names customary in the trade and mentioned in 2.2.2.3, Classification code 2F, UN No. 1965, Note 1 may be used only as a complement.*

[15] *Add the units of measurements after the numerical values.*

TC2 Shells, and their items of equipment, shall be made of aluminium not less than 99.5% pure or of suitable steel not liable to cause hydrogen peroxide to decompose. Where shells are made of aluminium not less than 99.5% pure, the wall thickness need not exceed 15 mm, even where calculation in accordance with 6.8.2.1.17 gives a higher value.

TC3 The shells shall be made of austenitic steel.

TC4 Shells shall be provided with an enamel or equivalent protective lining if the material of the shell is attacked by UN No. 3250 chloroacetic acid.

TC5 Shells shall be provided with a lead lining not less than 5 mm thick or an equivalent lining.

TC6 Where the use of aluminium is necessary for tanks, such tanks shall be made of aluminium not less than 99.5% pure; the wall thickness need not exceed 15 mm even where calculation in accordance with 6.8.2.1.17 gives a higher value.

TC7 The effective minimum thickness of the shell shall not be less than 3 mm.

(b) **Items of equipment (TE)**

TE1 If tanks, battery-vehicles or MEGCs are fitted with safety valves, a bursting disc shall be placed before the valves. The arrangement of the bursting disc and safety valve shall be such as to satisfy the competent authority. A pressure gauge or another suitable indicator shall be provided in the space between the bursting disc and the safety valve, to enable detection of any rupture, perforation or leakage of the disc which may disrupt the action of the safety valve.

TE2 The bottom discharge system of tanks may consist of an external pipe with a stop-valve, if it is constructed in a metallic material liable to deformation.

TE3 Tanks shall in addition meet the following requirements. The heating device shall not penetrate into, but shall be exterior to the shell. However, a pipe used for extracting the phosphorus may be equipped with a heating jacket. The device heating the jacket shall be so regulated as to prevent the temperature of the phosphorus from exceeding the filling temperature of the shell. Other piping shall enter the shell in its upper part; openings shall be situated above the highest permissible level of the phosphorus and be capable of being completely enclosed under lockable caps. The tank shall be equipped with a gauging system for verifying the level of the phosphorus and, if water is used as a protective agent, with a fixed gauge mark showing the highest permissible level of the water.

TE4 Shells shall be equipped with thermal insulation made of materials which are not readily flammable.

TE5 If shells are equipped with thermal insulation, such insulation shall be made of materials which are not readily flammable.

TE6 Tanks may be equipped with valves opening automatically inwards or outwards under the effect of a difference of pressure of between 20 kPa and 30 kPa (0.2 bar and 0.3 bar).

TE7 The shell-discharge system shall be equipped with two mutually independent shut-off devices mounted in series, the first taking the form of a quick-closing internal stop-valve of an approved type and the second that of an external stop-valve, one at each

end of the discharge pipe. A blank flange, or another device providing the same measure of security, shall also be fitted at the outlet of each external stop-valve. The internal stop-valve shall be such that if the pipe is wrenched off the stop-valve will remain integral with the shell and in the closed position.

TE8 The connections to the external pipe-sockets of tanks shall be made of materials not liable to cause decomposition of hydrogen peroxide.

TE9 Tanks shall be fitted in their upper part with a shut-off device preventing any build-up of excess pressure inside the shell due to the decomposition of the substances carried, any leakage of liquid, and any entry of foreign matter into the shell.

TE10 The shut-off devices of tanks shall be so designed as to preclude obstruction of the devices by solidified ammonium nitrate during carriage. Where tanks are sheathed in thermally-insulating material, the material shall be of an inorganic nature and entirely free from combustible matter.

TE11 Shells and their service equipment shall be so designed as to prevent the entry of foreign matter, leakage of liquid or any building up of dangerous excess pressure inside the shell due to the decomposition of the substances carried.

TE12 Tanks shall be equipped with thermal insulation complying with the requirements of 6.8.3.2.14. If the SADT of the organic peroxide in the tank is 55 °C or less, or the tank is constructed of aluminium, the shell shall be completely insulated. The sun shield and any part of the tank not covered by it, or the outer sheathing of a complete lagging, shall be painted white or finished in bright metal. The paint shall be cleaned before each transport journey and renewed in case of yellowing or deterioration. The thermal insulation shall be free from combustible matter. Tanks shall be fitted with temperature sensing devices.

Tanks shall be fitted with safety valves and emergency pressure-relief devices. Vacuum-relief devices may also be used. Emergency pressure-relief devices shall operate at pressures determined according to both the properties of the organic peroxide and the construction characteristics of the tank. Fusible elements shall not be permitted in the body of the shell.

Tanks shall be fitted with spring-loaded safety valves to prevent significant pressure build-up within the shell of the decomposition products and vapours released at a temperature of 50 °C. The capacity and start-to-discharge pressure of the safety-valve(s) shall be based on the results of the tests specified in special provision TA2. The start-to-discharge pressure shall however in no case be such that liquid could escape from the valve(s) if the tank were overturned.

The emergency-relief devices may be of the spring-loaded or frangible types designed to vent all the decomposition products and vapours evolved during a period of not less than one hour of complete fire-engulfment as calculated by the following formula:

$$q = 70961 \times F \times A^{0.82}$$

where:

q = heat absorption [W]
A = wetted area [m^2]
F = insulation factor

F = 1 for non-insulated tanks, or

$$F = \frac{U(923 - T_{PO})}{47032}$$ for insulated tanks

where:

K = heat conductivity of insulation layer [$W \cdot m^{-1} \cdot K^{-1}$]
L = thickness of insulation layer [m]
U = K/L = heat transfer coefficient of the insulation [$W \cdot m^{-2} \cdot K^{-1}$]
T_{PO} = temperature of peroxide at relieving conditions [K]

The start-to-discharge pressure of the emergency-relief device(s) shall be higher than that above specified and based on the results of the tests referred to in special provision TA2. The emergency-relief devices shall be dimensioned in such a way that the maximum pressure in the tank never exceeds the test pressure of the tank.

NOTE: *An example of a method to determine the size of emergency-relief devices is given in Appendix 5 of the Manual of Tests and Criteria.*

For tanks equipped with thermal insulation consisting of a complete cladding, the capacity and setting of the emergency-relief device(s) shall be determined assuming a loss of insulation from 1% of the surface area.

Vacuum-relief devices and spring-loaded safety valves of tanks shall be provided with flame arresters unless the substances to be carried and their decomposition products are non-combustible. Due attention shall be paid to the reduction of the relief capacity caused by the flame arrester.

TE13 Tanks shall be thermally insulated and fitted with a heating device on the outside.

TE14 Tanks shall be equipped with thermal insulation. They may also be equipped with pressure-release devices opening automatically inwards or outwards under the effect of a difference of pressure of between 20 kPa and 30 kPa (0.2 bar and 0.3 bar). The thermal insulation directly in contact with the shell shall have an ignition temperature at least 50 °C higher than the maximum temperature for which the tank was designed.

TE15 *(Reserved)*

TE16 *(Reserved)*
TE17 *(Reserved)*

TE18 Tanks intended for the carriage of substances filled at a temperature higher than 190 ºC shall be equipped with deflectors placed at right angles to the upper filling openings, so as to avoid a sudden localized increase in wall temperature during filling.

TE19 Fittings and accessories mounted in the upper part of the tank shall be either:

- inserted in a recessed housing; or
- equipped with an internal safety valve; or
- shielded by a cap, or by transverse and/or longitudinal members, or by other equally effective devices, so profiled that in the event of overturning the fittings and accessories will not be damaged.

Fittings and accessories mounted in the lower part of the tank:

Pipe-sockets, lateral shut-off devices, and all discharge devices shall either be recessed by at least 200 mm from the extreme outer edge of the tank or be protected by a rail having a coefficient of inertia of not less than 20 cm^3 transversally to the direction of travel; their ground clearance shall be not less than 300 mm with the tank full.

Fittings and accessories mounted on the rear face of the tank shall be protected by the bumper prescribed in 9.7.6. Their height above the ground shall be such that they are adequately protected by the bumper

TE20 Notwithstanding the other tank-codes which are permitted in the hierarchy of tanks of the rationalized approach in 4.3.4.1.2, tanks shall be equipped with a safety valve.

(c) **Type approval (TA)**

TA1 Tanks shall not be approved for the carriage of organic substances.

TA2 This substance may be carried in fixed or demountable tanks or tank-containers under the conditions laid down by the competent authority of the country of origin, if, on the basis of the tests mentioned below, the competent authority is satisfied that such a transport operation can be carried out safely. If the country of origin is not party to ADR, these conditions shall be recognized by the competent authority of the first ADR country reached by the consignment.

For the type approval tests shall be undertaken:

- to prove the compatibility of all materials normally in contact with the substance during carriage;

- to provide data to facilitate the design of the emergency pressure-relief devices and safety valves taking into account the design characteristics of the tank; and

- to establish any special requirements necessary for the safe carriage of the substance.

The test results shall be included in the report for the type approval.

(d) **Tests (TT)**

NOTE: *Tanks shall be subjected to the initial and periodic hydraulic pressure tests at a pressure depending on their calculation pressure at least equal to the pressure indicated below:*

Calculation pressure (bar)	***Test pressure (bar)***
G [18]	*G* [18]
1.5	*1.5*
2.65	*2.65*
4	*4*
10	*4*
15	*4*
21	*10 (4* [19]*)*

TT1 Tanks of pure aluminium need to be subjected to the initial and periodic hydraulic pressure tests at a pressure of only 250 kPa (2.5 bar) (gauge pressure).

TT2 The condition of the lining of shells shall be inspected every year by an expert approved by the competent authority, who shall inspect the inside of the shell.

TT3 By derogation from the requirements of 6.8.2.4.2, periodic inspections shall take place at least every eight years and shall include a thickness check using suitable instruments. For such tanks, the leakproofness test and check for which provision is made in 6.8.2.4.3 shall be carried out at least every four years.

TT4 *(Reserved)*

TT5 The hydraulic pressure tests shall take place at least every

3 years. | 2½ years.

TT6 The periodic tests, including the hydraulic pressure test, shall be carried out at least every 3 years.

[18] *G = minimum calculation pressure according to the general requirements 6.8.2.1.14 (see 4.3.4.1).*

[19] *Minimum test pressure for UN No. 1744 bromine or UN No. 1744 bromine solution.*

TT7 Notwithstanding the requirements of 6.8.2.4.2, the periodic internal inspection may be replaced by a programme approved by the competent authority.

(e) **Marking (TM)**

NOTE: *These particulars shall be in an official language of the country of approval, and also, if that language is not English, French or German, in English, French or German, unless any agreements concluded between the countries concerned in the transport operation provide otherwise.*

TM1 Tanks shall bear in addition to the particulars prescribed in 6.8.2.5.2, the words: "**Do not open during carriage. Liable to spontaneous combustion**" (see also the Note above).

TM2 Tanks shall bear in addition to the particulars prescribed in 6.8.2.5.2, the words: "**Do not open during carriage. Gives off flammable gases on contact with water**" (see also the Note above).

TM3 Tanks shall also bear, on the plate prescribed in 6.8.2.5.1, the proper shipping names of the approved substances and the maximum permissible load of the tank in kg.

TM4 For tanks the following additional particulars shall be marked by stamping or by any other similar method on the plate prescribed in 6.8.2.5.2 or directly on the shell itself, if the walls are so reinforced that the strength of the tank is not impaired: the chemical name with the approved concentration of the substance concerned.

TM5 Tanks shall bear, in addition to the particulars referred to in 6.8.2.5.1 the date (month, year) of the most recent inspection of the internal condition of the shell.

TM6 *(Reserved)*

TM7 The trefoil symbol, as described in 5.2.1.7.6, shall be marked by stamping or any other equivalent method on the plate described in 6.8.2.5.1. This trefoil may be engraved directly on the walls of the shell itself, if the walls are so reinforced that the strength of the shell is not impaired.

6.8.5 Requirements concerning the materials and construction of fixed welded tanks, demountable welded tanks, and welded shells of tank-containers for which a test pressure of not less than 1 MPa (10 bar) is required, and of fixed welded tanks, demountable welded tanks and welded shells of tank-containers intended for the carriage of refrigerated liquefied gases of Class 2

6.8.5.1 ***Materials and shells***

6.8.5.1.1 (a) Shells intended for the carriage of :

- compressed, liquefied gases or gases dissolved under pressure of Class 2;
- UN Nos. 1366, 1370, 1380, 2003, 2005, 2445, 2845, 2870, 3049, 3050, 3051, 3052, 3053, 3076, 3194 and 3203 of Class 4.2; and
- UN No. 1052 hydrogen fluoride, anhydrous and UN No.1790 hydrofluoric acid with more than 85% hydrogen fluoride of Class 8

shall be made of steel.

(b) Shells constructed of fine-grained steels for the carriage of:

- corrosive gases of Class 2 and UN No. 2073 ammonia solution; and
- UN No. 1052 hydrogen fluoride, anhydrous and UN No.1790 hydrofluoric acid with more than 85% hydrogen fluoride of Class 8

shall be heat-treated for thermal stress relief.

(c) Shells intended for the carriage of refrigerated liquefied gases of Class 2, shall be made of steel, aluminium, aluminium alloy, copper or copper alloy (e.g. brass). However, shells made of copper or copper alloy shall be allowed only for gases containing no acetylene; ethylene, however, may contain not more than 0.005% acetylene.

(d) Only materials appropriate to the lowest and highest working temperatures of the shells and of their fittings and accessories may be used.

6.8.5.1.2 The following materials shall be allowed for the manufacture of shells:

(a) steels not subject to brittle fracture at the lowest working temperature (see 6.8.5.2.1):

- mild steels (except for refrigerated liquefied gases of Class 2);
- fine-grained steels, down to a temperature of -60 ºC;
- nickel steels (with a nickel content of 0.5 to 9%), down to a temperature of -196 ºC, depending on the nickel content;
- austenitic chrome-nickel steels, down to a temperature of -270 ºC;

(b) aluminium not less than 99.5% pure or aluminium alloys (see 6.8.5.2.2);

(c) deoxidized copper not less than 99.9% pure, or copper alloys having a copper content of over 56% (see 6.8.5.2.3).

6.8.5.1.3 (a) Shells made of steel, aluminium or aluminium alloys shall be either seamless or welded.

(b) Shells made of austenitic steel, copper or copper alloy may be hard-soldered.

6.8.5.1.4 The fittings and accessories may either be screwed to the shells or be secured thereto as follows:

(a) shells made of steel, aluminium or aluminium alloy: by welding;

(b) shells made of austenitic steel, of copper or of copper alloy: by welding or hard-soldering.

6.8.5.1.5 The construction of shells and their attachment to the vehicle, to the underframe or in the container frame shall be such as to preclude with certainty any such reduction in the temperature of the load-bearing components as would be likely to render them brittle. The means of attachment of shells shall themselves be so designed that even when the shell is at its lowest working temperature they still possess the necessary mechanical properties.

6.8.5.2 ***Test requirements***

6.8.5.2.1 *Steel shells*

The materials used for the manufacture of shells and the weld beads shall, at their lowest working temperature, but at least at -20 ºC, meet at least the following requirements as to impact strength:

- The tests shall be carried out with test-pieces having a V-shaped notch;

- The minimum impact strength (see 6.8.5.3.1 to 6.8.5.3.3) for test-pieces with the longitudinal axis at right angles to the direction of rolling and a V-shaped notch (conforming to ISO R 148) perpendicular to the plate surface, shall be 34 J/cm2 for mild steel (which, because of existing ISO standards, may be tested with test-pieces having the longitudinal axis in the direction of rolling); fine-grained steel; ferritic alloy steel Ni < 5%, ferritic alloy steel 5% < Ni < 9%; or austenitic Cr - Ni steel;

- In the case of austenitic steels, only the weld bead need be subjected to an impact-strength test;

- For working temperatures below -196ºC the impact-strength test is not performed at the lowest working temperature, but at -196 ºC.

6.8.5.2.2 *Shells made of aluminium or aluminium alloy*

The seams of shells shall meet the requirements laid down by the competent authority.

6.8.5.2.3 *Shells made of copper or copper alloy*

It is not necessary to carry out tests to determine whether the impact strength is adequate.

6.8.5.3 ***Impact-strength tests***

6.8.5.3.1 For sheets less than 10 mm but not less than 5 mm thick, test-pieces having a cross-section of 10 mm x e mm, where "e" represents the thickness of the sheet, shall be used. Machining to 7.5 mm or 5 mm is permitted if it is necessary. The minimum value of 34 J/cm^2 shall be required in every case.

NOTE*: No impact-strength test shall be carried out on sheets less than 5 mm thick, or on their weld seams.*

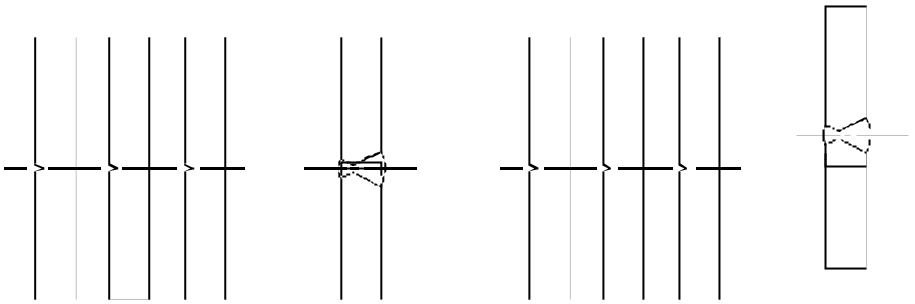
6.8.5.3.2 (a) For the purpose of testing sheets, the impact strength shall be determined on three test-pieces. Test-pieces shall be taken at right angles to the direction of rolling; however, for mild steel they may be taken in the direction of rolling.

(b) For testing weld seams the test-pieces shall be taken as follows:

when e < 10 mm:

three test-pieces with the notch at the centre of the weld;

three test-pieces with the notch in the centre of the heat affected zone (the V-notch to cross the fusion boundary at the centre of the specimen);

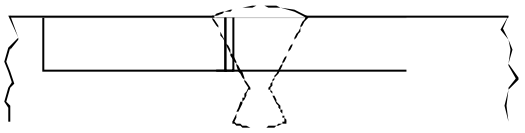


Centre of the weld Heat affected zone

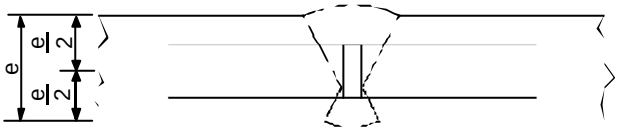
when 10 mm < e < 20 mm:

three test-pieces from the centre of the weld;

three test-pieces from the heat affected zone (the V-notch to cross the fusion boundary at the centre of the specimen);



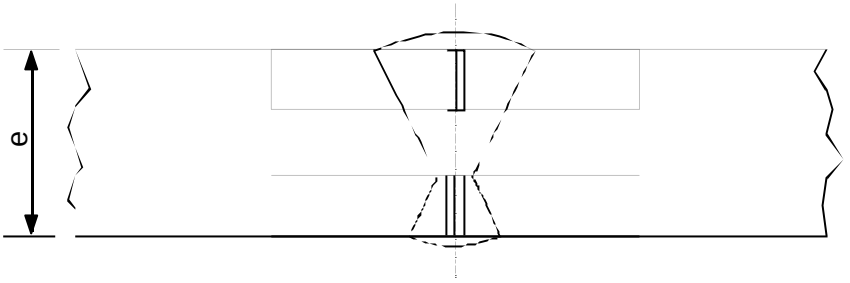
Centre of weld



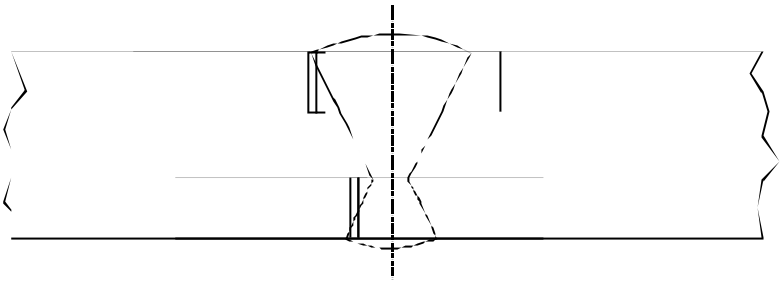
Heat affected zone

when e > 20 mm

two sets of three test-pieces, one set on the upper face, one set on the lower face at each of the points indicated below (the V-notch to cross the fusion boundary at the centre of the specimen for those taken from the heat affected zone)



Centre of weld



Heat affected zone

6.8.5.3.3 (a) For sheets, the average of the three tests shall meet the minimum value of 34 J/cm^2 indicated in 6.8.5.2.1; not more than one of the individual values may be below the minimum value and then not below 24 J/cm^2.

(b) For welds, the average value obtained from the three test-pieces taken at the centre of the weld shall not be below the minimum value of 34 J/cm^2; not more than one of the individual values may be below the minimum value and then not below 24 J/cm^2.

(c) For the heat affected zone (the V-notch to cross the fusion boundary at the centre of the specimen) the value obtained from not more than one of the three test-pieces may be below the minimum value of 34 J/cm^2, though not below 24 J/cm^2.

6.8.5.3.4 If the requirements prescribed in 6.8.5.3.3 are not met, one retest only may be done if:

(a) the average value of the first three tests is below the minimum value of 34 J/cm^2, or

(b) more than one of the individual values is less than the minimum value of 34 J/cm^2 but not below 24 J/cm^2.

6.8.5.3.5 In a repeated impact test on sheets or welds, none of the individual values may be below 34 J/cm^2. The average value of all the results of the original test and of the retest should be equal to or more than the minimum of 34 J/cm^2.

On a repeated impact strength test on the heat-affected zone, none of the individual values may be below 34 J/cm^2.

CHAPTER 6.9

REQUIREMENTS FOR THE DESIGN, CONSTRUCTION, EQUIPMENT, TYPE APPROVAL, TESTING AND MARKING OF FIBRE-REINFORCED PLASTICS (FRP) TANKS

NOTE: *For portable tanks see Chapter 6.7; for fixed tanks (tank-vehicles), demountable tanks and tank-containers and tank swap bodies, with shells made of metallic materials, and battery-vehicles and multiple element gas containers (MEGCs) see Chapter 6.8; for vacuum operated waste tanks see Chapter 6.10.*

6.9.1 General

6.9.1.1 FRP tanks shall be designed, manufactured and tested in accordance with a quality assurance programme recognized by the competent authority; in particular, lamination work and welding of thermoplastic liners shall only be carried out by qualified personnel in accordance with a procedure recognized by the competent authority.

6.9.1.2 For the design and testing of FRP tanks, the provisions of 6.8.2.1.1, 6.8.2.1.7, 6.8.2.1.13, 6.8.2.1.14 (a) and (b), 6.8.2.1.25, 6.8.2.1.27, 6.8.2.1.28 and 6.8.2.2.3 shall also apply.

6.9.1.3 Heating elements shall not be used for FRP tanks.

6.9.1.4 For the stability of tank-vehicles, the requirements of 9.7.5.1 shall apply.

6.9.2 Construction

6.9.2.1 Shells shall be made of suitable materials, which shall be compatible with the substances to be carried in a service temperature range of between -40°C and +50°C, unless temperature ranges are specified for specific climatic conditions by the competent authority of the country where the transport operation is performed.

6.9.2.2 Shells shall consist of the following three elements :

- internal liner,
- structural layer,
- external layer.

6.9.2.2.1 The internal liner is the inner shell wall zone designed as the primary barrier to provide for the long-term chemical resistance in relation to the substances to be carried, to prevent any dangerous reaction with the contents or the formation of dangerous compounds and any substantial weakening of the structural layer owing to the diffusion of products through the internal liner.

The internal liner may either be a FRP liner or a thermoplastic liner.

6.9.2.2.2 FRP liners shall consist of:

(a) surface layer ("gel-coat"): adequate resin rich surface layer, reinforced with a veil, compatible with the resin and contents. This layer shall have a fibre mass content of not more than 30 % and have a thickness between 0.25 and 0.60 mm;

(b) strengthening layer(s): layer or several layers with a minimum thickness of 2 mm, containing a minimum of 900 g/m² of glass mat or chopped fibres with a mass content

in glass of not less than 30% unless equivalent safety is demonstrated for a lower glass content.

6.9.2.2.3 Thermoplastic liners shall consist of thermoplastic sheet material as referred to in 6.9.2.3.4, welded together in the required shape, to which the structural layers are bonded. Durable bonding between liners and the structural layer shall be achieved by the use of an appropriate adhesive.

***NOTE**: For the carriage of flammable liquids the internal layer may require additional measures in accordance with 6.9.2.14, in order to prevent the accumulation of electrical charges.*

6.9.2.2.4 The structural layer of the shell is the zone specially designed according to 6.9.2.4 to 6.9.2.6 to withstand the mechanical stresses. This part normally consists of several fibre reinforced layers in determined orientations.

6.9.2.2.5 The external layer is the part of the shell which is directly exposed to the atmosphere. It shall consist of a resin rich layer with a thickness of at least 0.2 mm. For a thickness larger than 0.5 mm, a mat shall be used. This layer shall have a mass content in glass of less than 30% and shall be capable of withstanding exterior conditions, in particular the occasional contact with the substance to be carried. The resin shall contain fillers or additives to provide protection against deterioration of the structural layer of the shell by ultra-violet radiation.

6.9.2.3 ***Raw materials***

6.9.2.3.1 All materials used for the manufacture of FRP tanks shall be of known origin and specifications.

6.9.2.3.2 *Resins*

The processing of the resin mixture shall be carried out in strict compliance with the recommendations of the supplier. This concerns mainly the use of hardeners, initiators and accelerators. These resins can be:

- unsaturated polyester resins;
- vinyl ester resins;
- epoxy resins;
- phenolic resins.

The heat distortion temperature (HDT) of the resin, determined in accordance with ISO 75-1:1993 shall be at least 20°C higher than the maximum service temperature of the tank, but shall in any case not be lower than 70 °C.

6.9.2.3.3 *Reinforcement fibres*

The reinforcement material of the structural layers shall be a suitable grade of fibres such as glass fibres of type E or ECR according to ISO 2078:1993. For the internal surface liner, glass fibres of type C according to ISO 2078:1993 may be used. Thermoplastic veils may only be used for the internal liner when their compatibility with the intended contents has been demonstrated.

6.9.2.3.4 *Thermoplastic liner material*

Thermoplastic liners, such as unplastified polyvinyl chloride (PVC-U), polypropylene (PP), polyvinylidene fluoride (PVDF), polytetrafluoroethylene (PTFE), etc. may be used as lining materials.

6.9.2.3.5 *Additives*

Additives necessary for the treatment of the resin, such as catalysts, accelerators, hardeners and thixotropic substances as well as materials used to improve the tank, such as fillers, colours, pigments etc. shall not cause weakening of the material, taking into account lifetime and temperature expectancy of the design.

6.9.2.4 Shells, their attachments and their service and structural equipment shall be designed to withstand without loss of contents (other than quantities of gas escaping through any degassing vents) during the design lifetime:

- the static and dynamic loads in normal conditions of carriage;

- the prescribed minimum loads as defined in 6.9.2.5 to 6.9.2.10.

6.9.2.5 At the pressures as indicated in 6.8.2.1.14 (a) and (b), and under the static gravity forces caused by the contents with maximum density specified for the design and at maximum filling degree, the design stress σ in longitudinal and circumferential direction of any layer of the shell shall not exceed the following value:

$$\sigma \leq \frac{R_m}{K}$$

where:

R_m = the value of tensile strength given by taking the mean value of the test results minus twice the standard deviation of the test results. The tests shall be carried out, in accordance with the requirements of EN 61:1977, on not less than six samples representative of the design type and construction method;

K = $S \times K_0 \times K_1 \times K_2 \times K_3$

where

K shall have a minimum value of 4, and

S = the safety coefficient. For the general design, if the tanks are referred to in Column (12) of Table A of Chapter 3.2 by a tank code including the letter "G" in its second part (see 4.3.4.1.1), the value for S shall be equal to or more than 1.5. For tanks intended for the carriage of substances which require an increased safety level, i.e. if the tanks are referred to in Column (12) of Table A of Chapter 3.2 by a tank code including the number "4" in its second part (see 4.3.4.1.1), the value of S shall be multiplied by a factor of two, unless the shell is provided with protection against damage consisting of a complete metal skeleton including longitudinal and transverse structural members;

K_0 = a factor related to the deterioration in the material properties due to creep and ageing and as a result of the chemical action of the substances to be carried. It shall be determined by the formula:

$$K_0 = \frac{1}{\alpha\beta}$$

where "α" is the creep factor and "β" is the ageing factor determined in accordance with EN 978:1997 after performance of the test according to EN 977:1997. Alternatively, a conservative value of K_0 = 2 may be applied. In order to determine α and β the initial deflection shall correspond to 2σ;

K_1 = a factor related to the service temperature and the thermal properties of the resin, determined by the following equation, with a minimum value of 1:

$$K_1 = 1.25 - 0.0125 (HDT - 70)$$

where HDT is the heat distortion temperature of the resin, in ºC;

K_2 = a factor related to the fatigue of the material; the value of K_2 = 1.75 shall be used unless otherwise agreed with the competent authority. For the dynamic design as outlined in 6.9.2.6 the value of K_2 = 1.1 shall be used;

K_3 = a factor related to curing and has the following values:

- 1.1 where curing is carried out in accordance with an approved and documented process;

- 1.5 in other cases.

6.9.2.6 At the dynamic stresses, as indicated in 6.8.2.1.2 the design stress shall not exceed the value specified in 6.9.2.5, divided by the factor α.

6.9.2.7 At any of the stresses as defined in 6.9.2.5 and 6.9.2.6, the resulting elongation in any direction shall not exceed 0.2 % or one tenth of the elongation at fracture of the resin, whichever is lower.

6.9.2.8 At the specified test pressure, which shall not be less than the relevant calculation pressure as specified in 6.8.2.1.14 (a) and (b) the maximum strain in the shell shall not be greater than the elongation at fracture of the resin.

6.9.2.9 The shell shall be capable of withstanding the ball drop test according to 6.9.4.3.3 without any visible internal or external defects.

6.9.2.10 The overlay laminates used in the joints, including the end joints, the joints of the surge plates and the partitions with the shell shall be capable of withstanding the static and dynamic stresses mentioned above. In order to avoid concentrations of stresses in the overlay lamination, the applied tapper shall not be steeper than 1:6.

The shear strength between the overlay laminate and the tank components to which it is bonded shall not be less than:

$$\tau = \frac{Q}{l} \leq \frac{\tau_R}{K}$$

where:

τ_R is the bending shear strength according to EN 63:1977 with a minimum of $\tau_R = 10$ N/mm^2, if no measured values are available;

Q is the load per unit width that the joint shall carry under the static and dynamic loads;

K is the factor calculated in accordance with 6.9.2.5 for the static and dynamic stresses;

l is the length of the overlay laminate.

6.9.2.11 Openings in the shell shall be reinforced to provide at least the same safety factors against the static and dynamic stresses as specified in 6.9.2.5 and 6.9.2.6 as that for the shell itself. The number of openings shall be minimized. The axis ratio of oval-shaped openings shall be not more than 2.

6.9.2.12 For the design of flanges and pipework attached to the shell, handling forces and the fastening of bolts shall also be taken into account.

6.9.2.13 The tank shall be designed to withstand, without significant leakage, the effects of a full engulfment in fire for 30 minutes as specified by the test requirements in 6.9.4.3.4. Testing may be waived with the agreement of the competent authority, where sufficient proof can be provided by tests with comparable tank designs.

6.9.2.14 ***Special requirements for the transport of substances with a flash-point of not more than 61 °C***

FRP tanks used for the carriage of substances with a flash-point of not more than 61°C shall be constructed so as to ensure the elimination of static electricity from the various component parts so as to avoid the accumulation of dangerous charges.

6.9.2.14.1 The electrical surface resistance of the inside and outside of the shell as established by measurements shall not be higher than 10^9 ohms. This may be achieved by the use of additives in the resin or interlaminate conducting sheets, such as metal or carbon network.

6.9.2.14.2 The discharge resistance to earth as established by measurements shall not be higher than 10^7 ohms.

6.9.2.14.3 All components of the shell shall be electrically connected to each other and to the metal parts of the service and structural equipment of the tank and to the vehicle. The electrical resistance between components and equipment in contact with each other shall not exceed 10 ohms.

6.9.2.14.4 The electrical surface-resistance and discharge resistance shall be measured initially on each manufactured tank or a specimen of the shell in accordance with a procedure recognized by the competent authority.

6.9.2.14.5 The discharge resistance to earth of each tank shall be measured as part of the periodic inspection in accordance with a procedure recognized by the competent authority.

6.9.3 Items of equipment

6.9.3.1 The requirements of 6.8.2.2.1, 6.8.2.2.2 and 6.8.2.2.4 to 6.8.2.2.8 shall apply.

6.9.3.2 In addition, when they are shown under an entry in Column (13) of Table A of Chapter 3.2, the special provisions of 6.8.4 (b) (TE) shall also apply.

6.9.4 Type testing and approval

6.9.4.1 For any design of a FRP tank type, its materials and a representative prototype shall be subjected to the design type testing as outlined below.

6.9.4.2 ***Material testing***

6.9.4.2.1 The elongation at fracture according to EN 61:1977 and the heat distortion temperature according to ISO 75-1:1993 shall be determined for the resins to be used.

6.9.4.2.2 The following characteristics shall be determined for samples cut out of the shell. Samples manufactured in parallel may only be used, if it is not possible to use cutouts from the shell. Prior to testing, any liner shall be removed.

The tests shall cover:

- Thickness of the laminates of the central shell wall and the ends;

- Mass content and composition of glass, orientation and arrangement of reinforcement layers;

- Tensile strength, elongation at fracture and modulus of elasticity according to EN 61:1977 in the direction of stresses. In addition, the elongation at fracture of the resin shall be established by means of ultrasound;

- Bending strength and deflection established by the bending creep test according to EN 63:1977 for a period of 1000 hours using a sample with a minimum width of 50 mm and a support distance of at least 20 times the wall thickness. In addition, the creep factor α and the ageing factor β shall be determined by this test and according to EN 978:1997.

6.9.4.2.3 The interlaminate shear strength of the joints shall be measured by testing representative samples in the tensile test according to EN 61:1977.

6.9.4.2.4 The chemical compatibility of the shell with the substances to be carried shall be demonstrated by one of the following methods with the agreement of the competent authority. This demonstration shall account for all aspects of the compatibility of the materials of the shell and its equipment with the substances to be carried, including chemical deterioration of the shell, initiation of critical reactions of the contents and dangerous reactions between both.

- In order to establish any deterioration of the shell, representative samples taken from the shell, including any internal liners with welds, shall be subjected to the chemical compatibility test according to EN 977:1997 for a period of 1000 hours at 50°C. Compared with a virgin sample, the loss of strength and elasticity modulus measured by the bending test according to EN 978:1997 shall not exceed 25 %. Cracks, bubbles, pitting effects as well as separation of layers and liners and roughness shall not be acceptable.

- Certified and documented data of positive experiences on the compatibility of the filling substances in question with the materials of the shell with which they come into contact at given temperatures, times and any other relevant service conditions.

- Technical data published in relevant literature, standards or other sources, acceptable to the competent authority.

6.9.4.3 ***Type testing***

A representative prototype tank shall be subjected to tests as specified below. For this purpose service equipment may be replaced by other items if necessary.

6.9.4.3.1 The prototype shall be inspected for compliance with the design type specification. This shall include an internal and external visual inspection and measurement of the main dimensions.

6.9.4.3.2 The prototype, equipped with strain gauges at all locations where a comparison with the design calculation is required, shall be subjected to the following loads and the strains shall be recorded:

- Filled with water to the maximum filling degree. The measuring results shall be used to calibrate the design calculation according to 6.9.2.5;

- Filled with water to the maximum filling degree and subjected to accelerations in all three directions by means of driving and braking exercises with the prototype attached to a vehicle. For comparison with the design calculation according to 6.9.2.6 the strains recorded shall be extrapolated in relation to the quotient of the accelerations required in 6.8.2.1.2 and measured;

- Filled with water and subjected to the specified test pressure. Under this load, the shell shall exhibit no visual damage or leakage.

6.9.4.3.3 The prototype shall be subjected to the ball drop test according to EN 976-1:1997, No. 6.6. No visible damage inside or outside the tank shall occur.

6.9.4.3.4 The prototype with its service and structural equipment in place and filled to 80% of its maximum capacity with water, shall be exposed to a full engulfment in fire for 30 minutes, caused by an open heating oil pool fire or any other type of fire with the same effect. The dimensions of the pool shall exceed those of the tank by at least 50 cm to each side and the distance between fuel level and tank shall be between 50 cm and 80 cm. The rest of the tank below liquid level, including openings and closures, shall remain leakproof except for drips.

6.9.4.4 ***Type approval***

6.9.4.4.1 The competent authority or a body designated by that authority shall issue in respect of each new type of tank or tank-container an approval attesting that the design is suitable for the purpose for which it is intended and meets the construction and equipment requirements of this chapter as well as the special provisions applicable to the substances to be carried.

6.9.4.4.2 The approval shall be based on the calculation and the test report, including all material and prototype test results and its comparison with the design calculation, and shall refer to the design type specification and the quality assurance programme.

6.9.4.4.3 The approval shall include the substances or group of substances for which compatibility with the shell is provided. Their chemical names or the corresponding collective entry (see 2.1.1.2), and their class and classification code shall be indicated.

6.9.4.4.4 In addition, it shall include design and threshold values (such as life-time, service temperature range, working and test pressures, material data) specified and all precautions to be taken for the manufacture, testing, type approval, marking and use of any tank, manufactured in accordance with the approved design type.

6.9.5 Inspections

6.9.5.1 For every tank, manufactured in conformity with the approved design, material tests and inspections shall be performed as specified below.

6.9.5.1.1 The material tests according to 6.9.4.2.2, except for the tensile test and for a reduction of the testing time for the bending creep test to 100 hours shall be performed with samples taken from the shell. Samples manufactured in parallel may only be used, if no cutouts from the shell are possible. The approved design values shall be met.

6.9.5.1.2 Shells and their equipment shall either together or separately undergo an initial inspection before being put into service. This inspection shall include:

- a check of conformity to the approved design;
- a check of the design characteristics;
- an internal and external examination;
- a hydraulic pressure test at the test pressure indicated on the plate prescribed in 6.8.2.5.1;
- a check of operation of the equipment;
- a leakproofness test, if the shell and its equipment have been pressure tested separately.

6.9.5.2 For the periodic inspection of tanks the requirements of 6.8.2.4.2 to 6.8.2.4.4 shall apply.

6.9.5.3 The inspections and tests in accordance with 6.9.5.1 and 6.9.5.2 shall be carried out by the expert approved by the competent authority. Certificates shall be issued showing the results of these operations. These certificates shall refer to the list of the substances permitted for carriage in this shell in accordance with 6.9.4.4.

6.9.6 Marking

6.9.6.1 The requirements of 6.8.2.5 shall apply to the marking of FRP tanks, with the following amendments:

- the tank plate may also be laminated to the shell or be made of suitable plastics materials;
- the design temperature range shall always be marked.

6.9.6.2 In addition, when they are shown under an entry in Column (13) of Table A of Chapter 3.2, the special provisions of 6.8.4 (e) (TM) shall also apply.

CHAPTER 6.10

REQUIREMENTS FOR THE CONSTRUCTION, EQUIPMENT, TYPE APPROVAL, INSPECTION AND MARKING OF VACUUM-OPERATED WASTE TANKS

NOTE 1: *For portable tanks see Chapter 6.7; for fixed tanks (tank-vehicles), demountable tanks and tank containers and tank swap bodies, with shells made of metallic materials, and battery-vehicles and multiple element gas containers (MEGCs) see Chapter 6.8; for fibre-reinforced plastic tanks see Chapter 6.9.*

NOTE 2: *This Chapter applies to fixed tanks and demountable tanks.*

6.10.1 General

6.10.1.1 *Definition*

NOTE: *A tank which fully complies with the requirements of Chapter 6.8 is not considered to be a "vacuum-operated waste tank".*

6.10.1.1.1 The term "*protected area*" means the areas located as follows:

(a) The lower part of the tank in a zone which extends over a 60° angle on either side of the lower generating line;

(b) The top part of the tank in a zone which extends over a 30° angle on either side of the top generating line;

(c) On the end front of the tank on motor vehicles;

(d) On the rear end of the tank inside the protection volume formed by the device stipulated in 9.7.6.

6.10.1.2 *Scope*

6.10.1.2.1 The special requirements of 6.10.2 to 6.10.4 complete or modify Chapter 6.8 and are applied to vacuum-operated waste tanks.

Vacuum-operated waste tanks may be equipped with openable ends, if the requirements of Chapter 4.3 allow bottom discharge of the substances to be carried (indicated by letters "A" or "B" in Part 3 of the tank code given in Column (12) of Table A of Chapter 3.2, in accordance with 4.3.4.1.1).

Vacuum-operated waste tanks shall comply with all requirements of Chapter 6.8, with the exception of requirements overtaken by a special provision in this Chapter. However the requirements of 6.8.2.1.19, 6.8.2.1.20, and 6.8.2.1.21 shall not apply.

6.10.2 Construction

6.10.2.1 Tanks shall be designed for a calculation pressure equal to 1.3 times the filling or discharge pressure but not less than 400 kPa (4 bar) (gauge pressure). For the carriage of substances for which a higher calculation pressure of the tank is specified in Chapter 6.8, this higher pressure shall apply.

6.10.2.2 Tanks shall be designed to withstand a negative internal pressure of 100 kPa (1 bar).

6.10.3 Items of equipment

6.10.3.1 The items of equipment shall be so arranged as to be protected against the risk of being wrenched off or damaged during carriage or handling. This requirement can be fulfilled by placing the items of equipment in a so called "protected area" (see 6.10.1.1.1).

6.10.3.2 The bottom discharge of shells may be constituted by external piping with a stop-valve fitted as close to the shell as practicable and a second closure which may be a blank flange or other equivalent device.

6.10.3.3 The position and closing direction of the stop-valve(s) connected to the shell, or to any compartment in the case of compartmented shells, shall be unambiguous, and be able to be checked from the ground.

6.10.3.4 In order to avoid any loss of contents in the event of damage to the external filling and discharge fittings (pipes, lateral shut-off devices), the internal stop-valve, or the first external stop-valve (where applicable), and its seatings shall be protected against the danger of being wrenched off by external stresses or shall be so designed as to withstand them. The filling and discharge devices (including flanges or threaded plugs) and protective caps (if any) shall be capable of being secured against any unintended opening.

6.10.3.5 The tanks may be equipped with openable ends. Openable ends shall comply with the following conditions:

(a) The ends shall be designed to be secured leaktight when closed;

(b) Unintentional opening shall not be possible;

(c) Where the opening mechanism is power operated the end shall remain securely closed in the event of a power failure;

(d) A safety or breakseal device shall be incorporated to ensure that the openable end cannot be opened when there is still a residual over pressure in the tank. This requirement does not apply to openable ends which are power-operated, where the movement is positively controlled. In this case the controls shall be of the dead-man type and be so positioned that the operator can observe the movement of the openable end at all times and is not endangered during opening and closing of the openable end; and

(e) Provisions shall be made to protect the openable end and prevent it from being forced open during a roll-over of the vehicle.

6.10.3.6 Vacuum-operated waste tanks which are fitted with an internal piston to assist in the cleaning of the tank or discharging shall be provided with stop-devices to prevent the piston in every operational position being ejected from the tank when a force equivalent to the maximum allowed working pressure of the tank is applied to the piston. The maximum allowed working pressure for tanks or compartments with pneumatic operated piston shall not exceed 100 kPa (1.0 bar). The internal piston shall be constructed in a manner and of materials which will not cause an ignition source when the piston is moved.

The internal piston may be used as a compartment provided it is secured in position. Where any of the means by which the internal piston is secured is external to the tank, it shall be placed in a position not liable to accidental damage.

6.10.3.7 The tanks may be equipped with suction booms if:

(a) the boom is fitted with an internal or external stop-valve fixed directly to the shell, or directly to a bend that is welded to the shell;

(b) the stop-valve mentioned in (a) is so arranged that carriage with the valve in an open position is prevented; and

(c) the boom is constructed in such a way that the tank will not leak as a result of accidental impact on the boom.

6.10.3.8 The tanks shall be fitted with the following additional service equipment:

(a) The outlet of a pump/exhauster unit shall be so arranged as to ensure that any flammable or toxic vapours are diverted to a place where they will not cause a danger;

(b) A device to prevent immediate passage of flame shall be fitted to both the inlet and outlet of a vacuum pump/exhauster unit which may create sparks and which is fitted on a tank used for the carriage of flammable wastes;

(c) Pumps which can deliver a positive pressure shall have a safety device fitted in the pipework which can be pressurised. The safety device shall be set to discharge at a pressure not exceeding the maximum working pressure of the tank;

(d) A stop-valve shall be fitted between the shell, or the outlet of the overfill prevention device fitted to the shell, and the pipework connecting the shell to the pump/exhauster unit;

(e) The tank shall be fitted with a suitable pressure/vacuum manometer which shall be mounted in a position where it can be easily read by the person operating the pump/exhauster unit. A distinguishing line shall be marked on the scale to indicate the maximum working pressure of the tank;

(f) The tank, or in case of compartmented tanks, every compartment, shall be equipped with a level indicating device. Sight glasses may be used as level indicating devices provided:

(i) they form a part of the tank wall and have a resistance to the pressure comparable to that of the tank; or they are fitted external to the tank;

(ii) the top and bottom connections to the tank are equipped with shut-off valves fixed directly to the shell and so arranged that carriage with the valves in an open position is prevented;

(iii) are suitable for operation at the maximum allowed working pressure of the tank; and

(iv) are placed in a position where they will not be liable to accidental damage.

6.10.3.9 Shells of vacuum-operated waste tanks shall have a safety valve preceded by a bursting disc.

6.10.4 Inspection

Vacuum-operated waste tanks shall be subject to an internal and external examination at least every three years.

PART 7

Provisions concerning the conditions of carriage, loading, unloading and handling

CHAPTER 7.1

GENERAL PROVISIONS

7.1.1 The carriage of dangerous goods is subject to the mandatory use of a particular type of carriage in accordance with the provisions of this Chapter and Chapter 7.2 for carriage in packages, Chapter 7.3 for carriage in bulk and Chapter 7.4 for carriage in tanks. In addition, the provisions of Chapter 7.5 concerning loading, unloading and handling shall be observed.

Columns (16), (17) and (18) of Table A of Chapter 3.2 show the particular provisions of this Part that apply to specific dangerous goods.

7.1.2 In addition to the provisions of this Part, vehicles used for the carriage of dangerous goods shall, as regards their design, construction and, if appropriate, their approval, conform to the relevant requirements of Part 9.

7.1.3 Large containers, portable tanks and tank-containers which meet the definition of "container" given in the CSC (1972), as amended, or in UIC leaflets [1] 590 (updated 1.1.89) and 592-1 to 592-4 (updated 1.7.94) may not be used to carry dangerous goods unless the large container or the frame of the portable tank or tank-container satisfies the provisions of the CSC or of UIC leaflets 590 and 592-1 to 592-4.

7.1.4 A large container may be presented for carriage only if it is structurally serviceable.

"Structurally serviceable" means that the container is free from major defects in its structural components, e.g. top and bottom side rails, doorsill and header, floor cross members, corner posts, and corner fittings. "Major defects" are dents or bends in structural members greater than 19 mm in depth, regardless of length; cracks or breaks in structural members; more than one splice or an improper splice (e.g. a lapped splice) in top or bottom end rails or door headers or more than two splices in any one top or bottom side rail or any splice in a door sill or corner post; door hinges and hardware that are seized, twisted, broken, missing or otherwise inoperative; non-closing gaskets and seals; any distortion of the overall configuration sufficient to prevent proper alignment of handling equipment, mounting and securing on a chassis or vehicle.

In addition, deterioration in any component of the container, such as rusted metal in side walls or disintegrated fibreglass is unacceptable, regardless of the material of construction. Normal wear, including oxidization (rust), slight dents and scratches and other damage that do not affect serviceability or weather-tightness are, however, acceptable.

Prior to loading the container shall also be checked to ensure that it is free from any residue of a previous load and that the interior floor and walls are free from protrusions.

7.1.5 Large containers shall meet the requirements concerning the body of the vehicle laid down in this Part and, if appropriate, those laid down in Part 9 for the load in question; the body of the vehicle need not then satisfy those provisions.

However, large containers carried on vehicles whose platforms have insulation and heat-resistant qualities which satisfy those requirements need not then satisfy the said requirements.
This provision also applies to small containers for the carriage of explosive substances and articles of Class 1.

---

[1] *UIC leaflets are published by the Union Internationale des chemins de fer, Service Publications - 16, rue Jean Rey - F - 75015 Paris.*

7.1.6 Subject to the provisions of the last part of the first sentence of 7.1.5, the fact that dangerous goods are contained in one or more containers shall not affect the conditions to be met by the vehicle by reason of the nature and quantities of the dangerous goods carried.

CHAPTER 7.2

PROVISIONS CONCERNING CARRIAGE IN PACKAGES

7.2.1 Unless otherwise provided in 7.2.2 to 7.2.4, packages may be loaded:

(a) in closed vehicles or in closed containers; or

(b) in sheeted vehicles or in sheeted containers; or

(c) in open vehicles or in open containers.

7.2.2 Packages comprising packagings made of materials sensitive to moisture shall be loaded on to closed or on to sheeted vehicles or into closed or sheeted containers.

7.2.3 Certain packagings and IBCs may only be carried in closed vehicles or in closed containers (see 4.1.2.3 and packing instructions P002 (PP12), IBC04, IBC05, IBC06, IBC07 and IBC08).

7.2.4 When they are shown under an entry in Column (16) of Table A of Chapter 3.2, the following special provisions apply:

V1 Packages shall be loaded on to closed or sheeted vehicles or into closed or sheeted containers.

V2 (1) Packages shall only be loaded on to EX/II or EX/III vehicles which satisfy the relevant requirements of Part 9. The choice of vehicle depends on the quantity to be carried, which is limited per transport unit in accordance with the provisions concerning loading (see7.5.5.2).

(2) Trailers, except semi-trailers, which satisfy the requirements for EX/II or EX/III vehicles may be drawn by motor vehicles which do not satisfy those requirements.

For carriage in containers, see also 7.1.3 to 7.1.6.

Where substances or articles of Class 1 in quantities requiring a transport unit made up of EX/III vehicle(s) are being carried in containers to or from harbour areas, rail terminals or airports of arrival or departure as part of a multimodal journey, a transport unit made up of EX/II vehicle(s) may be used instead, provided that the containers being carried comply with the appropriate requirements of the IMDG Code, the RID or the ICAO Technical Instructions.

V3 For free-flowing powdery substances and for fireworks the floor of a container shall have a non-metallic surface or covering.

V4 *(Reserved)*

V5 Packages may not be carried in small containers.

V6 Flexible IBCs shall be carried in closed vehicles or in closed containers, in sheeted vehicles or in sheeted containers. The sheet shall be of an impermeable and non-combustible material.

V7 If packages are carried in a closed vehicle or in a closed container, the vehicle or container shall be provided with adequate ventilation.

V8 (1) Organic peroxides and self-reactive substances shall be forwarded in such manner that the control temperatures indicated in 2.2.41.1.19 and 2.2.41.4 or in 2.2.52.1.16 and 2.2.52.4, as appropriate, are never exceeded.

(2) The means of temperature control chosen for the transport operation depends on a number of factors such as:

- the control temperature(s) of the substance(s) to be carried;
- the difference between the control temperature and the expected ambient temperature;
- the effectiveness of the thermal insulation;
- the duration of the transport operation; and
- the safety margin to be allowed for delays en route.

(3) Suitable methods to prevent the control temperature from being exceeded are listed below, in ascending order of effectiveness:

R1 Thermal insulation, provided that the initial temperature of the substance(s) is sufficiently below the control temperature;

R2 Thermal insulation and coolant system, provided that:

- an adequate quantity of non-flammable coolant (e.g. liquid nitrogen or solid carbon dioxide), allowing a reasonable margin for possible delay, is carried or a means of replenishment is assured;
- liquid oxygen or air is not used as coolant;
- there is a uniform cooling effect even when most of the coolant has been consumed; and
- the need to ventilate the transport unit before entering is clearly indicated by a warning on the door(s);

R3 Thermal insulation and single mechanical refrigeration, provided that for substances with a flash-point lower than the sum of the emergency temperature plus 5 °C explosion-proof electrical fittings, EEx IIB T3, are used within the cooling compartment to prevent ignition of flammable vapours from the substances;

R4 Thermal insulation and combined mechanical refrigeration system and coolant system, provided that:

- the two systems are independent of one another; and
- the requirements of methods R2 and R3 above are met;

R5 Thermal insulation and dual mechanical refrigeration system, provided that:

- apart from the integral power supply unit, the two systems are independent of one another;

- each system alone is capable of maintaining adequate temperature control; and

- for substances with a flash-point lower than the sum of the emergency temperature plus 5 °C explosion-proof electrical fittings, EEx IIB T3, are used within the cooling compartment to prevent ignition of flammable vapours from the substances.

(4) Methods R4 and R5 may be used for all organic peroxides and self-reactive substances.

Method R3 may be used for organic peroxides and self-reactive substances of Types C, D, E and F and, when the maximum ambient temperature to be expected during carriage does not exceed the control temperature by more than 10 °C, for organic peroxides and self-reactive substances of Type B.

Method R2 may be used for organic peroxides and self-reactive substances of Types C, D, E and F when the maximum ambient temperature to be expected during carriage does not exceed the control temperature by more than 30 °C.

Method R1 may be used for organic peroxides and self-reactive substances of Types C, D, E and F when the maximum ambient temperature to be expected during carriage is at least 10 °C below the control temperature.

(5) Where substances are required to be carried in insulated, refrigerated or mechanically-refrigerated vehicles or containers, these vehicles or containers shall satisfy the requirements of Chapter 9.6.

(6) If substances are contained in protective packagings filled with a coolant, they shall be loaded in closed or sheeted vehicles or closed or sheeted containers. If the vehicles or containers used are closed they shall be adequately ventilated. Sheeted vehicles and containers shall be fitted with sideboards and a tailboard. The sheets of these vehicles and containers shall be of an impermeable and non-combustible material.

(7) Any control and temperature sensing devices in the refrigeration system shall be readily accessible and all electrical connections shall be weatherproof. The temperature of the air inside the transport unit shall be measured by two independent sensors and the output shall be recorded so that any change in temperature is readily detectable. When substances having a control temperature of less than +25 °C are carried, the transport unit shall be equipped with visible and audible alarms, powered independently of the refrigeration system and set to operate at or below the control temperature.

(8) A back-up refrigeration system or spare parts shall be available.

CHAPTER 7.3

PROVISIONS CONCERNING CARRIAGE IN BULK

7.3.1 Goods may not be carried in bulk in vehicles or containers unless a special provision, identified by the code VV, explicitly authorizing this mode of carriage is indicated in Column (17) of Table A of Chapter 3.2 for these goods and unless the conditions of this special provision are satisfied.

Nevertheless, empty packagings, uncleaned may be carried in bulk if this mode of carriage is not explicitly prohibited by other provisions of ADR.

NOTE*: *For carriage in tanks, see Chapters 4.2 and 4.3.

7.3.2 Suitable measures shall be taken for all carriage in bulk to ensure that none of the contents can escape.

7.3.3 When they are shown under an entry in Column (17) of Table A of Chapter 3.2, the following special provisions apply:

VV1 Carriage in bulk in closed or sheeted vehicles, in closed containers or in large sheeted containers is permitted.

VV2 Carriage in bulk is permitted in closed vehicles with a metal body, closed metal containers and in sheeted vehicles and sheeted large containers covered with a non-combustible sheet and having a metal body or having floor and walls protected from the load.

VV3 Carriage in bulk is permitted in sheeted vehicles and sheeted large containers with adequate ventilation.

VV4 Carriage in bulk is permitted in closed or sheeted vehicles with a metal body, and in closed metal containers or in sheeted large metal containers. For UN Nos. 2008, 2009, 2210, 2545, 2546, 2881, 3189 and 3190, only carriage in bulk of solid waste is permitted.

VV5 Carriage in bulk is permitted in specially equipped vehicles and containers.

The openings used for loading and unloading shall be capable of being closed hermetically.

VV6 *(Reserved)*

VV7 Carriage in bulk in closed or sheeted vehicles, in closed containers or in large sheeted containers is permitted only if the substance is in pieces.

VV8 Carriage in bulk is permitted, as a full load, in closed vehicles, closed containers or sheeted vehicles or large containers covered with an impermeable, non-combustible sheet.

Vehicles and containers shall be so constructed either that the substances contained cannot come into contact with wood or any other combustible material, or that the entire surface of the floor and walls, if made of wood or another combustible material has been provided with an impermeable surfacing resistant to combustion or has been coated with sodium silicate or a similar substance.

VV9a Carriage in bulk is permitted, as a full load, in sheeted vehicles, closed containers or in sheeted large containers with complete walls.

For substances of Class 8, the body of the vehicle or container shall be equipped with a suitable and sufficiently stout inner lining.

VV9b Carriage in bulk of full loads (if Class 8, only for wastes) is permitted in closed containers or in sheeted large containers with complete walls. For wastes of Class 8, containers shall be equipped with a suitable and sufficiently stout inner lining.

VV10 Carriage in bulk is permitted in sheeted vehicles, closed containers or sheeted large containers with complete walls.

The body of vehicles or containers shall be leakproof or rendered leakproof, for example by means of a suitable and sufficiently stout inner lining.

VV11 Carriage in bulk is permitted in specially equipped vehicles and containers in a manner which avoids risks to humans, animals and the environment, e.g. by loading the wastes in bags or by airtight connections.

VV12 Substances for which carriage in tank-vehicles, in portable tanks or in tank-containers is unsuitable because of the high temperature and density of the substance may be carried in special vehicles or containers in accordance with standards specified by the competent authority of the country of origin. If the country of origin is not a contracting party to ADR, the conditions laid down shall be recognized by the competent authority of the first country contracting party to ADR reached by the consignment.

VV13 Carriage in bulk is permitted in specially equipped vehicles or containers in accordance with standards specified by the competent authority of the country of origin. If the country of origin is not a contracting party to ADR, the conditions laid down shall be recognized by the competent authority of the first country contracting party to ADR reached by the consignment.

VV14 (1) Used batteries may be carried in bulk in specially equipped vehicles or containers. Large plastics containers shall not be permitted. Small plastics containers shall be capable of withstanding, when fully loaded, a drop from a height of 0.8 m onto a hard surface at -18 °C, without breakage.

(2) The load compartments of vehicles or containers shall be of steel resistant to the corrosive substances contained in the batteries. Less resistant steels may be used when there is a sufficiently great wall thickness or a plastics lining/layer resistant to the corrosive substances.

The design of the load compartments of vehicles or containers shall take account of any residual currents and impact from the batteries.

***NOTE**: Steel exhibiting a maximum rate of progressive reduction of 0.1 mm per year under the effects of the corrosive substances may be considered as resistant.*

(3) It shall be ensured by means of constructional measures that there will be no leakage of corrosive substances from the load compartments of vehicles or

containers during carriage. Open load compartments shall be covered. The cover shall be resistant to the corrosive substances.

(4) Before loading, the load compartments of vehicles or containers, including their equipment, shall be inspected for damage. Vehicles or containers with damaged load compartments shall not be loaded.

The load compartments of vehicles or containers shall not be loaded above the top of their walls.

(5) No batteries containing different substances and no other goods liable to react dangerously with each other shall be present in the load compartments of vehicles or containers (see "*Dangerous reaction*" in 1.2.1).

During carriage no dangerous residue of the corrosive substances contained in the batteries shall adhere to the outer surface of the load compartments of vehicles or containers.

CHAPTER 7.4

PROVISIONS CONCERNING CARRIAGE IN TANKS

7.4.1 Goods may not be carried in tanks unless a tank code is indicated in Columns (12) and (13) of Table A of Chapter 3.2. The carriage shall be in accordance with the provisions of Chapters 4.2 or 4.3, and the vehicles, whether they be tank-vehicles (with a fixed or demountable tank), battery-vehicles or vehicles carrying tank-containers or portable tanks, shall satisfy the relevant requirements of Chapters 9.1, 9.2 and 9.7.2 concerning the vehicle to be used, as indicated in Column (14) of Table A of Chapter 3.2.

7.4.2 The vehicles designated by the codes FL, OX or AT in 9.1.1.2 shall be used as follows:

- Where a FL vehicle is prescribed, only an FL vehicle may be used;
- Where a OX vehicle is prescribed, only an OX vehicle may be used;
- Where a AT vehicle is prescribed, AT, FL and OX vehicles may be used.

CHAPTER 7.5

PROVISIONS CONCERNING LOADING, UNLOADING AND HANDLING

7.5.1 General provisions concerning loading, unloading and handling

7.5.1.1 The vehicle and its driver, upon arrival at the loading and unloading sites, shall comply with the regulatory provisions (especially those concerning safety, cleanliness and satisfactory operation of the vehicle equipment used in loading and unloading).

7.5.1.2 The loading shall not be carried out if an examination of the documents and a visual inspection of the vehicle and its equipment show that the vehicle or the driver do not comply with the regulatory provisions.

7.5.1.3 The unloading shall not be carried out, if the above-mentioned inspections reveal deficiencies that might affect the safety of the unloading.

7.5.1.4 In accordance with the special provisions of 7.3.3 or 7.5.11, in conformity with Columns (17) and (18) of Table A of Chapter 3.2, certain dangerous goods shall only be forwarded as a "full load" (see definition in 1.2.1). In such a case, the competent authorities may require the vehicle or large container used for such carriage to be loaded at only one point and unloaded at only one point.

7.5.2 Mixed loading prohibition

7.5.2.1 Packages bearing different danger labels shall not be loaded together in the same vehicle or container unless mixed loading is permitted according to the following Table based on the danger labels they bear.

NOTE: *In accordance with 5.4.1.4.2, separate transport documents shall be drawn up for consignments that cannot be loaded together in the same vehicle or container.*

Labels Nos.	1	1.4	1.5	1.6	2.1, 2.2, 2.3	3	4.1	4.1 + l	4.2	4.3	5.1	5.2	5.2 + 1	6.1	6.2	7 A, B, C	8	9
1	See 7.5.2.2																	[b]
1.4					[a]	[a]	[a]		[a]	[a]	[a]	[a]		[a]	[a]	[a]	[a]	[a] [b]
1.5																		[b]
1.6																		[b]
2.1, 2.2, 2.3		[a]			X	X	X		X	X	X	X		X	X	X	X	X
3		[a]			X	X	X		X	X	X	X		X	X	X	X	X
4.1		[a]			X	X	X		X	X	X	X		X	X	X	X	X
4.1 + 1								X										
4.2		[a]			X	X	X		X	X	X	X		X	X	X	X	X
4.3		[a]			X	X	X		X	X	X	X		X	X	X	X	X
5.1		[a]			X	X	X		X	X	X	X		X	X	X	X	X
5.2		[a]			X	X	X		X	X	X	X		X	X	X	X	X
5.2 + 1													X					
6.1		[a]			X	X	X		X	X	X	X		X	X	X	X	X
6.2		[a]			X	X	X		X	X	X	X		X	X	X	X	X
7A, B, C		[a]			X	X	X		X	X	X	X		X	X	X	X	X
8		[a]			X	X	X		X	X	X	X		X	X	X	X	X
9	[b]	[a] [b]	[b]	[b]	X	X	X		X	X	X	X		X	X	X	X	X

X *Mixed loading permitted.*

[a] *Mixed loading permitted with 1.4S substances and articles.*

[b] *Mixed loading permitted between goods of Class 1 and life-saving appliances of Class 9 (UN Nos. 2990 and 3072).*

7.5.2.2 Packages containing substances or articles of Class 1, bearing a label conforming to models Nos. 1, 1.4, 1.5 or 1.6 which are assigned to different compatibility groups shall not be loaded together in the same vehicle or container, unless mixed loading is permitted in accordance with the following Table for the corresponding compatibility groups.

Compatibility Group	**A**	**B**	C	**D**	**E**	**F**	**G**	**H**	**J**	**L**	**N**	**S**
A	X											
B		X		[a]								X
C			X	X	X		X				[b] [c]	X
D		[a]	X	X	X		X				[b] [c]	X
E			X	X	X		X				[b] [c]	X
F						X						X
G			X	X	X		X					X
H								X				X
J									X			X
L										[d]		
N			[b] [c]	[b] [c]	[b] [c]						[b]	X
S		X	X	X	X	X	x	X	X		X	X

X *Mixed loading permitted.*

[a] *Packages containing articles of compatibility group B and substances and articles of compatibility group D may be loaded together on one vehicle provided they are carried in separate containers or compartments of a design approved by the competent authority or a body designated by it, such that there is no danger of transmission of detonation from the articles of compatibility group B to the substances or articles of compatibility group D.*

[b] *Different types of articles of division 1.6, compatibility group N, may be carried together as articles of division 1.6, compatibility group N, only when it is proven by testing or analogy that there is no additional risk of sympathetic detonation between the articles. Otherwise they should be treated as hazard division 1.1.*

[c] *When articles of compatibility group N are carried with substances or articles of compatibility groups C, D or E, the articles of compatibility group N should be considered as having the characteristics of compatibility group D.*

[d] *Packages containing substances and articles of Compatibility Group L may be loaded together on one vehicle or in one container with packages containing the same type of substances and articles of that compatibility group.*

7.5.2.3 For the purpose of the application of the prohibitions of mixed loading on one vehicle, no account shall be taken of substances contained in closed containers with complete sides. Nevertheless, the mixed loading prohibitions laid down in 7.5.2.1 concerning mixed loading of packages bearing labels conforming to models Nos. 1, 1.4, 1.5 or 1.6 with other packages, and in 7.5.2.2 concerning mixed loading of explosives of different compatibility groups shall also apply between dangerous goods contained in a container and the other dangerous goods loaded on the same vehicle, whether or not the latter goods are enclosed in one or more other containers.

7.5.3 *(Reserved)*

7.5.4 Precautions with respect to foodstuffs, other articles of consumption and animal feeds

If special provision CV28 is indicated for a substance or article in Column (18) of Table A of Chapter 3.2, precautions with respect to foodstuffs, other articles of consumption and animal feeds shall be taken as follows.

Packages as well as uncleaned empty packagings, including large packagings and intermediate bulk containers (IBCs), bearing labels conforming to models Nos. 6.1 or 6.2 and those bearing labels conforming to model No.9 containing goods of UN Nos. 2212, 2315, 2590, 3151, 3152 or 3245, shall not be stacked on or loaded in immediate proximity to packages known to contain foodstuffs, other articles of consumption or animal feeds in vehicles, in containers and at places of loading, unloading or transhipment.

When these packages, bearing the said labels, are loaded in immediate proximity of packages known to contain foodstuffs, other articles of consumption or animal feeds, they shall be kept apart from the latter:

(a) by complete partitions which should be as high as the packages bearing the said labels;

(b) by packages not bearing labels conforming to models Nos. 6.1, 6.2 or 9 or packages bearing labels conforming to model No.9 but not containing goods of UN Nos. 2212, 2315, 2590, 3151, 3152 or 3245; or

(c) by a space of at least 0.8 m;

unless the packages bearing the said labels are provided with an additional packaging or are completely covered (e.g. by a sheeting, a fibreboard cover or other measures).

7.5.5 Limitation of the quantities carried

7.5.5.1 If the provisions below or the additional provisions of 7.5.11 require a limitation of the quantity of specific goods that can be carried, in accordance with the information in Column (7) of Table A of Chapter 3.2, the fact that dangerous goods are contained in one or more containers shall not affect the mass limitations per transport unit laid down by these provisions.

7.5.5.2 ***Limitations with respect to explosive substances and articles***

7.5.5.2.1 *Substances and quantities carried*

The total net mass in kg of explosive substance (or in the case of explosive articles, the total net mass of explosive substance contained in all the articles combined) which may be carried on one transport unit shall be limited as indicated in the table below (see also 7.5.2.2 as regards the prohibition of mixed loading):

Maximum permissible net mass in kg of explosive in Class 1 goods per transport unit

Transport Unit	Division	1.1		1.2	1.3	1.4		1.5 and 1.6	Empty uncleaned packagings
	Compatibility group	1.1A	Other than 1.1A			Other than 1.4S	1.4S		
EX/II [a]		6.25	1 000	3 000	5 000	15 000	Unlimited	5 000	Unlimited
EX/III [a]		18.75	16 000	16 000	16 000	16 000	Unlimited	16 000	Unlimited

[a] *For the description of EX/II and EX/III vehicles see Part 9.*

7.5.5.2.2 Where substances and articles of different divisions of Class 1 are loaded on one transport unit in conformity with the prohibitions of mixed loading contained in 7.5.2.2, the load as a whole shall be treated as if it belonged to the most dangerous division (in the order 1.1, 1.5, 1.2, 1.3, 1.6, 1.4). However, the net mass of explosives of compatibility group S shall not count towards the limitation of quantities carried.

Where substances classified as 1.5D are carried on one transport unit together with substances or articles of division 1.2, the entire load shall be treated for carriage as if it belonged to division 1.1.

7.5.5.3 ***Limitations with respect to organic peroxides and self-reactive substances***

The quantity of organic peroxides of Class 5.2 and self-reactive substances of Class 4.1 that can be carried in a single transport unit is limited as follows:

Organic peroxide or self-reactive substance	Substances of Type B without temperature control	Substances of Type C without temperature control	Substances of Type D, E or F without temperature control	Substances of Type B with temperature control	Substances of Type C with temperature control	Substances of Type D, E or F with temperature control
Maximum quantity per transport unit	1 000 kg [a]	10 000 kg	20 000 kg	1 000 kg [b]	5 000 kg [c]	20 000 kg

[a] *5 000 kg if the loading space is ventilated at the top and if the transport unit is insulated with heat-resistant material (see 9.3.4).*

[b] *5 000 kg if the transport unit is insulated with a heat-resistant material (see 9.3.4)*

[c] *10 000 kg if the transport unit is insulated with a heat-resistant material (see 9.3.4)*

When substances are carried together in one transport unit, the limits given above shall not be exceeded and the total contents shall not exceed 20 000kg.

7.5.6 *(Reserved)*

7.5.7 Handling and stowage

7.5.7.1 The various components of a load comprising dangerous goods shall be properly stowed on the vehicle or in the container and secured by appropriate means to prevent them from being significantly displaced in relation to each other and to the walls of the vehicle or container. The load may be protected, for example, by the use of side wall fastening straps, sliding slatboards and adjustable brackets, air bags and anti-slide locking devices. The load is also sufficiently protected within the meaning of the first sentence if each layer of the whole loading space is completely filled with packages.

7.5.7.2 The provisions of 7.5.7.1 also apply to the loading, stowage and unloading of containers on to and from vehicles.

7.5.7.3 The driver or any other member of the crew may not open a package containing dangerous goods.

7.5.8 Cleaning after unloading

7.5.8.1 If, when a vehicle or container which has contained packaged dangerous goods is unloaded, some of the contents are found to have escaped, the vehicle or container shall be cleaned as soon as possible and in any case before reloading.

If it is not possible to do the cleaning locally, the vehicle or container shall be carried, with due regard to adequate safety, to the nearest suitable place where cleaning can be carried out.

Carriage is adequately safe if suitable measures have been taken to prevent the uncontrolled release of the dangerous goods that have escaped.

7.5.8.2 Vehicles or containers which have been loaded with dangerous goods in bulk shall be properly cleaned before reloading unless the new load consists of the same dangerous goods as the preceding load.

7.5.9 Prohibition of smoking

Smoking shall be prohibited during handling operations in the vicinity of vehicles or containers and inside the vehicles or containers.

7.5.10 Precautions against electrostatic charges

In the case of substances with a flash-point of 61 °C or below, a good electrical connection from the chassis of the vehicle, the portable tank or the tank-container to earth shall be established before tanks are filled or emptied. In addition, the rate of filling shall be limited.

7.5.11 Additional provisions applicable to certain classes or specific goods

In addition to the provisions of sections 7.5.1 to 7.5.10, the following provisions shall apply when they are shown under an entry indicated in Column (18) of Table A of Chapter 3.2.

CV1 (1) The following operations are prohibited:

(a) Loading or unloading goods in a public place in a built-up area without special permission from the competent authorities;

(b) Loading or unloading goods in a public place elsewhere than in a built-up area without prior notice thereof having been given to the competent authorities, unless these operations are urgently necessary for reasons of safety.

(2) If, for any reason, handling operations have to be carried out in a public place, then substances and articles of different kinds shall be separated according to the labels.

CV2 (1) Before loading, the loading surface of the vehicle or container shall be thoroughly cleaned.

(2) The use of fire or naked flame shall be prohibited on vehicles and containers carrying goods, in their vicinity and during the loading and unloading of these goods.

CV3 See 7.5.5.2.

CV4 Substances and articles of compatibility group L shall only be carried as a full load.

CV5 to CV8 *(Reserved)*

CV9 Packages shall not be thrown or subjected to impact.

Receptacles shall be so stowed in the vehicle or container that they cannot overturn or fall.

CV10 Cylinders as defined in 1.2.1, shall be laid parallel to or at right angles to the longitudinal axis of the vehicle or container; however, those situated near the forward transverse wall shall be laid at right angles to the said axis.

Short cylinders of large diameter (about 30 cm and over) may be stowed longitudinally with their valve-protecting devices directed towards the middle of the vehicle or container.

Cylinders which are sufficiently stable or are carried in suitable devices effectively preventing them from overturning may be placed upright.

Cylinders which are laid flat shall be securely and appropriately wedged, attached or secured so that they cannot shift.

CV11 Receptacles shall always be placed in the position for which they were designed and be protected against any possibility of being damaged by other packages.

CV12 When pallets loaded with articles are stacked, each tier of pallets shall be evenly distributed over the lower tier, if necessary by the interposition of a material of adequate strength.

CV13 If any substances have leaked and been spilled in a vehicle or container, it may not be re-used until after it has been thoroughly cleaned and, if necessary, disinfected or decontaminated. Any other goods and articles carried in the same vehicle or container shall be examined for possible contamination.

CV14 Goods shall be shielded from direct sunlight and heat during carriage.

Packages shall be stored only in cool, well-ventilated places away from heat sources.

CV15 See 7.5.5.3.

CV16 to CV19 *(Reserved)*

CV20 The provisions of Chapter 5.3 and special provisions V1 and V8(5) and (6) shall not apply provided that the substance is packaged in accordance with packing method OP1 or OP2 of packing instruction P520 in 4.1.4.1, as required, and the total quantity of substances to which this derogation applies per transport unit is limited to 10 kg.

CV21 The transport unit shall be thoroughly inspected prior to loading.

Before carriage, the carrier shall be informed:

- about the operation of the refrigeration system, including a list of the suppliers of coolant available en route;

- procedures to be followed in the event of loss of temperature control.

In the case of temperature control in accordance with methods R2 or R4 of special provision V8(3) of Chapter 7.2, a sufficient quantity of non-flammable refrigerant (e.g. liquid nitrogen or dry ice), including a reasonable margin for possible delays, shall be carried unless a means of replenishment is assured.

Packages shall be so stowed as to be readily accessible.

The specified control temperature shall be maintained during the whole transport operation, including loading and unloading, as well as any intermediate stops.

CV22 Packages shall be loaded so that a free circulation of air within the loading space provides a uniform temperature of the load. If the contents of one vehicle or large container exceed 5 000 kg of flammable solids and/or organic peroxides, the load shall be divided into stacks of not more than 5 000 kg separated by air spaces of at least 0.05 m.

CV23 When handling packages, special measures shall be taken to ensure that they do not come into contact with water.

CV24 Before loading, vehicles and containers shall be thoroughly cleaned and in particular be free of any combustible debris (straw, hay, paper, etc.).

The use of readily flammable materials for stowing packages is prohibited.

CV25 (1) Packages shall be so stowed that they are readily accessible.

(2) When packages are to be carried at an ambient temperature of not more than 15 °C or refrigerated, the temperature shall be maintained when unloading or during storage.

(3) Packages shall be stored only in cool places away from sources of heat.

CV26 The wooden parts of a vehicle or container which have come into contact with these substances shall be removed and burnt.

CV27 (1) Packages shall be so stowed that they are readily accessible.

(2) When packages are to be carried refrigerated, the functioning of the cooling chain shall be ensured when unloading or during storage.

(3) Packages shall only be stored in cool places away from sources of heat.

CV28 See 7.5.4.

CV29 to
CV32 *(Reserved)*

CV33 **NOTE 1**: "Critical group" means a group of members of the public which is reasonably homogeneous with respect to its exposure for a given radiation source and given exposure pathway and is typical of individual receiving the highest effective dose by the given exposure pathway from the given source.

***NOTE 2**: "Members of the public" means in a general sense, any individuals in the population except when subject to occupational or medical exposure.*

***NOTE 3:** "Workers" are any persons who work, whether full time, part-time or temporarily, for an employer and who have recognised rights and duties in relation to occupational radiation protection.*

(1) *Segregation*

(1.1) Packages, overpacks, containers and tanks shall be segregated during carriage:

(a) from areas where persons other than those referred to in paragraph (c) have regular access;

(i) in accordance with Table A below; or

(ii) by a distance calculated to ensure members of the critical group in that area receive less than 1mSv per year;

and

(b) from undeveloped photographic film and mailbags, in accordance with Table B below;

***NOTE:** Mailbags shall be assumed to contain undeveloped film and plates and therefore be separated from radioactive material in the same way.*

and

(c) from workers in regularly occupied working areas either;

(i) in accordance with Table A below; or

(ii) by a distance calculated to ensure that workers in that area receive less than 5mSv per year;

NOTE: *Workers subject to individual monitoring for the purpose of radiation protection shall not be considered for the purpose of segregation.*

and

(d) from other dangerous goods in accordance with 7.5.2.1.

Table A: Minimum distances between packages of category II-YELLOW or of category III-YELLOW and persons

Sum of transport indexes not more than	Exposure time per year (hours)			
	Areas where members of the public have regular access		Regularly occupied working areas	
	50	250	50	250
	Segregation distance in metres, no shielding material intervening, from:			
2	1	3	0.5	1
4	1.5	4	0.5	1.5
8	2.5	6	1.0	2.5
12	3	7.5	1.0	3
20	4	9.5	1.5	4
30	5	12	2	5
40	5.5	13.5	2.5	5.5
50	6.5	15.5	3	6.5

(1.2) Category II-YELLOW or III-YELLOW packages or overpacks shall not be carried in compartments occupied by passengers, except those exclusively reserved for couriers specially authorized to accompany such packages or overpacks.

(1.3) No persons other than the driver and the other members of the crew shall be permitted in vehicles carrying packages, overpacks or containers bearing category II-YELLOW or III-YELLOW labels.

(1.4) Radioactive material shall be sufficiently segregated from undeveloped photographic film. The basis for determining segregation distances for this purpose shall be that the radiation exposure of undeveloped photographic film due to the carriage of radioactive material be limited to 0.1 mSv per consignment of such film (see Table B below).

Table B: Minimum distances between packages of category II-YELLOW or of category III-YELLOW and packages bearing the word "FOTO", or mailbags

Total number of packages not more than		Sum of transport indexes not more than	Journey or storage duration, in hours							
Category			1	2	4	10	24	48	120	240
III-yellow	II-yellow		Minimum distances in metres							
		0.2	0.5	0.5	0.5	0.5	1	1	2	3
		0.5	0.5	0.5	0.5	1	1	2	3	5
	1	1	0.5	0.5	1	1	2	3	5	7
	2	2	0.5	1	1	1.5	3	4	7	9
	4	4	1	1	1.5	3	4	6	9	13
	8	8	1	1.5	2	4	6	8	13	18
1	10	10	1	2	3	4	7	9	14	20
2	20	20	1.5	3	4	6	9	13	20	30
3	30	30	2	3	5	7	11	16	25	35
4	40	40	3	4	5	8	13	18	30	40
5	50	50	3	4	6	9	14	20	32	45

(2) *Activity limits*

The total activity in a vehicle, for carriage of LSA material or SCO in Industrial Packages Type 1 (Type IP-1), Type 2 (Type IP-2), Type 3 (Type IP-3) or unpackaged, shall not exceed the limits shown in Table C below.

Table C: Vehicle activity limits for LSA material and SCO in industrial packages or unpackaged

Nature of material or object	Activity limit for vehicle
LSA-I	No limit
LSA-II and LSA-III non-combustible solids	No limit
LSA-II and LSA-III combustible solids, and all liquids and gases	100 A_2
SCO	100 A_2

(3) *Stowage during carriage and storage in transit*

(3.1) Consignments shall be securely stowed.

(3.2) Provided that its average surface heat flux does not exceed 15 W/m^2 and that the immediately surrounding cargo is not in bags, a package or overpack may be carried or stored among packaged general cargo without any special stowage provisions except as may be specifically required by the competent authority in an applicable approval certificate.

(3.3) Loading of containers and accumulation of packages, overpacks and containers shall be controlled as follows:

(a) Except under the condition of exclusive use, the total number of packages, overpacks and containers aboard a single vehicle shall be so limited that the total sum of the transport indexes aboard the vehicle does not exceed the values shown in Table D below. For consignments of LSA-I material there shall be no limit on the sum of the transport indexes;

(b) Where a consignment is carried under exclusive use, there shall be no limit on the sum of the transport indexes aboard a single vehicle;

(c) The radiation level under routine conditions of carriage shall not exceed 2 mSv/h at any point on, and 0.1 mSv/h at 2 m from, the external surface of the vehicle;

(d) The total sum of the criticality safety indexes in a container and aboard a vehicle shall not exceed the values shown in Table E below.

Table D: Transport Index limits for containers and vehicles not under exclusive use

Type of container or vehicle	Limit on total sum of transport indexes in a container or aboard a vehicle
Small container	50
Large container	50
Vehicle	50

Table E: Criticality Safety Index for containers and vehicles containing fissile material

Type of container or vehicle	Limit on total sum of criticality safety indexes	
	Not under exclusive use	Under exclusive use
Small container	50	n.a.
Large container	50	100
Vehicle	50	100

(3.4) Any package or overpack having either a transport index greater than 10, or any consignment having a criticality safety index greater than 50, shall be carried only under exclusive use.

(3.5) For consignments under exclusive use, the radiation level shall not exceed:

(a) 10 mSv/h at any point on the external surface of any package or overpack, and may only exceed 2 mSv/h provided that:

(i) the vehicle is equipped with an enclosure which, during routine conditions of carriage, prevents the access of unauthorized persons to the interior of the enclosure;

(ii) provisions are made to secure the package or overpack so that its position within the vehicle enclosure remains fixed during routine conditions of carriage, and

(iii) there is no loading or unloading during the shipment;

(b) 2 mSv/h at any point on the outer surfaces of the vehicle, including the upper and lower surfaces, or, in the case of an open vehicle, at any point on the vertical planes projected from the outer edges of the vehicle, on the upper surface of the load, and on the lower external surface of the vehicle; and

(c) 0.1 mSv/h at any point 2 m from the vertical planes represented by the outer lateral surfaces of the vehicle, or, if the load is carried in an open vehicle, at any point 2m from the vertical planes projected from the outer edges of the vehicle.

(4) *Segregation of packages containing fissile material during carriage and storage in transit*

(4.1) The number of packages, overpacks and containers containing fissile material stored in transit in any one storage area shall be so limited that the total sum of the criticality safety indexes in any group of such packages, overpacks or containers does not exceed 50. Groups of such packages, overpacks and containers shall be stored so as to maintain a spacing of at least 6 m from other groups of such packages, overpacks or containers.

(4.2) Where the total sum of the criticality safety indexes on board a vehicle or in a container exceeds 50, as permitted in Table E above, storage shall be such as to maintain a spacing of at least 6 m from other groups of packages, overpacks or containers containing fissile material or other vehicles carrying radioactive material.

(5) *Damaged or leaking packages, contaminated packagings*

(5.1) If it is evident that a package is damaged or leaking, or if it is suspected that the package may have leaked or been damaged, access to the package shall be restricted and a qualified person shall, as soon as possible, assess the extent of contamination and the resultant radiation level of the package. The scope of the assessment shall include the package, the vehicle, the adjacent loading and unloading areas, and, if necessary, all other material which has been carried in the vehicle.

When necessary, additional steps for the protection of persons property and the environment, in accordance with provisions established by the competent authority, shall be taken to overcome and minimize the consequences of such leakage or damage.

(5.2) Packages damaged or leaking radioactive contents in excess of allowable limits for normal conditions of carriage may be removed to an acceptable interim location under supervision, but shall not be forwarded until repaired or reconditioned and decontaminated.

(5.3) A vehicle and equipment used regularly for the carriage of radioactive material shall be periodically checked to determine the level of contamination. The frequency of such checks shall be related to the likelihood of contamination and the extent to which radioactive material is carried.

(5.4) Except as provided in paragraph (5.5), any vehicle, or equipment or part thereof which has become contaminated above the limits specified in 4.1.9.1.2 in the course of carriage of radioactive material, or which shows a radiation level in excess of 5 µSv/h at the surface, shall be decontaminated as soon as possible by a qualified person and shall not be re-used unless the non-fixed contamination does not exceed the limits specified in 4.1.9.1.2, and the radiation level resulting from the fixed contamination on surfaces after decontamination is less than 5 µSv/h at the surface.

(5.5) An overpack, container, tank, intermediate bulk container or vehicle dedicated to the carriage of radioactive material under exclusive use shall be excepted from the requirements of the previous paragraph (5.4) and in 4.1.9.1.4 solely with regard to its internal surfaces and only for as long as it remains under that specific exclusive use.

(6) *Other provisions*

Where a consignment is undeliverable, the consignment shall be placed in a safe location and the competent authority shall be informed as soon as possible and a request made for instructions on further action.

ANNEX B

PROVISIONS CONCERNING TRANSPORT EQUIPMENT AND TRANSPORT OPERATIONS

PART 8

Requirements for vehicle crews, equipment, operation and documentation

CHAPTER 8.1

GENERAL REQUIREMENTS CONCERNING TRANSPORT UNITS AND EQUIPMENT ON BOARD

8.1.1 Transport units

A transport unit loaded with dangerous goods may in no case include more than one trailer (or semi-trailer).

8.1.2 Documents to be carried on the transport unit

8.1.2.1 In addition to the documents required under other regulations, the following documents shall be carried on the transport unit:

(a) The transport documents prescribed in 5.4.1, covering all the dangerous goods carried and, when appropriate, the container packing certificate prescribed in 5.4.2;

(b) The instructions in writing prescribed in 5.4.3, relating to all the dangerous goods carried;

(c) A copy of the main text of the special agreement(s) concluded in accordance with Chapter 1.5, if carriage is carried out on the basis of such agreement(s).

8.1.2.2 Where the provisions of ADR require the following documents to be drawn up, they shall likewise be carried on the transport unit:

(a) The certificate of approval referred to in 9.1.2 for each transport unit or element thereof;

(b) The driver's training certificate prescribed in 8.2.1;

(c) The permit authorizing the transport operation, as prescribed in 5.4.1.2.1 (c), 5.4.1.2.3.3, 2.2.41.1.13 and 2.2.52.1.8.

8.1.2.3 The instructions in writing prescribed in 5.4.3 shall be kept in a readily identifiable form in the driver's cab. The carrier shall ensure that the drivers concerned understand and are capable of carrying out these instructions properly.

8.1.2.4 Instructions in writing which are not applicable to the goods which are on board the vehicle shall be kept separate from pertinent documents in such a way as to prevent confusion.

8.1.3 Placarding and marking

Transport units carrying dangerous goods shall be placarded and marked in conformity with Chapter 5.3.

8.1.4 Fire-fighting appliances

8.1.4.1 Every transport unit carrying dangerous goods shall be equipped with:

(a) At least one portable fire extinguisher of minimum capacity 2 kg dry powder (or equivalent rating for suitable extinguishants) suitable for fighting a fire in the engine or cab of the transport unit, and such that, if it is used to fight a fire involving the load, it does not aggravate the fire and, if possible, controls it; however, if the vehicle is

equipped with a fixed fire extinguisher, automatic or easily brought into action for fighting a fire in the engine, the portable extinguisher need not be suitable for fighting a fire in the engine;

(b) In addition to the equipment prescribed under (a) above, at least one portable fire extinguisher of minimum capacity 6 kg dry powder (or equivalent rating for suitable extinguishants) suitable for fighting a tyre/brake fire or one involving the load, and such that, if it is used to fight a fire in the engine or cab of the transport unit, it does not aggravate the fire. Motor vehicles with a maximum permissible mass of 3.5 tonnes or less may be equipped with a portable fire extinguisher of a minimum capacity of 2 kg of powder.

8.1.4.2 The extinguishing agents contained in the fire extinguishers with which a transport unit is equipped shall be such that they are not liable to release toxic gases into the driver's cab or under the influence of the heat of the fire.

8.1.4.3 The portable fire extinguishers conforming to the provisions of 8.1.4.1 above shall be fitted with a seal verifying that they have not been used. In addition, they shall bear a mark of compliance with a standard recognized by a competent authority and an inscription indicating the expiry date (month, year).

8.1.5 Miscellaneous equipment

Every transport unit carrying dangerous goods shall be equipped with:

(a) For each vehicle, at least one scotch of a size suited to the weight of the vehicle and to the diameter of the wheels;

(b) The necessary equipment to take the general actions referred to in the safety instructions set out in 5.4.3, in particular:

- Two self-standing warning signs (e.g. reflective cones or triangles or flashing amber lights which are independent from the electrical equipment of the vehicle);

- A suitable warning vest or warning clothing (e.g. as described in European Standard EN 471) for each member of the vehicle crew;

- A pocket lamp (see also 8.3.4) for each member of the vehicle crew;

- A respiratory protective device in conformity with additional requirement S7 (see Chapter 8.5) if this additional requirement applies according to the indication in Column (19) of Table A of Chapter 3.2;

(c) The necessary equipment to take the additional and special actions referred to in the instructions in writing set out in 5.4.3.

CHAPTER 8.2

REQUIREMENTS CONCERNING THE TRAINING OF THE VEHICLE CREW

8.2.1 General requirements concerning the training of drivers

8.2.1.1 Drivers of vehicles with a permissible maximum mass exceeding 3.5 tonnes carrying dangerous goods, drivers of vehicles referred to in 8.2.1.3 and drivers of other vehicles referred to in 8.2.1.4 shall hold a certificate issued by the competent authority or by any organization recognized by that authority stating that they have participated in a training course and passed an examination on the particular requirements that have to be met during carriage of dangerous goods.

8.2.1.2 Drivers of vehicles specified in 8.2.1.1 shall attend a basic training course. Training shall be given in the form of a course approved by the competent authority. Its main objectives are to make drivers aware of hazards arising in the carriage of dangerous goods and to give them basic information indispensable for minimizing the likelihood of an incident taking place and, if it does, to enable them to take measures which may prove necessary for their own safety and that of the public and the environment, for limiting the effects of an incident. This training, which shall include individual practical exercises, shall act as the basis of training for all categories of drivers covering at least the subjects defined in 8.2.2.3.2.

8.2.1.3 Drivers of vehicles carrying dangerous goods in fixed tanks or demountable tanks with a capacity exceeding 1 m^3, drivers of battery-vehicles with a total capacity exceeding 1 m^3 and drivers of vehicles carrying dangerous goods in tank-containers, portable tanks or MEGCs with an individual capacity exceeding 3 m^3 on a transport unit, shall attend a specialization training course for carriage in tanks covering at least the subjects defined in 8.2.2.3.3.

8.2.1.4 Irrespective of the permissible maximum mass of the vehicle, drivers of vehicles carrying substances or articles of Class 1 (see additional requirement S1 in Chapter 8.5) or certain radioactive material (see special provisions S11 and S12 in Chapter 8.5) shall attend specialization training courses covering at least the subjects defined in 8.2.2.3.4 or 8.2.2.3.5.

8.2.1.5 By means of appropriate endorsements on his certificate made every five years by the competent authority or by any organization recognized by that authority, a vehicle driver shall be able to show that he has in the year before the date of expiry of his certificate completed a refresher training course and has passed corresponding examinations. The new period of validity shall begin with the date of expiry of the certificate.

8.2.1.6 Initial or refresher basic training courses and initial or refresher specialization training courses may be given in the form of comprehensive courses, conducted integrally, on the same occasion and by the same training organization.

8.2.1.7 Initial training courses, refresher courses, practical exercises, examinations and the role of competent authorities shall comply with the provisions of 8.2.2.

8.2.1.8 All training certificates conforming to the requirements of this section and issued in accordance with the model shown in 8.2.2.8.3 by the competent authority of a Contracting Party or by any organization recognized by that authority shall be accepted during their period of validity by the competent authorities of other Contracting Parties.

8.2.1.9 The certificate shall be prepared in the language or one of the languages of the country of the competent authority which issued the certificate or recognized the issuing organization and, if this language is not English, French or German, also in English, French or German, except

where otherwise provided by agreements concluded between the countries concerned with the transport operation.

8.2.2 Special requirements concerning the training of drivers

8.2.2.1 The necessary knowledge and skills shall be imparted by training covering theoretical courses and practical exercises. The knowledge shall be tested in an examination.

8.2.2.2 The training provider shall ensure that the training instructors have a good knowledge of, and take into consideration, recent developments in regulations and training requirements relating to the carriage of dangerous goods. The training shall be practice-related. The training programme shall conform with the approval, on the subjects set out in 8.2.2.3.2 to 8.2.2.3.5. The initial training and refresher training shall also include individual practical exercises (see 8.2.2.4.5).

8.2.2.3 ***Structure of training***

8.2.2.3.1 Initial and refresher training shall be given in the form of a basic course and, when applicable, specialization courses.

8.2.2.3.2 Subjects to be covered by the basic course will be, at least:

(a) General requirements governing the carriage of dangerous goods;

(b) Main types of hazard;

(c) Information on environmental protection in the control of the transfer of wastes;

(d) Preventive and safety measures appropriate to the various types of hazard;

(e) What to do after an accident (first aid, road safety, basic knowledge about the use of protective equipment, etc.);

(f) Marking, labelling, placarding and orange-coloured plate marking;

(g) What a driver should and should not do during the carriage of dangerous goods;

(h) Purpose and the method of operation of technical equipment on vehicles;

(i) Prohibitions on mixed loading in the same vehicle or container;

(j) Precautions to be taken during loading and unloading of dangerous goods;

(k) General information concerning civil liability;

(l) Information on multimodal transport operations;

(m) Handling and stowage of packages.

8.2.2.3.3 Special subjects to be covered by the specialization course for carriage in tanks shall be, at least:

(a) Behaviour of vehicles on the road, including movements of the load;

(b) Specific requirements of the vehicles;

(c) General theoretical knowledge of the various and different filling and discharge systems;

(d) Specific additional provisions applicable to the use of those vehicles (certificates of approval, approval marking, placarding and orange-coloured plate marking, etc.).

8.2.2.3.4 Special subjects to be covered by the specialization course for the carriage of substances and articles of Class 1 shall be, at least:

(a) Specific hazards related to explosive and pyrotechnical substances and articles;

(b) Specific requirements concerning mixed loading of substances and articles of Class 1.

8.2.2.3.5 Special subjects to be covered by the specialization course for the carriage of radioactive material of Class 7 shall be, at least:

(a) Specific hazards related to ionizing radiation;

(b) Specific requirements concerning packing, handling, mixed loading and stowage of radioactive material;

(c) Special measures to be taken in the event of an accident involving radioactive material.

8.2.2.4 ***Initial training programme***

8.2.2.4.1 The minimum duration of the theoretical element of each initial course or part of the comprehensive course shall be as follows:

Basic course	18 teaching units [1]
Specialization course for carriage in tanks	12 teaching units [1]
Specialization course for carriage of substances and articles of Class 1	8 teaching units
Specialization course for carriage of radioactive material of Class 7	8 teaching units

8.2.2.4.2 The total duration of the comprehensive course may be determined by the competent authority, who shall maintain the duration of the basic course and the specialization course for tanks, but may supplement it with shortened specialization courses for Classes 1 and 7.

8.2.2.4.3 Teaching units are intended to last 45 minutes.

8.2.2.4.4 Normally, not more than eight teaching units are permitted on each day of the course.

8.2.2.4.5 The individual practical exercises shall take place in connection with the theoretical training, and shall at least cover first aid, fire-fighting and what to do in case of an incident or accident.

[1] *Additional teaching units are required for practical exercises referred to in 8.2.2.4.5 below which will vary depending on the number of drivers under instruction.*

8.2.2.5 ***Refresher training programme***

8.2.2.5.1 Refresher training courses undertaken at regular intervals serve the purpose of bringing the drivers' knowledge up to date; they shall cover new technical, legal and substance-related developments.

8.2.2.5.2 Refresher courses shall have been completed before the period referred to in 8.2.1.5 has expired.

8.2.2.5.3 The duration of each refresher course shall be of at least one day.

8.2.2.5.4 Normally, not more than eight teaching units shall be permitted on each day of the course.

8.2.2.6 ***Approval of training***

8.2.2.6.1 The training courses shall be subject to approval by the competent authority.

8.2.2.6.2 Approval shall only be given with regard to applications submitted in writing.

8.2.2.6.3 The following documents shall be attached to the application for approval:

(a) A detailed training programme specifying the subjects taught and indicating the time schedule and planned teaching methods;

(b) Qualifications and fields of activities of the teaching personnel;

(c) Information on the premises where the courses take place and on the teaching materials as well as on the facilities for the practical exercises;

(d) Conditions of participation in the courses, such as number of participants.

8.2.2.6.4 The competent authority shall organize the supervision of training and examinations.

8.2.2.6.5 Approval shall be granted in writing by the competent authority subject to the following conditions:

(a) The training shall be given in conformity with the application documents;

(b) The competent authority shall be granted the right to send authorized persons to be present at the training courses and examinations;

(c) The competent authority shall be advised in time of the dates and the places of the individual training courses;

(d) The approval may be withdrawn if the conditions of approval are not complied with.

8.2.2.6.6 The approval document shall indicate whether the courses concerned are basic or specialization courses, initial or refresher courses.

8.2.2.6.7 If the training body, after a training course has been given approval, intends to make any alterations with respect to such details as were relevant to the approval, it shall seek permission in advance from the competent authority. This applies in particular to changes concerning the training programme.

8.2.2.7 ***Examinations***

8.2.2.7.1 *Examinations for the initial basic course*

8.2.2.7.1.1 After completion of the basic training, including the practical exercises, an examination shall be held on the basic course.

8.2.2.7.1.2 In the examination, the candidate has to prove that he has the knowledge, insight and skill for the practice of professional driver of vehicles carrying dangerous goods as provided in the basic training course.

8.2.2.7.1.3 For this purpose the competent authority, or the examination body approved by that authority, shall prepare a catalogue of questions which refer to the items summarized in 8.2.2.3.2. Questions in the examination shall be drawn from this catalogue. The candidates shall not have any knowledge of the questions selected from the catalogue prior to the examination.

8.2.2.7.1.4 A single examination for comprehensive courses may be held.

8.2.2.7.1.5 Each competent authority shall supervise the modalities of the examination.

8.2.2.7.1.6 The examination shall take the form of a written examination or a combination of a written and oral examination. Each candidate shall be asked at least 25 written questions. The duration of the examination shall be at least 45 minutes. The questions may be of a varying degree of difficulty and be allocated a different weighting.

8.2.2.7.2 *Examinations for initial specialization courses for carriage in tanks or for carriage of explosive substances and articles or radioactive material.*

8.2.2.7.2.1 After having sat the examination on the basic course and after having attended the specialization course for carriage in tanks or for the carriage of explosive or radioactive material, the candidate shall be allowed to take part in the corresponding examination.

8.2.2.7.2.2 This examination shall be held and supervised on the same basis as in 8.2.2.7.1.

8.2.2.7.2.3 At least 15 questions shall be asked with respect to each specialization course.

8.2.2.7.3 *Examinations for refresher courses*

8.2.2.7.3.1 After having undertaken a refresher training course the candidate shall be allowed to take part in the corresponding examination.

8.2.2.7.3.2 The examination shall be held and supervised on the same basis as set out in 8.2.2.7.1.

8.2.2.7.3.3 At least 15 questions shall be asked with respect to the refresher training course.

8.2.2.8 ***Certificate of driver's training***

8.2.2.8.1 According to 8.2.1.8, the certificate shall be issued:

(a) After completion of a basic training course, provided the candidate has successfully passed the examination in accordance with 8.2.2.7.1;

(b) If applicable, after completion of a specialization course for carriage in tanks or carriage of explosive substances or articles or of radioactive material, or after having acquired the knowledge referred to in special provisions S1 and S11 in Chapter 8.5,

provided the candidate has successfully passed an examination in accordance with 8.2.2.7.2.

8.2.2.8.2 The certificate shall be renewed if the candidate furnishes proof of his participation in a refresher course in accordance with 8.2.1.5 and if he has successfully passed an examination in accordance with 8.2.2.7.3.

8.2.2.8.3 The certificate shall have the layout of the model below. It is recommended that the format shall be the same as the European national driving permit, namely A7 (105 mm x 74 mm), or a double sheet that can be folded to that format.

Model of certificate

1

ADR - TRAINING CERTIFICATE FOR DRIVERS OF VEHICLES CARRYING DANGEROUS GOODS
in tanks 1/ other than in tanks 1/

Certificate No. .....

Distinguishing sign of issuing State .....

Valid for class(es) 1/ 2/

in tanks	other than in tanks
1	1
2	2
3	3
4.1, 4.2, 4.3	4.1, 4.2, 4.3
5.1, 5.2	5.1, 5.2
6.1, 6.2	6.1, 6.2
7	7
8	8
9	9

until (date) 3/ .....

1/ Strike out what does not apply.
2/ For extension to other classes, see page 3.
3/ For renewal, see page 2.

2

Surname .....

First name(s) .....

Date of birth ..... Nationality .....

Signature of holder .....

Issued by .....

Date .....

Signature 4/.....

Renewed until .....

By .....

Date .....

Signature 4/ .....

4/ and/or seal (or stamp) of issuing authority.

3

EXTENDED TO CLASS(ES) 5/

in tanks
1
2
3 Date .....
4.1, 4.2, 4.3
5.1, 5.2 Signature and/or seal or stamp
6.1, 6.2 .....
7
8
9

other than in tanks
1
2
3 Date .....
4.1, 4.2, 4.3
5.1, 5.2 Signature and/or seal or stamp
6.1, 6.2 .....
7
8
9

5/ Strike out what does not apply.

4

For national regulations only

8.2.3 Training of all persons, other than the drivers referred to in 8.2.1, involved in the carriage of dangerous goods by road

Persons whose duties concern the carriage of dangerous goods by road shall have received training in the requirements governing the carriage of such goods appropriate to their responsibilities and duties according to Chapter 1.3. This requirement shall apply to individuals such as personnel who are employed by the road vehicle operator or the consignor, personnel who load or unload dangerous goods, personnel in freight forwarding or shipping agencies and drivers not referred to in 8.2.1.

.

CHAPTER 8.3

MISCELLANEOUS REQUIREMENTS TO BE COMPLIED WITH BY THE VEHICLE CREW

8.3.1 Passengers

Apart from members of the vehicle crew, no passengers may be carried in transport units carrying dangerous goods.

8.3.2 Use of fire-fighting appliances

The crew of the vehicle shall know how to use the fire-fighting appliances.

8.3.3 Prohibition on opening packages

A driver or a driver's assistant may not open a package containing dangerous goods.

8.3.4 Portable lighting apparatus

A vehicle may not be entered by persons carrying lighting apparatus comprising a flame. In addition, the lighting apparatus used shall not exhibit any metal surface liable to produce sparks.

8.3.5 Prohibition on smoking

Smoking shall be prohibited during handling operations in the vicinity of vehicles and inside the vehicles.

8.3.6 Running the engine during loading or unloading

Except where the engine has to be used to drive the pumps or other appliances for loading or unloading the vehicle and the laws of the country in which the vehicle is operating permit such use, the engine shall be shut off during loading and unloading operations.

8.3.7 Use of the parking brake

No transport unit carrying dangerous goods may be parked without the parking brakes being applied.

CHAPTER 8.4

REQUIREMENTS CONCERNING THE SUPERVISION OF VEHICLES

Vehicles carrying dangerous goods in the quantities shown in special provisions S1 (6) and S14 to S21 of Chapter 8.5 for a given substance according to Column (19) of Table A of Chapter 3.2 shall be supervised or alternatively may be parked, unsupervised, in a secure depot or secure factory premises. If such facilities are not available, the vehicle, after having been properly secured, may be parked in an isolated position meeting the requirements of (a), (b) or (c) below:

(a) A vehicle park supervised by an attendant who has been notified of the nature of the load and the whereabouts of the driver;

(b) A public or private vehicle park where the vehicle is not likely to suffer damage from other vehicles; or

(c) A suitable open space separated from the public highway and from dwellings, where the public does not normally pass or assemble;

The parking facilities permitted in (b) shall be used only if those described in (a) are not available, and those described in (c) may be used only if facilities described in (a) and (b) are not available.

CHAPTER 8.5

ADDITIONAL REQUIREMENTS RELATING TO PARTICULAR CLASSES OR SUBSTANCES

In addition to the requirements of Chapters 8.1 to 8.4, when reference is made to them in Column (19) of Table A of Chapter 3.2, the following requirements shall apply to the carriage of the substances or articles concerned. In the event of conflict with the requirements of Chapters 8.1 to 8.4, the requirements of this Chapter shall take precedence.

S1: Additional requirements concerning the carriage of explosive substances and articles (Class 1)

(1) ***Special training of drivers***

(a) Irrespective of the permissible maximum mass of the vehicle, the requirements of 8.2.1 shall apply to drivers of vehicles carrying substances or articles of Class 1;

(b) Drivers of vehicles carrying substances or articles of Class 1 shall attend a specialization training course covering at least the subjects defined in 8.2.2.3.4;

(c) If, according to other regulations applicable in the country of a Contracting Party, a driver has followed equivalent training under a different regime or for a different purpose, covering the subjects referred to in (b), the specialization course may be totally or partially dispensed with.

(2) ***Approved official***

If the national regulations so provide, the competent authority of a country contracting party to ADR may require an approved official to be carried in the vehicle at the carrier's expense.

(3) ***Prohibition of fire and naked flame***

The use of fire or naked flame shall be prohibited on vehicles carrying substances and articles of Class 1, in their vicinity and during the loading and unloading of these substances and articles.

(4) ***Places of loading and unloading***

(a) Loading or unloading of substances and articles of Class 1 shall not take place in a public place in a built-up area without special permission from the competent authorities;

(b) Loading or unloading of substances and articles of Class 1 in a public space elsewhere than in a built-up area without prior notice thereof having been given to the competent authorities shall be prohibited, unless operations are urgently necessary for reasons of safety;

(c) If, for any reason, handling operations have to be carried out in a public place, then substances and articles of different kinds shall be separated according to the labels;

(d) When vehicles carrying substances and articles of Class 1 are obliged to stop for loading or unloading operations in a public place, a distance of at least 50 m shall be maintained between the stationary vehicles.

(5) ***Convoys***

(a) When vehicles carrying substances and articles of Class 1 travel in convoy, a distance of not less than 50 m shall be maintained between each transport unit and the next;

(b) The competent authority may lay down rules for the order or composition of convoys.

(6) ***Supervision of vehicles***

The requirements of Chapter 8.4 shall be applicable only when substances and articles of Class 1 having a total mass of explosive substance of more than 50 kg are carried in a vehicle.

In addition, these substances and articles shall be supervised at all times in order to prevent any malicious act and to alert the driver and the competent authorities in the event of loss or fire.

Empty uncleaned packagings are exempted.

S2: Additional requirements concerning the carriage of flammable liquids or gases

(1) ***Portable lamps***

Closed vehicles carrying liquids having a flash-point of not more than 61 °C or flammable substances or article of Class 2, shall not be entered by persons carrying lighting apparatus other than portable lamps so designed and constructed that they cannot ignite any flammable vapours or gases which may have penetrated into the interior of the vehicle.

(2) ***Operation of combustion heaters during loading or unloading***

The operation of combustion heaters of vehicles of type FL (see Part 9) is forbidden during loading and unloading and at loading sites.

(3) ***Precautions against electrostatic charges***

In the case of vehicles of type FL (see Part 9), a good electrical connection from the vehicle chassis to earth shall be established before tanks are filled or emptied. In addition, the rate of filling shall be limited.

S3: Special provisions concerning the carriage of infectious substances

For transport units carrying dangerous substances of Class 6.2, the requirements of 8.1.4.1 (b), 8.1.4.3 and 8.3.4 shall not apply.

S4: **Additional requirements concerning carriage under controlled temperatures**

Maintenance of the prescribed temperature is essential for safe carriage. In general, there shall be:

- thorough inspection of the transport unit prior to loading;
- instructions to the carrier about the operation of the refrigeration system, including a list of the suppliers of coolant available en route;
- procedures to be followed in the event of loss of control;
- regular monitoring of operating temperatures; and
- availability of a back-up refrigeration system or spare parts.

The temperature of the air space within the transport unit shall be measured by two independent sensors and the output shall be so recorded that temperature changes are readily detectable.

The temperature shall be checked every four to six hours and logged.

If the control temperature is exceeded during carriage, an alert procedure shall be initiated involving any necessary repairs to the refrigeration equipment or an increase in the cooling capacity (e.g. by adding liquid or solid coolant). There shall also be frequent checking of the temperature and preparations for implementation of the emergency procedures. If the emergency temperature (see also 2.2.41.1.17 and 2.2.52.1.15 to 2.2.52.1.18) is reached, the emergency procedures shall be set in operation.

S5: **Special provisions common to the carriage of radioactive material of Class 7 in excepted packages (UN Nos. 2908, 2909, 2910 and 2911) only**

The requirements of the instructions in writing of 8.1.2.1 (b) and of 8.2.1, 8.3.1 and 8.3.4 shall not apply.

S6: **Special provisions common to the carriage of radioactive material of Class 7 other than in excepted packages**

The provisions of 8.3.1 shall not apply to vehicles carrying only packages, overpacks or containers bearing category I-WHITE labels.

The provisions of 8.3.4 shall not apply provided there is no subsidiary risk.

Other additional requirements or special provisions

S7: When gases or articles designated with letters T, TO, TF, TC, TFC, TOC are being carried, each member of the vehicle crew shall be provided with a respiratory protective device enabling them to escape (e.g. escape hood or mask with a combined gas/particle cartridge A1B1E1K1-P1 or A2B2E2K2-P2, as described in European standard EN 141).

S8: When a transport unit is loaded with more than 2 000 kg of these substances, stops for service requirements shall as far as possible not be made near inhabited places or frequented places. A longer stop near such places is permissible only with the consent of the competent authorities.

S9: During the carriage of these substances, stops for service requirements shall as far as possible not be made near inhabited places or frequented places. A longer stop near such places is permissible only with the consent of the competent authorities.

S10: During the period April to October, when a vehicle is stationary, the packages shall, if the legislation of the country in which the vehicle is halted so requires, be effectively protected against the action of the sun, e.g. by means of sheets placed not less than 20 cm above the load.

S11: (1) Irrespective of the permissible maximum mass of the vehicle, the requirements of 8.2.1 shall apply.

(2) Drivers shall attend a specialization training course covering at least the subjects defined in 8.2.2.3.5.

(3) If, according to other regulations applicable in the country of a Contracting Party, a driver has followed equivalent training under a different regime or for a different purpose covering the subjects referred to in (2), the specialization course may be totally or partially dispensed with.

S12: If the total number of packages containing radioactive material carried does not exceed 10, and the sum of the carriage indices does not exceed 3, special provision S11 need not be applied. However, drivers shall then receive appropriate training, commensurate with and appropriate to their duties, which provides them with an awareness of the radiation hazards involved in the carriage of radioactive material. Such awareness training shall be confirmed by a certificate provided by their employer.

S13: When a consignment cannot be delivered, it shall be placed in a safe place; the competent authority should be informed as soon as possible and requested for instructions on how to proceed.

S14: The provisions of Chapter 8.4 concerning the supervision of vehicles shall apply when the total mass of these substances in the vehicle exceeds 100 kg.

S15: The provisions of Chapter 8.4 concerning the supervision of vehicles shall apply to substances of hazard group 4 whatever their mass and to substances of hazard group 3 when the total mass of such substances in the vehicle exceeds 100 kg. However, the provisions of Chapter 8.4 need not be applied when the loaded compartment is locked and the packages carried are otherwise protected against any illicit unloading.

S16: The provisions of Chapter 8.4 concerning the supervision of vehicles shall apply when the total mass of these substances in the vehicle exceeds 500 kg.

In addition, vehicles carrying more than 500 kg of these substances shall be subject at all times to supervision to prevent any malicious act and to alert the driver and competent authorities in the event of loss or fire.

S17: The provisions of Chapter 8.4 concerning the supervision of vehicles shall apply when the total mass of these substances in the vehicle exceeds 1 000 kg.

S18: The provisions of Chapter 8.4 concerning the supervision of vehicles shall apply when the total mass of such substances in the vehicle exceeds 2 000 kg.

S19: The provisions of Chapter 8.4 concerning the supervision of vehicles shall apply when the total mass of such substances in the vehicle exceeds 5 000 kg.

S20: The provisions of Chapter 8.4 concerning the supervision of vehicles shall apply when the total mass of these substances in the vehicle exceeds 10 000 kg.

S21: The provisions of Chapter 8.4 concerning the supervision of vehicles shall apply to all material, in whatever mass. In addition, these goods shall be subject at all times to supervision to prevent any malicious act and to alert the driver and the competent authorities in the event of loss or fire. However, the provisions of Chapter 8.4 need not be applied where:

(a) The loaded compartment is locked and the packages carried are otherwise protected against illicit unloading; and

(b) The dose rate does not exceed 5μSv/h at any accessible point on the outer surface of the vehicle.

PART 9

Requirements concerning the construction and approval of vehicles

CHAPTER 9.1

GENERAL REQUIREMENTS CONCERNING THE CONSTRUCTION AND APPROVAL OF VEHICLES

9.1.1 General provisions

9.1.1.1 *Scope*

The provisions of part 9 shall apply to vehicles of categories N and O, as defined in Annex 7 of the Consolidated Resolution on the Construction of Vehicles (R.E.3),[1] intended for the carriage of dangerous goods.

9.1.1.2 For the purposes of Part 9:

"Vehicle": means any vehicle, whether complete (e.g. one stage built vans, lorries, tractors, trailers), incomplete (e.g. chassis, chassis-cab, trailer-chassis) or, completed (e.g. chassis-cab fitted with a bodywork), intended for the carriage of dangerous goods by road;

"Base vehicle": means a chassis-cab vehicle, a tractor for semi-trailer, a trailer-chassis or a trailer with a self-supporting body intended for the carriage of dangerous goods, to which the requirements of Chapter 9.2 apply;

"EX/II vehicle" or "EX/III vehicle": means a vehicle intended for the carriage of explosives substances and articles (Class 1);

"FL vehicle": means a vehicle intended for the carriage of liquids having a flash-point of not more than 61°C (with the exception of diesel fuel complying with standard EN 590: 1993, gas oil, and heating oil (light) - UN No.1202 - with a flash-point as specified in standard EN 590: 1993) or flammable gases, in tank-containers, portable tanks or MEGCs of more than 3 m^3 capacity, fixed tanks or demountable tanks of more than 1 m^3 capacity or a battery-vehicle of more than 1 m^3 capacity intended for the carriage of flammable gases;

"OX vehicle": means a vehicle intended for the carriage of hydrogen peroxide, stabilized or hydrogen peroxide, aqueous solution stabilized with more than 60 per cent hydrogen peroxide (Class 5.1, UN No. 2015) in tank-containers or portable tanks of more than 3 m^3 capacity, fixed tanks or demountable tanks of more than 1 m^3 capacity;

"AT vehicle": means a vehicle, other than FL or OX, intended for the carriage of dangerous goods in tank-containers, portable tanks or MEGCs of more than 3 m^3 capacity, fixed tanks or demountable tanks of more than 1 m^3 capacity or a battery vehicle of more than 1 m^3 capacity other than an FL vehicle.

9.1.1.3 Vehicles carrying dangerous goods shall comply with the construction requirements for which this Part provides.

---

[1] *Document of the United Nations Economic Commission for Europe, TRANS/WP.29/78/rev.1, as amended.*

9.1.2 Approval of EX/II, EX/III, FL, OX and AT vehicles

NOTE: *No special certificates of approval shall be required for vehicles other than EX/II, EX/III, FL, OX and AT vehicles, apart from those required by the general safety regulations normally applicable to vehicles in the country of origin.*

9.1.2.1 *Single approval*

9.1.2.1.1 EX/II, EX/III, FL, OX and AT vehicles shall be subject to an annual technical inspection in their country of registration to make sure that they conform to the relevant provisions of this Part, and to the general safety regulations (concerning brakes, lighting, etc.) in force in their country of registration; if these vehicles are trailers or semi-trailers coupled behind a drawing vehicle, the drawing vehicle shall be subject to technical inspection for the same purposes.

When vehicles are required to be fitted with an endurance braking system, the manufacturer of the vehicle or his duly accredited representative shall issue a declaration of conformity with the provisions of 9.2.3.3. This declaration shall be presented at the first technical inspection.

NOTE: *For transitional provisions, see also 1.6.5.1.*

9.1.2.1.2 Conformity of EX/II, EX/III, FL, OX and AT vehicles with the requirements of this Part is subject to a certificate of approval issued by the competent authority of the country of registration for each vehicle whose inspection yields satisfactory results. It shall be drawn up in the language or one of the languages of the country issuing it, and also, if that language is not English, French, or German, in English, French or German, unless agreements concluded between the countries concerned in the transport operation provide otherwise. It shall conform to the model shown in 9.1.2.1.5.

9.1.2.1.3 A certificate of approval issued by the competent authorities of one Contracting Party for a vehicle registered in the territory of that Contracting Party shall be accepted, so long as its validity continues, by the competent authorities of the other Contracting Parties.

9.1.2.1.4 The validity of a certificate of approval shall expire not later than one year after the date of the technical inspection of the vehicle preceding the issue of the certificate. The next approval term shall, however, be related to the last nominal expiry date, if the technical inspection is performed within one month before or after that date. However, in the case of tanks subject to compulsory periodic inspection this provision shall not mean that tightness (leakproofness) tests, hydraulic pressure tests or internal inspections of tanks have to be carried out at intervals shorter than those laid down in Chapters 6.8 and 6.9.

9.1.2.1.5 The certificate of approval shall have the same layout as the model below. Its dimensions shall be 210 mm x 297 mm (format A4). Both front and back shall be used. The colour shall be white, with a pink diagonal stripe. The approval certificate for a vacuum-operated waste tank-vehicle shall bear the following remark: "**vacuum-operated waste tank-vehicle** ".

CERTIFICATE OF APPROVAL FOR VEHICLES CARRYING CERTAIN DANGEROUS GOODS

This certificate testifies that the vehicle specified below fulfils the conditions prescribed by the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR).

1. Certificate No:	**2. Vehicle manufacturer:**	**3. Vehicle Identification No.**	**4. Registration number** (if any):

5. Name and business address of carrier, operator or owner:

6. Description of vehicle: [1]

7. Vehicle designation(s) according to 9.1.1.2 of ADR: [2]

EX/II EX/III FL OX AT

8. Endurance braking system: [3]

- ❑ Not applicable
- ❑ The effectiveness according to 9.2.3.3 of ADR is sufficient for a total mass of the transport unit of _____ t [4]

9. Description of the fixed tank(s)/battery-vehicle (if any):

9.1 Manufacturer of the tank:
9.2 Approval number of the tank/battery-vehicle:
9.3 Tank manufacturer's serial number/Identification of elements of battery-vehicle:
9.4 Year of manufacture:
9.5 Tank code according to 4.3.3.1 or 4.3.4.1 of ADR:
9.6 Special provisions according to 6.8.4 of ADR (if applicable)

10. Dangerous goods authorised for carriage:

The vehicle fulfils the conditions required for the carriage of dangerous goods assigned to the vehicle designation(s) in No. 7.

10.1 In the case of an EX/II or EX?III vehicle [3]

- ❑ goods of Class 1 including compatibility group J
- ❑ goods of Class 1 excluding compatibility group J

10.2 In the case of a tank-vehicle/battery-vehicle [3]

- ❑ only the substances permitted under the tank code and any special provisions specified in No. 9 may be carried [5]

or

- ❑ only the following substances (Class, UN number, and if necessary packing group and proper shipping name) may be carried:

Only substances which are not liable to react dangerously with the materials of the shell, gaskets, equipment and protective linings (if applicable) may be carried.

11. Remarks:

12. Valid until:

Stamp of issuing service

Place, Date, Signature

1 According to the definitions for power-driven vehicles and for trailers of categories N and O as defined in Annex 7 of the Consolidated Resolution on the Construction of Vehicles (R.E.3) or in Directive 97/27/EC.

2 Strike out what is not appropriate.

3 Mark the appropriate.

4 Enter appropriate value. A value of 44t will not limit the "registration / in-service maximum permissible mass" indicated in the registration document(s).

5 Substances assigned to the tank code specified in No. 9 or to another tank code permitted under the hierachy in 4.3.3.1.2 or 4.3.4.1.2, taking account of the special provision(s), if any.

13. Extensions of validity	
Validity extended until	Stamp of issuing service, place, date, signature:

NOTE: This certificate shall be returned to the issuing service when the vehicle is taken out of service; if the vehicle is transferred to another carrier, operator or owner, as specified in No. 5; on expiry of the validity of the certificate; and if there is a material change in one or more essential characteristics of the vehicle.

9.1.2.1.6 Certificates of approval conforming to the requirements of ADR in force up to 30 June 2001 may continue to be used until 31 December 2003.

9.1.2.2 ***Type approval***

9.1.2.2.1 At the request of the manufacturer or his duly accredited representative, base vehicles of new motor vehicles and their trailers which are subject to approval according to 9.1.2.1 may be type approved by a competent authority in accordance with ECE Regulation No. 105 [2] or Directive 98/91/EC [3] provided that the requirements of the said Regulation or the said Directive correspond to those of Chapter 9.2 of this part. This type approval, granted by one Contracting Party, shall be accepted by the other Contracting Parties as ensuring the conformity of the base vehicle when the approval of the complete or completed vehicle is obtained, provided that no modification of the base vehicle alters its validity.

9.1.2.2.2 When the base vehicle has been type-approved, compliance with 9.2.4.7.2, shall be verified on the completed vehicle.

---

[2] *Regulation No. 105 (Uniform provisions concerning the approval of vehicles intended for the carriage of dangerous goods with regard to their specific constructional features)*

[3] *Directive 98/91/EC of the European Parliament and of the Council of 14 December 1998 relating to motor vehicles and their trailers intended for the transport of dangerous goods by road and amending Directive 70/156/EEC relating to the type approval of motor vehicles and their trailers (Official Journal of the European Communities No. L 011 of 16.01.1999, p. 0025 – 0036).*

CHAPTER 9.2

REQUIREMENTS CONCERNING THE CONSTRUCTION OF BASE VEHICLES

9.2.1 Base vehicles of EX/II, EX/III, FL, OX and AT vehicles shall comply with the requirements of this Chapter, according to the table below.

For vehicles other than of EX/II, EX/III, FL, OX and AT:

- the requirements of 9.2.3.1 are applicable to all vehicles first registered after 30 June 1997;

- the requirements of 9.2.5 are applicable to all motor vehicles with a maximum mass exceeding 12 tonnes registered after 31 December 1987.

		VEHICLES					COMMENTS
TECHNICAL SPECIFICATIONS		**EX/II**	**EX/III**	**AT**	**FL**	**OX**	
9.2.2	**ELECTRICAL EQUIPMENT**						
9.2.2.2	Wiring		X	X [a]	X	X	[a] In the case of AT vehicles carrying tank-containers, portable tanks or MEGCs, this requirement shall apply only to vehicles first registered after 30 June 1997. Applicable to all AT vehicles carrying tank-containers, portable tanks or MEGCs as from 1 January 2005.
9.2.2.3	Battery master switch						
9.2.2.3.1			X		X		
9.2.2.3.2			X		X		
9.2.2.3.3					X		
9.2.2.3.4			X		X		
9.2.2.4	Batteries	X	X		X		
9.2.2.5	Permanently energized circuits						
9.2.2.5.1					X		
9.2.2.5.2			X				
9.2.2.6	Electrical installation at rear of cab		X		X		

TECHNICAL SPECIFICATIONS		VEHICLES					COMMENTS
		EX/II	**EX/III**	**AT**	**FL**	**OX**	
9.2.3	**BRAKING EQUIPEMENT**						
9.2.3.1	General provisions	X	X	X	X	X	
9.2.3.2	Anti-lock braking system		X [b, d]	X [b, d]	X [b, d]	X [b, d]	[b] Applicable to vehicles first registered after 30 June 1993 in respect of motor vehicles (tractors and rigid vehicles) having a maximum mass exceeding 16 tonnes and trailers (i.e. full trailers, semi-trailers and centre-axle trailers) with a maximum mass exceeding 10 tonnes. Applicable to motor vehicles authorized to tow trailers with a maximum mass exceeding 10 tonnes, first registered after 30 June 1995. Applicable to all vehicles which are first approved in accordance with 9.1.2 after 30 June 2001 regardless of the date on which they were first registered. [d] Mandatory compliance for all vehicles as from 1 January 2010 .
9.2.3.3	Endurance braking system		X [c, d]	X [c, d]	X [c, d]	X [c, d]	[c] Applicable to all vehicles, except for transport units comprising a motor vehicle and a trailer, in which case the requirement shall apply only to motor vehicles first registered after 30 June 1993 . [d] Mandatory compliance for all vehicles as from 1 January 2010 .
9.2.3.4	Emergency braking devices for trailers						
9.2.3.4.1		X					
9.2.3.4.2			X				

TECHNICAL SPECIFICATIONS		VEHICLES					COMMENTS
		EX/II	**EX/III**	**AT**	**FL**	**OX**	
9.2.4	**PREVENTION OF FIRE RISKS**						
9.2.4.2	Vehicle cab						
9.2.4.2.1		X	X				
9.2.4.2.2						X	
9.2.4.3	Fuel tanks	X	X		X	X	
9.2.4.4	Engine	X	X		X	X	
9.2.4.5	Exhaust system	X	X		X		
9.2.4.6	Vehicle endurance braking		X	X	X	X	
9.2.4.7	Combustion heaters						
9.2.4.7.1 9.2.4.7.2 9.2.4.7.5		X [e]	X [e]	X [e]	X [e]	X [e]	[e] Applicable to motor vehicles equipped after 30 June 1999. Mandatory compliance by 1 January 2010 for vehicles equipped before 1 July 1999 .
9.2.4.7.3 9.2.4.7.4					X [e]		[e] Applicable to motor vehicles equipped after 30 June 1999. Mandatory compliance by 1 January 2010 for vehicles equipped before 1 July 1999.
9.2.4.7.6		X	X				
9.2.5	**SPEED LIMITATION DEVICE**	X [f]	X [f]	X [f]	X [f]	X [f]	[f] Applicable to motor vehicles with a maximum mass exceeding 12 tonnes registered after 31 December 1987.
9.2.6	**COUPLING DEVICE OF TRAILERS**	X	X				

9.2.2 Electrical equipment

9.2.2.1 ***General provisions***

The electrical installation as a whole shall meet the provisions of 9.2.2.2 to 9.2.2.6 in accordance with the table of 9.2.1.

9.2.2.2 ***Wiring***

9.2.2.2.1 The size of conductors shall be large enough to avoid overheating. Conductors shall be adequately insulated. All circuits shall be protected by fuses or automatic circuit breakers, except for the following:

- from the battery to the cold start and stopping systems of the engine;
- from the battery to the alternator;
- from the alternator to the fuse or circuit breaker box;
- from the battery to the starter motor;
- from the battery to the power control housing of the endurance braking system (see 9.2.3.3), if this system is electrical or electromagnetic;
- from the battery to the electrical lifting mechanism for lifting the bogie axle.

The above unprotected circuits shall be as short as possible.

9.2.2.2.2 Cables shall be securely fastened and positioned in such a way that the conductors are adequately protected against mechanical and thermal stresses.

9.2.2.3 ***Battery master switch***

9.2.2.3.1 A switch for breaking the electrical circuits shall be placed as close to the battery as practicable.

9.2.2.3.2 A control device to facilitate the disconnecting and reconnecting functions of the switch shall be installed in the driver's cab. It shall be readily accessible to the driver and be distinctively marked. It shall be protected against inadvertent operation by either adding a protective cover, by using a dual movement control device or by other suitable means. Additional control devices may be installed provided they are distinctively marked and protected against inadvertent operation.

9.2.2.3.3 The switch shall have a casing with protection degree IP 65 in accordance with IEC Standard 529.

9.2.2.3.4 The cable connections on the switch shall have protection degree IP 54. However, this does not apply if these connections are contained in a housing which may be the battery box. In this case it is sufficient to insulate the connections against short circuits, for example with a rubber cap.

9.2.2.4 ***Batteries***

The battery terminals shall be electrically insulated or covered by the insulating battery box cover. If the batteries are not located under the engine bonnet, they shall be fitted in a vented box.

9.2.2.5 ***Permanently energized circuits***

9.2.2.5.1 (a) Those parts of the electrical installation including the leads which shall remain energized when the battery master switch is open, shall be suitable for use in hazardous areas. Such equipment shall meet the general requirements of IEC 60079, parts 0 and 14 [1] and the additional requirements applicable from IEC 60079, parts 1, 2, 5, 6, 7, 11, 15 or 18 [2] ;

(b) For the application of IEC 60079 part 14 [1], the following classification shall be used:

Permanently energized electrical equipment including the leads which is not subject to 9.2.2.3 and 9.2.2.4 shall meet the requirements for Zone 1 for electrical equipment in general or meet the requirements for Zone 2 for electrical equipment situated in the driver's cab. The requirements for explosion group IIC, temperature class T6 shall be met.

9.2.2.5.2 Bypass connections to the battery master switch for electrical equipment which must remain energized when the battery master switch is open shall be protected against overheating by suitable means, such as a fuse, a circuit breaker or a safety barrier (current limiter).

9.2.2.6 ***Provisions concerning that part of the electrical installation situated to the rear of the driver's cab***

The whole installation shall be so designed, constructed and protected such that it cannot provoke any ignition or short-circuit under normal conditions of use of vehicles and that these risks can be minimized in the event of an impact or deformation. In particular:

9.2.2.6.1 *Wiring*

The wiring located to the rear of the driver's cab shall be protected against impact, abrasion and chafing during normal vehicle operation. Examples of appropriate protection are given in figures 1, 2, 3 and 4 below. However, the sensor cables of anti-lock braking devices do not need additional protection.

---

[1] *The requirements of IEC 60079 part 14 do not take precedence over the requirement of this Part.*

[2] *As an alternative, the general requirements of EN 50014 and the additional requirements of EN 50015, 50016, 50017, 50018, 50019, 50020 or 50028 may be used.*

FIGURES

Figure N°1

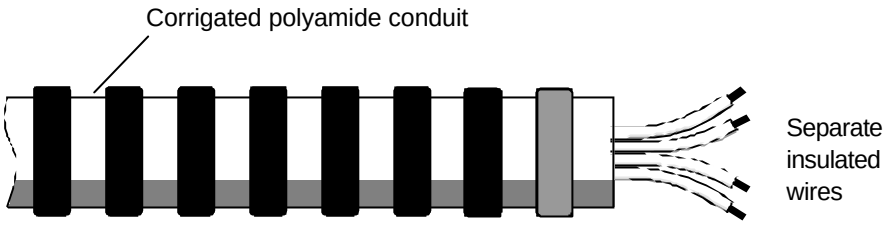


Figure N°2

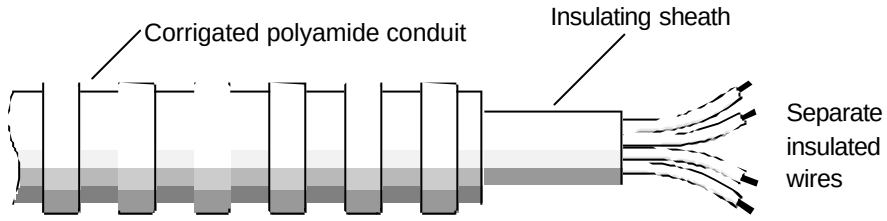


Figure N°3

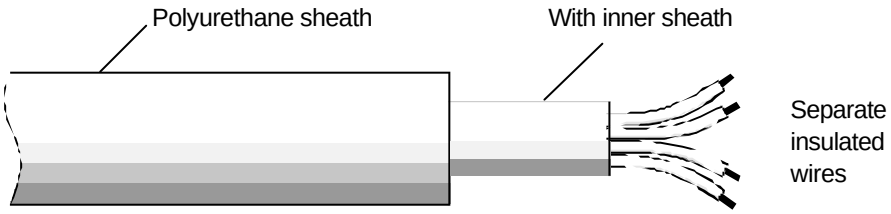
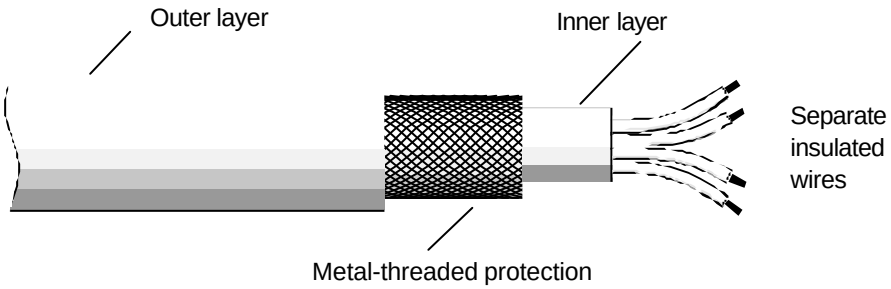


Figure N°4



9.2.2.6.2 *Lighting*

Lamp bulbs with a screw cap shall not be used.

9.2.2.6.3 *Electrical connections*

Electrical connections between motor vehicles and trailers shall have a protection degree IP54 in accordance with IEC standard 529 and be designed to prevent accidental disconnection. Examples of appropriate connections are given in ISO 12 098:1994 and ISO 7638:1985.

9.2.3 Braking equipment

9.2.3.1 ***General provisions***

In addition to the following technical provisions, to be applied in accordance with the table of 9.2.1, motor vehicles and trailers intended for use as transport units for dangerous goods shall fulfil all relevant technical requirements of ECE Regulation No.13 [3] or Directive 71/320/EEC [4], as amended, in accordance with the dates of application specified therein.

9.2.3.2 ***Anti-lock braking system***

9.2.3.2.1 Motor vehicles having a maximum mass exceeding 16 tonnes, or authorized to tow a trailer with a maximum mass exceeding 10 tonnes, shall be equipped with an anti-lock braking system of category 1 according to ECE Regulation No. 13 [5], Annex 13.

9.2.3.2.2 Trailers having a maximum mass exceeding 10 tonnes shall be equipped with an anti-lock braking system of category A according to ECE Regulation No. 13 [5], Annex 13.

9.2.3.3 ***Endurance braking system***

9.2.3.3.1 Endurance braking system means a system intended to stabilize vehicle speed on a long descent, without the use of the service, secondary or parking braking systems.

9.2.3.3.2 Motor vehicles having a maximum mass exceeding 16 tonnes or authorized to tow a trailer with a maximum mass exceeding 10 tonnes shall be fitted with an endurance braking system which complies with the following requirements:

(a) The endurance braking system may be a single device or a combination of several devices. Each device may have its own control;

(b) All three endurance braking control options provided for in paragraph 2.14 of ECE Regulation No. 13 [5] shall be permitted, but, in the case of a failure of the anti-lock system, integrated or combined retarders shall be switched off automatically;

---

[3] *ECE Regulation No. 13 (Uniform provisions concerning the approval of vehicles of categories M, N and O with regard to braking).*

[4] *Directive 71/320/EEC (originally published in the Official Journal of the European Communities No. L202 of 6.9.1971).*

[5] *ECE Regulation No. 13 (Uniform provisions concerning the approval of vehicles of categories M, N and O with regard to braking) or the corresponding provisions of Directive 71/320/EEC (originally published in the Official Journal of the European Communities No. L 202 of 6.9.1971), as amended.*

(c) The effectiveness of the endurance braking system shall be controlled by the anti-lock braking system such that the axle(s) braked by the endurance braking system cannot be locked by the endurance braking system at speeds above 15 km/h. However, this provision shall not apply to that part of the braking system constituted by natural engine braking;

(d) The endurance braking system shall comprise several stages of effectiveness, including a low stage appropriate for the unladen condition. Where the endurance braking system of a motor vehicle is constituted by its engine, the different gear ratios shall be considered to provide the different stages of effectiveness;

(e) The performance of the endurance braking system shall be such that it fulfils the requirements of ECE Regulation No. 13 [5], Annex 5 (Type II A test), with a laden vehicle mass comprising the laden mass of the motor vehicle and its authorized maximum towed mass but not exceeding a total of 44 tonnes;

(f) If the motor vehicle does not fulfil the performance requirements for the endurance braking system as defined in (e) above, it shall at least fulfil the requirements of ECE Regulation No. 13 [5], Annex 5, and shall be restricted to being coupled only to a trailer fitted with an endurance braking system. Such a motor vehicle shall be fitted with a control device for the endurance braking system on the trailer.

9.2.3.3.3 If a trailer is equipped with an endurance braking system it shall fulfil the requirements of ECE Regulation No. 13 [5], Annex 5, and the provisions of 9.2.3.3.2 (a) to (d) above.

9.2.3.4 ***Emergency braking devices for trailers***

9.2.3.4.1 Trailers shall be equipped with an effective system for braking or restraining them if they become detached from the motor vehicle towing them.

9.2.3.4.2 Trailers shall be fitted with an effective braking device which acts on all the wheels, is actuated by the drawing vehicle's service-brake control and automatically stops the trailer in the event of breakage of the coupling.

NOTE: *The use of trailers equipped only with an inertia braking system shall be limited to a maximum load of 50 kg net explosive mass.*

9.2.4 Prevention of fire risks

9.2.4.1 ***General provisions***

The following technical provisions shall apply in accordance with the table of 9.2.1.

[5] *ECE Regulation No. 13 (Uniform provisions concerning the approval of vehicles of categories M, N and O with regard to braking) or the corresponding provisions of Directive 71/320/EEC (originally published in the Official Journal of the European Communities No. L 202 of 6.9.1971), as amended.*

9.2.4.2 ***Vehicle cab***

9.2.4.2.1 Only material not readily flammable shall be used in the construction of the driver's cab. This provision will be deemed to be met if, in accordance with the procedure specified in ISO standard 3795:1989, samples of the following cab components have a burn rate not exceeding 100 mm/min: seat cushions, seat backs, safety belts, head lining, opening roofs, armrests, all trim panels including door, front, rear, and side panels, compartment shelves, head restraints, floor coverings, sun visors, curtains, shades, wheel housing covers, engine compartment covers, mattress covers and any other interior materials, including padding and crash-deployed elements, that are designed to absorb energy on contact by occupants in the event of a crash.

9.2.4.2.2 Unless the driver's cab is made of materials which are not readily flammable, a shield made of metal or other suitable material of the same width as the tank shall be fitted at the rear of the cab. Any windows in the rear of the cab or in the shield shall be hermetically closed and made of fire-resistant safety glass with fire-resistant frames. Furthermore, there shall be a clear space of not less than 15 cm between the tank and the cab or the shield.

9.2.4.3 ***Fuel tanks***

The fuel tanks for supplying the engine of the vehicle shall meet the following requirements:

(a) In the event of any leakage, the fuel shall drain to the ground without coming into contact with hot parts of the vehicle or the load;

(b) Fuel tanks containing petrol shall be equipped with an effective flame trap at the filler opening or with a closure enabling the opening to be kept hermetically sealed.

9.2.4.4 ***Engine***

The engine propelling the vehicle shall be so equipped and situated to avoid any danger to the load through heating or ignition. In the case of EX/II and EX/III vehicles the engine shall be of compression-ignition construction.

9.2.4.5 ***Exhaust system***

The exhaust system as well as the exhaust pipes shall be so directed or protected to avoid any danger to the load through heating or ignition. Parts of the exhaust system situated directly below the fuel tank (diesel) shall have a clearance of at least 100 mm or be protected by a thermal shield.

9.2.4.6 ***Vehicle endurance braking***

Vehicles equipped with endurance braking systems emitting high temperatures placed behind the rear wall of the driver's cab shall be equipped with a thermal shield securely fixed and located between this system and the tank or load so as to avoid any heating, even local, of the tank wall or the load.

In addition, the thermal shield shall protect the braking system against any outflow or leakage, even accidental, of the load. For instance, a protection including a twin-shell shield shall be considered satisfactory.

9.2.4.7 ***Combustion heaters***

9.2.4.7.1 *(Reserved)*

9.2.4.7.2 The combustion heaters and their exhaust gas routing shall be designed, located, protected or covered so as to prevent any unacceptable risk of heating or ignition of the load. This requirement shall be considered as fulfilled if the fuel tank and the exhaust system of the appliance conform to provisions similar to those prescribed for fuel tanks and exhaust systems of vehicles in 9.2.4.3 and 9.2.4.5 respectively.

9.2.4.7.3 The combustion heaters shall be put out of operation by at least the following methods:

(a) Intentional manual switching off from the driver's cab;

(b) Stopping of the vehicle engine; in this case the heating device may be restarted manually by the driver;

(c) Start up of a feed pump on the motor vehicle for the dangerous goods carried.

9.2.4.7.4 After running is permitted after the combustion heaters have been put out of operation. For the methods of 9.2.4.7.3 (b) and (c) the supply of combustion air shall be interrupted by suitable measures after an afterrunning cycle of not more than 40 seconds. Only heaters shall be used for which proof has been furnished that the heat exchanger is resistant to the reduced afterrunning cycle of 40 seconds for the time of their normal use.

9.2.4.7.5 The combustion heater shall be switched on manually. Programming devices shall be prohibited.

9.2.4.7.6 Combustion heaters with gaseous fuels are not permitted.

9.2.5 **Speed limitation device**

Motor vehicles (rigid vehicles and tractors for semi-trailers) with a maximum mass exceeding 12 tonnes, shall be equipped with a speed limitation device according to the technical requirements of ECE Regulation No. 89 [6], as amended. The set speed V as defined in paragraph 2.1.2 of ECE Regulation No. 89 [6] shall not exceed 85 km/h.

---

[6] *ECE Regulations No. 89: uniform provisions concerning the approval of:*

I. Vehicles with regard to limitation of their maximum speed;
II. Vehicles with regard to the installation of a speed limitation device (SLD) of an approved type;
III. Speed limitation devices (SLD).

As an alternative, the corresponding provisions of directive 92/6/EEC of the Council of 10 February 1992 (originally published in the Official Journal of the European Communities No. L 057 of 02.03.1992) and directive 92/24/EEC of the Council of 31 March 1992 (originally published in the Official Journal of the European Communities No. L 129 of 14.05.1992), as amended, may apply provided that they have been amended in accordance with the latest amended form of ECE Regulation No. 89 applicable at the time of the vehicle approval.

9.2.6 Coupling devices of trailers

Coupling devices of trailers shall comply with the technical requirements of ECE Regulation No. 55 [7] or Directive 94/20/EC [8], as amended, in accordance with the dates of application specified therein.

[7] *ECE Regulation No. 55 (Uniform provisions concerning the approval of mechanical coupling components of combinations of vehicles).*

[8] *Directive 94/20/EC of the European parliament and of the Council of 30 of May 1994 (originally published in the Official Journal of the European Communities No. L 195 of 29.07.1994).*

CHAPTER 9.3

ADDITIONAL REQUIREMENTS CONCERNING COMPLETE OR COMPLETED EX/II OR EX/III VEHICLES

9.3.1 Materials to be used in the construction of vehicle bodies

No materials likely to form dangerous compounds with the explosive substances carried shall be used in the construction of the body.

9.3.2 Combustion heaters

Combustion heaters shall not be installed in load compartments of EX/II and EX/III vehicles.

Combustion heaters shall meet the requirements of 9.2.4.7.1, 9.2.4.7.2, 9.2.4.7.5, 9.2.4.7.6 and the following:

(a) The switch may be installed outside the driver's cab;

(b) The device may be switched off from outside the load compartment; and

(c) It is not necessary to prove that the heat exchanger is resistant to the reduced after running cycle.

No fuel tanks, power sources, combustion air or heating air intakes as well as exhaust tube outlets required for the operation of the combustion heater shall be installed in the load compartment. It shall be ensured that the heating air outlet cannot be blocked by cargo. The temperature to which packages are heated shall not exceed 50 ºC.

9.3.3 EX/II vehicles

The vehicles shall be designed, constructed and equipped so that the explosives are protected from external hazards and the weather. They shall be either closed or sheeted. Sheeting shall be resistant to tearing and be of impermeable material, not readily flammable. It shall be tautened so as to cover the vehicle on all sides, with an overlap of not less than 20 cm down the sides of the vehicle, and be kept in position by a lockable device.

The load carrying compartment of closed vehicles shall not have windows and all openings shall have lockable, close-fitting doors or covers.

9.3.4 EX/III vehicles

These vehicles shall be closed. The loading surface, including the front wall, shall be continuous. The insulating and heat resisting properties of the body shall be at least equivalent to those of a partition consisting of a metal outer wall lined with a layer of fire-proofed wood of 10 mm thickness; or the body shall be of a construction which shall ensure that no flame penetration of the wall or hot spots of more than 120 °C on the inner wall surface will occur within 15 minutes from the start of a fire resulting from the operation of the vehicle, such as a tyre fire. All the doors shall be capable of being locked. They shall be so placed and constructed as to overlap the joints.

9.3.5 Load compartment and engine

The engine shall be placed forward of the front wall of the load compartment; it may nevertheless be placed under the load compartment, provided this is done in such a way that

any excess heat does not constitute a hazard to the load by raising the temperature on the inner surface of the load compartment above 80 ºC.

9.3.6 Load compartment and exhaust system

The exhaust system of EX/II and EX/III vehicles or others parts of these complete or completed vehicles shall be so constructed and situated that any excess heat shall not constitute a hazard to the load by raising the temperature on the inner surface of the load compartment above 80 ºC.

9.3.7 Electrical equipment

9.3.7.1 The electrical installation on EX/III vehicles shall meet the requirements of 9.2.2.2, 9.2.2.3, 9.2.2.4, 9.2.2.5.2 and 9.2.2.6.

9.3.7.2 The rated voltage of the electrical system shall not exceed 24V.

9.3.7.3 The electrical installation in the load compartment shall be dust-protected (at least IP54 or equivalent) or, in the case of Compatibility Group J, at least IP65 (e.g. flame-proof Eex d).

CHAPTER 9.4

ADDITIONAL REQUIREMENTS CONCERNING THE CONSTRUCTION OF THE BODIES OF COMPLETE OR COMPLETED VEHICLES INTENDED FOR THE CARRIAGE OF DANGEROUS GOODS IN PACKAGES (OTHER THAN EX/II AND EX/III VEHICLES)

9.4.1 Combustion heaters shall meet the following requirements:

(a) The switch may be installed outside the driver's cab;

(b) The device may be switched off from outside the load compartment; and

(c) It is not necessary to prove that the heat exchanger is resistant to the reduced after running cycle.

9.4.2 If the vehicle is intended for the carriage of dangerous goods for which a label conforming to models Nos. 1, 1.4, 1.5, 1.6, 3, 4.1, 4.3, 5.1 or 5.2 is prescribed, no fuel tanks, power sources, combustion air or heating air intakes as well as exhaust tube outlets required for the operation of the combustion heater shall be installed in the load compartment. It shall be ensured that the heating air outlet cannot be blocked by cargo. The temperature to which packages are heated shall not exceed 50º C. Heating devices installed inside the load compartments shall be designed so as to prevent the ignition of an explosive atmosphere under operating conditions.

9.4.3 Additional requirements concerning the construction of the bodies of vehicles intended for the carriage of given dangerous goods or specific packagings may be included in Part 7, Chapter 7.2 in accordance with the indications in Column (16) of Table A of Chapter 3.2, for a given substance.

CHAPTER 9.5

ADDITIONAL REQUIREMENTS CONCERNING THE CONSTRUCTION OF THE BODIES OF COMPLETE OR COMPLETED VEHICLES INTENDED FOR THE CARRIAGE OF DANGEROUS SOLIDS IN BULK

9.5.1 Combustion heaters shall meet the following requirements:

(a) The switch may be installed outside the driver's cab;

(b) The device may be switched off from outside the load compartment; and

(c) It is not necessary to prove that the heat exchanger is resistant to the reduced after running cycle.

9.5.2 If the vehicle is intended for the carriage of dangerous goods for which a label conforming to models Nos. 4.1, 4.3 or 5.1 is prescribed, no fuel tanks, power sources, combustion air or heating air intakes as well as exhaust tube outlets required for the operation of the combustion heater shall be installed in the load compartment. It shall be ensured that the heating air outlet cannot be blocked by cargo. The temperature to which the load is heated shall not exceed 50 ºC. Heating devices installed inside the load compartments shall be designed so as to prevent the ignition of an explosive atmosphere under operating conditions.

9.5.3 Additional requirements concerning the construction of the bodies of vehicles intended for the carriage of dangerous solids in bulk may appear in Part 7, Chapter 7.3 in accordance with the indications in Column (17) of Table A of Chapter 3.2, for a given substance.

CHAPTER 9.6

ADDITIONAL REQUIREMENTS CONCERNING COMPLETE OR COMPLETED VEHICLES INTENDED FOR THE CARRIAGE OF TEMPERATURE CONTROLLED SELF-REACTIVE SUBSTANCES OF CLASS 4.1 AND ORGANIC PEROXIDES OF CLASS 5.2

9.6.1 Insulated, refrigerated and mechanically-refrigerated vehicles intended for the carriage of temperature controlled self-reactive substances of Class 4.1 and organic peroxides of Class 5.2 shall conform to the following conditions:

(a) the vehicle shall be such and so equipped as regards its insulation and means of refrigeration, that the control temperature prescribed in 2.2.41.1.17 and 2.2.52.1.16 and in 2.2.41.4 and 2.2.52.4 for the substance to be carried is not exceeded. The overall heat transfer coefficient shall be not more than 0.4 W/m^2K;

(b) the vehicle shall be so equipped that vapours from the substances or the coolant carried cannot penetrate into the driver's cab;

(c) a suitable device shall be provided enabling the temperature prevailing in the loading space to be determined at any time from the cab;

(d) the loading space shall be provided with vents or ventilating valves if there is any risk of a dangerous excess pressure arising therein. Care shall be taken where necessary to ensure that refrigeration is not impaired by the vents or ventilating valves;

(e) the refrigerant shall not be flammable; and

(f) the refrigerating appliance of a mechanically refrigerated vehicle shall be capable of operating independently of the engine used to propel the vehicle.

9.6.2. Suitable methods (see V8(3)) to prevent the control temperature from being exceeded are listed in Chapter 7.2 (R1 to R5). Depending on the method used, additional provisions concerning the construction of vehicle bodies may be included in Chapter 7.2.

CHAPTER 9.7

ADDITIONAL REQUIREMENTS CONCERNING FIXED TANKS (TANK-VEHICLES) BATTERY-VEHICLES AND COMPLETE OR COMPLETED VEHICLES USED FOR THE CARRIAGE OF DANGEROUS GOODS IN DEMOUNTABLE TANKS WITH A CAPACITY GREATER THAN 1 M^3 OR IN TANK-CONTAINERS, PORTABLE TANKS OR MEGCs OF A CAPACITY GREATER THAN 3 M^3 (FL, OX AND AT VEHICLES)

9.7.1 General provisions

9.7.1.1 In addition to the vehicle proper, or the units of running gear used in its stead, a tank-vehicle comprises one or more shells, their items of equipment and the fittings for attaching them to the vehicle or to the running-gear units.

9.7.1.2 Once the demountable tank has been attached to the carrier vehicle, the entire unit shall meet the requirements prescribed for tank-vehicles.

9.7.2 Requirements concerning tanks

9.7.2.1 Fixed tanks or demountable tanks made of metal shall meet the relevant requirements of Chapter 6.8.

9.7.2.2 Elements of battery-vehicles and of MEGCs shall meet the relevant requirements of Chapter 6.2 in the case of cylinders, tubes, pressure drums and bundles of cylinders and the requirements of Chapter 6.8 in the case of tanks.

9.7.2.3 Tank-containers made of metal shall meet the requirements of Chapter 6.8, portable tanks shall meet the requirements of Chapter 6.7 or, if applicable, those of the IMDG Code (see 1.1.4.2).

9.7.2.4 Tanks made of fibre-reinforced plastics material shall meet the requirements of Chapter 6.9.

9.7.2.5 Vacuum-operated waste tank-vehicles shall meet the requirements of Chapter 6.10.

9.7.3 Fastenings

Fastenings shall be designed to withstand static and dynamic stresses in normal conditions of carriage, and minimum stresses as defined in 6.8.2.1.2, 6.8.2.1.11 to 6.8.2.1.15 and 6.8.2.1.16 in the case of tank-vehicles, battery-vehicles, and vehicles carrying demountable tanks.

9.7.4 Earthing of FL vehicles

Tanks made of metal or of fibre-reinforced plastics material of FL tank-vehicles and battery elements of FL battery-vehicles shall be linked to the chassis by means of at least one good electrical connection. Any metal contact capable of causing electrochemical corrosion shall be avoided.

NOTE: *See also 6.9.1.2 and 6.9.2.14.3.*

9.7.5 Stability of tank-vehicles

9.7.5.1 The overall width of the ground-level bearing surface (distance between the outer points of contact with the ground of the right-hand tyre and the left-hand tyre of the same axle) shall be at least equal to 90% of the height of the centre of gravity of the laden tank-vehicle. In an articulated vehicle the mass on the axles of the load-carrying unit of the laden semi-trailer shall not exceed 60% of the nominal total laden mass of the complete articulated vehicle.

9.7.5.2 In addition, tank-vehicles with fixed tanks with a capacity of more than 3 m^3 intended for the carriage of dangerous goods in the liquid or molten state tested with a pressure of less than 4 bar, shall comply with the technical requirements of ECE Regulation No. 111 [1] for lateral stability, as amended, in accordance with the dates of application specified therein. The requirements are applicable to tank-vehicles which are first registered as from 1 July 2003.

9.7.6 Rear protection of vehicles

A bumper sufficiently resistant to rear impact shall be fitted over the full width of the tank at the rear of the vehicle. There shall be a clearance of at least 100 mm between the rear wall of the tank and the rear of the bumper (this clearance being measured from the rearmost point of the tank wall or from projecting fittings or accessories in contact with the substance being carried). Vehicles with a tilting shell for the carriage of powdery or granular substances and a vacuum-operated waste tank with a tilting shell with rear discharge do not require a bumper if the rear fittings of the shell are provided with a means of protection which protects the shell in the same way as a bumper.

NOTE 1: *This provision does not apply to vehicles used for the carriage of dangerous goods in tank-containers, MEGCs or portable tanks.*

NOTE 2: *For the protection of tanks against damage by lateral impact or overturning, see 6.8.2.1.20 and 6.8.2.1.21 or, for portable tanks, 6.7.2.4.3 and 6.7.2.4.5.*

9.7.7 Combustion heaters

9.7.7.1 Combustion heaters shall meet the requirements of 9.2.4.7.1, 9.2.4.7.2, 9.2.4.7.5 and the following:

(a) The switch may be installed outside the driver's cab;

(b) The device may be switched off from outside the load compartment; and

(c) It is not necessary to prove that the heat exchanger is resistant to the reduced afterrunning cycle.

In addition for FL vehicles, they shall meet the requirements of 9.2.4.7.3 and 9.2.4.7.4.

[1] *ECE Regulation No. 111: Uniform provisions concerning the approval of tank-vehicles of categories N and O with regard to rollover stability.*

9.7.7.2 If the vehicle is intended for the carriage of dangerous goods for which a label conforming to models Nos. 3, 4.1, 4.3, 5.1 or 5.2 is prescribed, no fuel tanks, power sources, combustion air or heating air intakes as well as exhaust tube outlets required for the operation of the combustion heater shall be installed in the load compartment. It shall be ensured that the heating air outlet cannot be blocked by cargo. The temperature to which the load is heated shall not exceed 50 ºC. Heating devices installed inside the load compartments shall be designed so as to prevent the ignition of an explosive atmosphere under operating conditions.

9.7.8 Electrical equipment

9.7.8.1 The electrical installation on FL vehicles for which an approval according to 9.1.2 is required shall meet the requirements of 9.2.2.2, 9.2.2.3, 9.2.2.4, 9.2.2.5.1 and 9.2.2.6.

However additions to or modifications of the electrical installations of the vehicle shall meet the requirements for the electrical apparatus of the relevant group and temperature class according to the substances to be carried.

NOTE: *For transitional provisions, see also 1.6.6.*

9.7.8.2 Electrical equipment on FL vehicles, situated in areas where an explosive atmosphere is, or may be expected to be, present in such quantities as to require special precautions, shall be suitable for use in a hazardous area. Such equipment shall meet the general requirements of IEC 60079 parts 0 and 14 and the additional requirements applicable form IEC 60079 parts 1, 2, 5, 6, 7, 11 or 18 [2]. The requirements for the electrical apparatus of the relevant group and temperature class according to the substances to be carried shall be met.

For the application of IEC 60079 part 14 [2], the following classification shall be used:

ZONE 0

Inside tank compartments, fittings for filling and discharge and vapour recovery lines.

ZONE 1

Inside cabinets for equipment used for filling and discharge and within 0.5 m of venting devices and pressure relief safety valves.

9.7.8.3 Permanently energized electrical equipment, including the leads, which is situated outside Zones 0 and 1 shall meet the requirements for Zone 1 for electrical equipment in general or meet the requirements for Zone 2 electrical equipment situated in the driver's cab. The requirements for the relevant group of electrical apparatus according to the substances to be carried shall be met.

[2] *As an alternative, the general requirements of EN 50014 and the additional requirements of EN 50015, 50016, 50017, 50018, 50019, 50020 or 50028 may be used.*

Restructured

ADR

2001

The European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR), done at Geneva on 30 September 1957 under the auspices of the United Nations Economic Commission for Europe, is intended to increase the safety of international transport of dangerous goods by road. It entered into force on 29 January 1968 and has now 36 Contracting Parties.

Its Annexes A and B, which contain the conditions under which dangerous goods, when authorized for transport. may be carried inter nationally, are regularly examined, amended and updated to adapt to technological and industrial progress.

The restructured ADR, applicable as from 1 July 2001, is the final result of eight years of work aiming at presenting Annexes A and B in a more accessible and user-friendly format:

-the duties of the various participants in the transport chain have been identified more clearly, and the requirements concerning these various participants have been systematically grouped;

-the new structure is consistent with that of the United Nations Recommendations on the Transport of Dangerous Goods, Model Regulations, the International Maritime Dangerous Goods Code (of the International Maritime Organization), the lechnical Inst ructionsfer the Safe Transport of Dangerous Goods by Air (of the International Civil Aviation Organization) and the Regulations concerning the International Carriage of Dangerous Goods by Rail (of the Intergovernmental Organisation for International Carriage by Rail). This uniformity should facilitate compliance by consignors and carriers involved in multimodal transport operations.

Annexes A and B of ADR are also annexed to the European Union Council Directive 94/55/EC of 21 November 1994 which applies to the transport of dangerous goods by road within and between Member States of the European Union. These Member States are required, under Commission Directive 200 1/7/EC of 29 January 2001, to make the restructured Annexes A and B applicable by 31 December 2001 for radioactive material and by 31 December 2002 for other dangerous goods.

Printed at United Nations Geneva
GE.01-20870-March 2001-8,470

United Nations Publication
Sales No E.01.VIII.1

Complete set of two volumes: ISBN 92-1-139069-9
Volumes I and II not to be sold separately

ECE/TRANS/140 (Vol.II)

ISBN 92-1-139071-0 (Vol. II)