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Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals

Report of the Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals on its tenth session

held in Geneva on 11 December 2020

Addendum

Annex I

Amendments to the twenty-first revised edition of the Recommendations on the Transport of Dangerous Goods, Model Regulations (ST/SG/AC.10/1/Rev.21)

Recommendations

Paragraph 8 After “ST/SG/AC.10/11/Rev.7”, insert “and Amend.1”.

Chapter 1.1

In Note 1, after “ST/SG/AC.10/11/Rev.7”, insert “and Amend.1”.

Chapter 1.2

1.2.1 In the definition for “*Bundle of cylinders*” replace “an assembly of cylinders” by “a pressure receptacle comprising an assembly of cylinders or cylinder shells”.

Add the following new note under the definition of “*Closure*”:

“***NOTE:*** *For pressure receptacles, closures are, for example, valves, pressure relief devices, pressure gauges or level indicators.*”

Amend the definition for “*Cryogenic receptacle*” to read as follows:

“*Closed cryogenic receptacle* means a thermally insulated pressure receptacle for refrigerated liquefied gases of a water capacity of not more than 1 000 litres;”

In the definition for “*Cylinder*”, delete “transportable”.

In the definition of “*GHS*”, replace “eighth” by “ninth” and replace “ST/SG/AC.10/30/Rev.8” by “ST/SG/AC.10/30/Rev.9”.

In the definition of “*Liquid*”, in footnote 1, replace “ECE/TRANS/275 (Sales No. E.18.VIII.1)” by “ECE/TRANS/300 (Sales No. E.21.VIII.1)”.

In the definition of “*Manual of Tests and Criteria*”, after “ST/SG/AC.10/11/Rev.6”, insert “and Amend.1”.

In the definition for “*Metal hydride storage system*”, replace “receptacle” by “pressure receptacle shell”.

In the definition for “*Pressure drum*”, delete “transportable”.

In the definition for “*Pressure receptacle*”, after “*Pressure receptacle*”, add “means a transportable receptacle intended for holding substances under pressure including its closure(s) and other service equipment and”.

In the definition of “*Recycled plastics material*”, at the end of the Note, add the following new sentence: “*These guidelines have been developed based on the experience of the manufacturing of drums and jerricans from recycled plastics material and as such may need to be adapted for other types of packagings, IBCs and large packagings made of recycled plastics material.*”.

In the definition for “*Tank*”, delete “(see 6.7.2.1)”.

In the definition for “*Tube*”, delete “transportable”.

Amend the definition for “*Working pressure*” to read as follows:

“*Working pressure*

(a) For a compressed gas, means the settled pressure at a reference temperature of 15 °C in a full pressure receptacle;

(b) For UN 1001 acetylene, dissolved, means the calculated settled pressure at a uniform reference temperature of 15 °C in an acetylene cylinder containing the specified solvent content and the maximum acetylene content;

(c) For UN 3374 acetylene, solvent free, means the working pressure which was calculated for the equivalent cylinder for UN 1001 acetylene, dissolved.”

1.2.1 Add the following new definitions:

"*IAEA Regulations for the Safe Transport of Radioactive Material* means one of the editions of those Regulations, as follows:

(a) For the 1985, 1985 (as amended 1990) editions: IAEA Safety Series No. 6

(b) For the 1996 edition: IAEA Safety Series No. ST-1

(c) For the 1996 (revised) edition: IAEA Safety Series No. TS-R-1 (ST-1, Revised)

(d) For the 1996 (as amended 2003), 2005, 2009 editions: IAEA Safety Standards Series No. TS-R-1

(e) For the 2012 edition: IAEA Safety Standards Series No. SSR-6

(f) For the 2018 edition: IAEA Safety Standards Series No. SSR-6 (Rev.1);"

"Inner vessel, for a closed cryogenic receptacle, means the pressure vessel intended to contain the refrigerated liquefied gas;"

"Pressure receptacle shell means a cylinder, a tube a pressure drum or a salvage pressure receptacle without its closures or other service equipment, but including any permanently attached device(s) (e.g. neck ring, foot ring, etc.);

***NOTE:** The terms "cylinder shell", "pressure drum shell" and "tube shell" are also used."*

"Service equipment of a pressure receptacle means closure(s), manifold(s), piping, porous, absorbent or adsorbent material and any structural devices, e.g. for handling;"

1.2.2.1 In the table, after the entry for "Power", add the following new entry:

Electrical resistance	Ω (ohm)	--	$1\ \Omega = 1\ kg \cdot m^2 / s^3 / A^2$

Chapter 1.4

1.4.3.2.3 Delete footnotes 1 and 2. After "Convention on Physical Protection of Nuclear Material", add "(INFCIRC/274/Rev.1, IAEA, Vienna (1980))". After ""Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities"", add "(INFCIRC/225/Rev.5, IAEA, Vienna (2011))".

Chapter 1.5

1.5.1.1 Amend the second sentence to read "These Regulations are based on the 2018 edition of the IAEA Regulations for the Safe Transport of Radioactive Material".

Chapter 2.4

2.4.2.3.2.3 In the last sentence, after "The formulations" add "not listed in this provision but".

In the table, add the following new entry in proper order:

(7-METHOXY-5-METHYL-BENZOTHIOPHEN-2-YL) BORONIC ACID	88-100	OP7			3230	(11)

Under the table, add the following new table note:

"(11) The technical compound with the specified concentration limits may contain up to 12 % water and up to 1 % organic impurities."

Chapter 2.5

2.5.3.2.4 In the last sentence, after “The formulations” add “not listed in this provision but”.

In the table, add the following new entries in proper order:

ACETYL ACETONE PEROXIDE	≤ 35	≥ 57			≥ 8	OP8			3107	32)
tert-BUTYLPEROXY ISOPROPYLCARBONATE	≤ 62		≥ 38			OP7			3105	
tert-HEXYL PEROXYPIVALATE	≤ 52 as a stable dispersion in water					OP8	+15	+20	3117	

In the list of “Notes on 2.5.3.2.4” add the following entry:

“*32) Active oxygen ≤ 4.15 %*”

Chapter 2.6

In Note 2 under the title of the Chapter, at the end, add “*or UN 3462*”.

Chapter 2.7

2.7.2.3.1.4 Delete and add “2.7.2.3.1.4 *Deleted*.”.

2.7.2.3.1.5 Delete and add “2.7.2.3.1.5 *Deleted*.”.

2.7.2.3.4 Amend to read “*Low dispersible radioactive material*”.

2.7.2.3.4.1 (c) In the first sentence, replace “2.7.2.3.1.4” by “2.7.2.3.4.3”.

2.7.2.3.4.3 Insert a new paragraph 2.7.2.3.4.3 to read as follows:

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

Renumber current paragraph 2.7.2.3.4.3 to 2.7.2.3.4.4 and replace “2.7.2.3.4.1 and 2.7.2.3.4.2” by “2.7.2.3.4.1, 2.7.2.3.4.2 and 2.7.2.3.4.3”.

Chapter 2.8

2.8.3.2 In the second sentence, replace “OECD Test Guidelines[1,2,3,4]” by “OECD Test Guidelines Nos. 404[1], 435[2], 431[3] or 430[4]”. In the third sentence, replace “OECD Test Guidelines[1,2,3,4]” by “one of these or non-classified in accordance with OECD Test Guideline No. 439[5],”. In the fourth sentence, delete “*in vitro*”. At the end, add the following new sentence: “If the test results indicate that the substance or mixture is corrosive, but the test method does not allow discrimination between packing groups, it shall be assigned to packing group I if no other test results indicate a different packing group.”.

Add a footnote 5 to read “[5] *OECD Guideline for the testing of chemicals No. 439 “In Vitro Skin Irritation: Reconstructed Human Epidermis Test Method” 2015*”.

2.8.3.3 (c) (ii) Replace “ISO 3574 or Unified Numbering System (UNS) G10200 or a similar type” by “ISO 3574, Unified Numbering System (UNS) G10200”.

Chapter 2.9

2.9.3.4.3.4 (a) After (i), add a new note to read as follows:

"***NOTE:*** *In this situation, when ECx or NOEC of the tested mixture > 0.1 mg/l, there is no need to classify for long-term hazard under these Regulations.*"

2.9.4 (g) Amend the beginning of the sentence to read "Except for button cells installed in equipment (including circuit boards), manufacturers...".

Chapter 3.2, dangerous goods list

For UN 1002, in column (6), add "397".

For UN 1012, in column (6), add "398".

Delete the two entries for UN 1169.

For UN 1197, packing groups II and III, amend column (2) to read "EXTRACTS, LIQUID, for flavour or aroma".

For UN 1891, in column (3), replace "6.1" by "3". In column (4), add "6.1". In column (7a), replace "100 ml" by "1 L". In column (7b), replace "E4" by "E2".

For UN 3208, packing group II, in column (7b), replace "E0" by "E2".

For UN 3209, packing group II, in column (7b), replace "E2" by "E0".

For UN 3269, packing groups II and III, and UN 3527, packing groups II and III, in column (7b), replace "E0" by "See SP 340 in Chapter 3.3".

For UN 3538, in column (6), add "396".

Add the following new entry:

3550	COBALT DIHYDROXIDE POWDER, containing not less than 10 % respirable particles	6.1		I		0	E5	P002 IBC07	B1, B20	T6	TP33

Chapter 3.3

SP 188 (f) Delete note 1 and renumber "***NOTE 2***" to "***NOTE***".

SP 225 After (a), insert the following new note:

"***NOTE:*** *This entry applies to portable fire extinguishers, even if some components that are necessary for their proper functioning (e.g. hoses and nozzles) are temporarily detached, as long as the safety of the pressurized extinguishing agent containers is not compromised and the fire extinguishers continue to be identified as a portable fire extinguisher.*"

Add the following new special provisions:

"396 Large and robust articles may be transported with connected gas cylinders with the valves open regardless of 4.1.6.1.5 provided:

(a) The gas cylinders contain nitrogen of UN 1066 or compressed gas of UN 1956 or compressed air of UN 1002;

(b) The gas cylinders are connected with the article through pressure regulators and fixed piping in such a way that the pressure of the gas (gauge pressure) in the article does not exceed 35 kPa (0.35 bar);

(c) The gas cylinders are properly secured so that they cannot move in relation to the article and are fitted with strong and pressure resistant hoses and pipes;

(d) The gas cylinders, pressure regulators, piping and other components are protected from damage and impacts during transport by wooden crates or other suitable means;

(e) The transport document includes the following statement “Transport in accordance with special provision 396”;

(f) Cargo transport units containing articles transported with cylinders with open valves containing a gas presenting a risk of asphyxiation are well ventilated and are marked in accordance with 5.5.3.6.”

“397 Mixtures of nitrogen and oxygen containing not less than 19.5 % and not more than 23.5 % oxygen by volume may be transported under this entry when no other oxidizing gases are present. A Division 5.1 subsidiary hazard label is not required for any concentrations within this limit.”

“398 This entry applies to mixtures of butylenes, 1-butylene, cis-2-butylene and trans-2-butylene. For isobutylene, see UN 1055.”

Alphabetical index

In the Notes to the Index, note 2, after “tert”;”, add “the prefixes “cis” and “trans”;”.

Amend the entry for “EXTRACTS, AROMATIC, LIQUID” to read as follows:

Extracts, aromatic, liquid, see	3	1197

Amend the entry for “EXTRACTS, FLAVOURING, LIQUID” to read as follows:

Extracts, flavouring, liquid, see	3	1197

Add the following new entries in alphabetical order:

1-butylene, see	2.1	1012
cis-2-butylene, see	2.1	1012
trans-2-butylene, see	2.1	1012
COBALT DIHYDROXIDE POWDER, containing not less than 10 % respirable particles	6.1	3550
EXTRACTS, LIQUID, for flavour or aroma	3	1197

Chapter 4.1

4.1.1.15 Add a note at the end to read as follows:

“***NOTE:*** *For composite IBCs the period of use refers to the date of manufacture of the inner receptacle.*”

4.1.1.19.2 Delete the second sentence. In the fourth sentence, replace “1 000” by “3 000”.

4.1.3.3 Add a new last sentence to read as follows:

“Where packagings which need not meet the requirements of 4.1.1.3 (e.g., crates, pallets, etc.) are authorized in a packing instruction or the special provisions named in the dangerous goods list, these packages are not subject to the mass or volume limits generally applicable to packagings conforming to the requirements of Chapter 6.1, unless otherwise indicated in the relevant packing instruction or special provision.”

4.1.4.1, P003 Under special packing provision PP32, add a new Note to read as follows:

*“**NOTE:** The packagings authorized may exceed a net mass of 400 kg (see 4.1.3.3).”*

4.1.4.1, P004 At the end, after (3), add a new Note to read as follows:

*“**NOTE:** The packagings authorized in (2) and (3) may exceed a net mass of 400 kg (see 4.1.3.3).”*

4.1.4.1, P005 In the second row after the heading row, under the second paragraph, add a new Note to read as follows:

*"**NOTE:** The packagings authorized may exceed a net mass of 400 kg (see 4.1.3.3)."*

4.1.4.1, P006 (2) At the end, add a new Note to read as follows:

*"**NOTE:** The packagings authorized may exceed a net mass of 400 kg (see 4.1.3.3)."*

4.1.4.1, P130 Under special packing provision PP67, add a new Note to read as follows:

*"**NOTE:** The packagings authorized may exceed a net mass of 400 kg (see 4.1.3.3)."*

4.1.4.1, P137 In special packing provision PP70, first sentence, replace "in accordance with 5.2.1.7.1" by "as illustrated in figures 5.2.3 or 5.2.4".

4.1.4.1, P144 Under special packing provision PP77, add a new Note to read as follows:

*"**NOTE:** The packagings authorized may exceed a net mass of 400 kg (see 4.1.3.3)."*

4.1.4.1, P200 (5) In special packing provision "d", after "steel pressure receptacles", insert "or composite pressure receptacles with steel liners".

In special packing provision "z", at the end, add the following:

"Mixtures of fluorine and nitrogen with a fluorine concentration below 35 % by volume may be filled in pressure receptacles up to a maximum allowable working pressure for which the partial pressure of fluorine does not exceed 31 bar (abs.).

$$working\ pressure\ (\text{bar}) < \frac{31}{x_f} - 1$$

in which x_f = fluorine concentration in % by volume/100.

Mixtures of fluorine and inert gases with a fluorine concentration below 35 % by volume may be filled in pressure receptacles up to a maximum allowable working pressure for which the partial pressure of fluorine does not exceed 31 bar (abs.), additionally taking the coefficient of nitrogen equivalency in accordance with ISO 10156:2017 into account when calculating the partial pressure.

$$working\ pressure\ (\text{bar}) < \frac{31}{x_f}\left(x_f + K_k \times x_k\right) - 1$$

in which x_f = fluorine concentration in % by volume/100;

K_k = coefficient of equivalency of an inert gas relative to nitrogen (coefficient of nitrogen equivalency);

x_k = inert gas concentration in % by volume/100.

However, the working pressure for mixtures of fluorine and inert gases shall not exceed 200 bar. The minimum test pressure of pressure receptacles for mixtures of fluorine and inert gases equals 1.5 times the working pressure or 200 bar, with the greater value to be applied."

4.1.4.1, P200 In table 2:

- For UN 1008, replace "387" by "864" in column "LC_{50} ml/m^3".
- For UN 2196, replace "160" by "218" in column "LC_{50} ml/m^3", insert "X" in columns "Tubes", "Pressure drums" and "MEGCs", and delete ", k" in column "Special packing provisions".
- For UN 2198, replace "190" by "261" in column "LC_{50} ml/m^3", insert "X" in columns "Tubes", "Pressure drums" and "MEGCs", and delete "k" in column "Special packing provisions" (twice).

In table 3, for UN 1052, replace "966" by "1307" in column "LC_{50} in ml/m^3".

4.1.4.1, P205 (5), (6) and (7) Replace ISO "16111:2008" by "ISO 16111:2008 or ISO 16111:2018".

4.1.4.1, P205 (7) At the end, add the following new sentence: “See 6.2.2.4 to determine which standard is applicable at the time of periodic inspection and test.”.

4.1.4.1, P208 (1)(a) Replace “ISO 11513:2011 or ISO 9809-1:2010” by “ISO 11513:2011, ISO 11513:2019, ISO 9809-1:2010 or ISO 9809-1:2019”.

4.1.4.1, P208 (11) Replace “Annex A of ISO 11513:2011” by “Annex A of ISO 11513:2011 (applicable until 31 December 2024) or Annex A of ISO 11513:2019”.

4.1.4.1, P408 (2) At the end, add a new Note to read as follows:

*“**NOTE:** The packagings authorized may exceed a net mass of 400 kg (see 4.1.3.3).”*

4.1.4.1, P621 (1) For “Drums”, amend the text in parentheses to read “(1A1, 1A2, 1B1, 1B2, 1N1, 1N2, 1H1, 1H2, 1D, 1G)”. For “Jerricans”, amend the text in parentheses to read “(3A1, 3A2, 3B1, 3B2, 3H1, 3H2)”.

4.1.4.1, P801 At the end, after (2), add a new Note to read as follows:

*“**NOTE:** The packagings authorized in (1) and (2) may exceed a net mass of 400 kg (see 4.1.3.3).”*

4.1.4.1, P903 (2) In the first sentence, at the beginning, replace “cells or batteries” by “a cell or a battery” and at the end, delete “, and assemblies of such cells or batteries”.

4.1.4.1, P903 (4) and (5) In the penultimate sentence, transfer the phrase “when intentionally active” to the beginning of the sentence to read: “When intentionally active, devices such as radio frequency identification (RFID) tags, watches and temperature loggers, which are not capable of generating a dangerous evolution of heat, may be transported in strong outer packagings.”.

4.1.4.1, P903 At the end, after (5), add a new Note to read as follows:

*“**NOTE:** The packagings authorized in (2), (4) and (5) may exceed a net mass of 400 kg (see 4.1.3.3).”*

4.1.4.1, P905 In the second row after the heading row, after the first sentence, add a new Note to read as follows:

*“**NOTE:** The packagings authorized may exceed a net mass of 400 kg (see 4.1.3.3).”*

4.1.4.1, P906 (2) Under sub-paragraph (b), add a new Note to read as follows:

*“**NOTE 1:** The packagings authorized may exceed a net mass of 400 kg (see 4.1.3.3).”*

Under the last paragraph, before the additional provisions, add a new Note to read as follows:

*“**NOTE 2:** The packagings authorized may exceed a net mass of 400 kg (see 4.1.3.3).”*

4.1.4.1, P907 At the end, add a new Note to read as follows:

*“**NOTE:** The packagings authorized may exceed a net mass of 400 kg (see 4.1.3.3).”*

4.1.4.1, P909 At the end, after (4), add a new Note to read as follows:

*“**NOTE:** The packagings authorized in (3) and (4) may exceed a net mass of 400 kg (see 4.1.3.3).”*

4.1.4.1, P910 (3) At the end, add a new Note to read as follows:

*“**NOTE:** The packagings authorized may exceed a net mass of 400 kg (see 4.1.3.3).”*

4.1.4.1, P911 In note [a], at the end, add a new indent to read as follows:

“(i) In the case of multiple batteries and multiple items of equipment containing batteries, additional requirements such as the maximum number of batteries and items of equipment, the total maximum energy content of the batteries, and the configuration inside the package, including separations and protections of the parts, shall be considered.”

4.1.4.2, IBC02 In special packing provision B15, replace “of composite IBCs with a rigid plastics inner receptacle” by “of rigid plastics inner receptacles of composite IBCs”.

4.1.4.2, IBC07 Add the following new special packing provision:

“**B20** UN 3550 may be transported in flexible IBCs (13H3 or 13H4) with siftproof liners to prevent any egress of dust during transport.”

4.1.4.2, IBC520 In the second sentence (third row), after “The formulations” add “not listed in 2.4.2.3.2.3 and 2.5.3.2.4 but”.

4.1.4.3, LP906 Amend the third sentence to read “For batteries and items of equipment containing batteries:”.

In (2), amend the second paragraph to read as follows:

“A verification report shall be made available on request. As a minimum requirement, the name of the batteries, their type as defined in Section 38.3.2.3 of the Manual of Tests and Criteria, the maximum number of batteries, the total mass of batteries, the total energy content of the batteries, the large packaging identification and the test data according to the verification method as specified by the competent authority shall be listed in the verification report. A set of specific instructions describing the way to use the package shall also be part of the verification report.”

Add a fourth indent to read as follows:

“(4) The specific instructions for use of the package shall be made available by the packaging manufacturers and subsequent distributors to the consignor. They shall include at least the identification of the batteries and items of equipment that may be contained inside the packaging, the maximum number of batteries contained in the package and the maximum total of the batteries energy content, as well as the configuration inside the package, including the separations and protections used during the performance verification test.”

In note [a], at the end, add a new indent to read as follows:

“(i) In the case of multiple batteries and multiple items of equipment containing batteries, additional requirements such as the maximum number of batteries and items of equipment, the total maximum energy content of the batteries, and the configuration inside the package, including separations and protections of the parts, shall be considered.”

4.1.6.1.6 Add to the end of the first sentence “and taking into account the lowest pressure rating of any component”.

Insert the following new second sentence: “Service equipment having a pressure rating lower than other components shall nevertheless comply with 6.2.1.3.1.”

Delete the final sentence.

4.1.6.1.8 In the penultimate paragraph, first sentence, replace “1SO 11117:1998 or ISO 11117:2008 + Cor 1:2009” by “1SO 11117:1998, ISO 11117:2008 + Cor 1:2009 or ISO 11117:2019”.

In the final sentence, after “ISO 16111:2008”, add “or ISO 16111:2018”.

4.1.6.1.10 In the first sentence, insert “closed” before “cryogenic receptacles” and replace “P205 or P206” with “P205, P206 or P208”.

4.1.9.1.4 In the first sentence, delete “, tanks, intermediate bulk containers”.

Chapter 4.2

4.2.5.2.1 At the end, add “or Chapter 6.9”.

4.2.5.2.2 In the first sentence, in the text in parenthesis, after “reference steel”, add “or the minimum shell thickness of fibre-reinforced plastics”.

4.2.5.2.6 In the introductory paragraph, in the second sentence, after "(in mm reference steel)", insert "or the minimum shell thickness for fibre reinforced plastics (FRP) portable tanks".

4.2.5.2.6 In the table for T1-T22, in the heading row, add the following sentences at the end: "The instructions for portable tanks with FRP shells apply to substances of Classes or Divisions 1, 3, 5.1, 6.1, 6.2, 8 and 9. Additionally, the requirements of Chapter 6.9 apply to the portable tanks with FRP shells.".

4.2.5.2.6, T23 In the paragraph under the heading row, last sentence, after "The formulations" add "not listed in 2.4.2.3.2.3 and 2.5.3.2.4 but".

For UN No. 3109 "ORGANIC PEROXIDE, TYPE F, LIQUID" add "tert-Butyl hydroperoxide, not more than 56 % in diluent type B[b]" under the column "Substance".

Add a new note "b" under the table to read "[b] Diluent type B is tert-Butyl alcohol" and renumber existing table notes "b" to "d" to become "c" to "e".

4.2.5.3, TP32 (a) In the first sentence, after "of metal", insert "or fibre-reinforced plastics".

Chapter 4.3

4.3.1.15 Replace indents (a) to (i) with the following indents (a) to (c):

"(a) Bends, cracks or breaks in structural or supporting members, or any damage to service or operational equipment that affect the integrity of the container;

(b) Any distortion of the overall configuration or any damage to lifting attachments or handling equipment interface features great enough to prevent proper alignment of handling equipment, mounting and securing chassis or vehicle, or insertion into ships' cells; and, where applicable

(c) Door hinges, door seals and hardware that are seized, twisted, broken, missing, or otherwise inoperative."

Chapter 5.1

5.1.5.1.3 Amend to read as follows:

"5.1.5.1.3 A competent authority may approve provisions under which consignments that do not satisfy all the applicable requirements of these Regulations may be transported under special arrangement (see 1.5.4)."

Chapter 5.2

5.2.1.7.1 At the third indent, replace "Cryogenic receptacles" with "Closed or open cryogenic receptacles".

5.2.1.7.2 (a) Replace "cryogenic receptacles" with "closed or open cryogenic receptacles".

5.2.1.9.2 Remove the double asterisk in figure 5.2.5 and remove the note for the double asterisk below the figure.

At the end, add a new note to read as follows:

"***NOTE:*** *The mark shown in Figure 5.2.5 in 5.2.1.9 of the twenty-first revised edition of the Recommendations on the Transport of Dangerous Goods, Model Regulations, may continue to be applied until 31 December 2026.*"

Chapter 5.4

5.4.1.4.3 After (c), add the following new indent:

"(d) Molten substances: When a substance, which is solid in accordance with the definition in 1.2.1, is offered for transport in the molten state, the qualifying word "**MOLTEN**" shall be added as part of the proper shipping name, unless it is already part of the proper shipping name (see 3.1.2.5);"

Renumber existing indent (d) to (e).

At the end, add the following new indent:

"(f) Stabilized and temperature controlled substances: Unless already part of the proper shipping name the word "**STABILIZED**" shall be added to the proper shipping name if stabilization is used and the words "**TEMPERATURE CONTROLLED**" shall be added to the proper shipping name if stabilization is by temperature control or a combination of chemical stabilization and temperature control (see 3.1.2.6)."

5.4.1.5.3 Amend the paragraph below the heading to read as follows:

" For dangerous goods transported in salvage packagings in accordance with 4.1.1.18, including large salvage packagings, larger size packagings or large packagings of appropriate type and performance level to be used as a salvage packaging, the words "**SALVAGE PACKAGING**" shall be included.

For dangerous goods transported in salvage pressure receptacles in accordance with 4.1.1.19, the words "**SALVAGE PRESSURE RECEPTACLE**" shall be included."

5.4.1.5.4 Replace "If the word "STABILIZED" is part of" by "If the words "**TEMPERATURE CONTROLLED**" are part of" and delete "when stabilization is by means of temperature control,".

5.4.1.5.12 Amend to read as follows:

"5.4.1.5.12 *Additional entries in the case of the application of special provisions*

Where, in accordance with a special provision in Chapter 3.3, additional information is necessary, this additional information shall be included in the dangerous goods transport document."

Chapter 6.1

6.1.1.2 In the second sentence, replace "successfully to withstand the tests" by "to successfully fulfil the requirements".

6.1.1.4 In the Note, replace "*ISO 16106:2006*" by "*ISO 16106:2020*" and delete "*Packaging –*" in the standard's title.

Chapter 6.2

6.2.1.1.1 After "Pressure receptacles" delete "and their closures". At the end of the sentence replace "transport" with "transport and intended use".

6.2.1.1.4 At the end of the sentence replace "used" with "welded".

6.2.1.1.5 In the first sentence replace "cylinders, tubes, pressure drums" with "pressure receptacle shells".

In the final sentence after "The test pressure of a cylinder" insert "shell".

6.2.1.1.6 At the beginning of the first and the second sentences replace "Pressure receptacles" with "Cylinders or cylinder shells".

In the final sentence replace the first "pressure receptacle" with "cylinder shell" and the second and third "pressure receptacle" with "cylinder".

6.2.1.1.8.2 In the third and fourth sentences replace “pressure receptacle” with “inner vessel”.

At the end of the fourth sentence replace “fittings” with “service equipment”.

6.2.1.1.9 At the end of the heading replace “*pressure receptacles for acetylene”* with *“acetylene cylinders”.*

In the first sentence replace “Pressure receptacles” with “Cylinder shells”.

In (a) replace “pressure receptacle” with “cylinder shell”.

In the final sentence replace “compatible with the pressure receptacle” with “compatible with those parts of the cylinder that are in contact with it".

6.2.1.2.1 After “Construction materials of pressure receptacles” delete “and their closures”.

6.2.1.2.2 At the beginning of the first sentence, after “Pressure receptacles”, delete “and their closures”.

6.2.1.3.1 Replace “Valves, piping and other fittings” with “Service equipment” and replace “excluding pressure relief devices” with “excluding porous, absorbent or adsorbent material, pressure relief devices, pressure gauges or indicators”.

6.2.1.3.2 Amend to read as follows:

“6.2.1.3.2 Service equipment shall be configured or designed to prevent damage and unintended opening that could result in the release of the pressure receptacle contents during normal conditions of handling and transport. All closures shall be protected in the same manner as is required for valves in 4.1.6.1.8. Manifold piping leading to shut-off valves shall be sufficiently flexible to protect the shut-off valves and the piping from shearing or releasing the pressure receptacle contents.”

6.2.1.3.3 Replace “shall be fitted with devices” with “shall be fitted with handling devices”.

6.2.1.4.1 Delete the second sentence beginning “Pressure receptacles…”.

6.2.1.4.3 Insert a new paragraph 6.2.1.4.3 to read:

“6.2.1.4.3 Pressure receptacle shells and the inner vessels of closed cryogenic receptacles shall be inspected tested and approved by an inspection body.”

6.2.1.4.4 Insert a new paragraph 6.2.1.4.4 as follows:

“6.2.1.4.4 For refillable cylinders, pressure drums and tubes the conformity assessment of the shell and the closure(s) may be carried out separately. In these cases, an additional assessment of the final assembly is not required.

For bundles of cylinders, the cylinder shells and the valve(s) may be assessed separately, but an additional assessment of the complete assembly is required.

For closed cryogenic receptacles, the inner vessels and the closures may be assessed separately, but an additional assessment of the complete assembly is required.

For acetylene cylinders, conformity assessment shall comprise either:

(a) One assessment of conformity covering both the cylinder shell and the contained porous material; or

(b) A separate assessment of conformity for the empty cylinder shell and an additional assessment of conformity covering the cylinder shell with the contained porous material.”

6.2.1.5.1 In the first sentence replace “closed cryogenic receptacles and metal hydride storage systems” with “closed cryogenic receptacles, metal hydride storage systems and bundles of cylinders” and after “the applicable design standards” insert “or recognised technical codes”.

In the line before (a), replace “pressure receptacles” with “pressure receptacle shells”.

In (d), at the end delete “of the pressure receptacles”.

In (e), replace “neck threads” with “threads used to fit closures”.

In the line before (g), replace “all pressure receptacles” with “all pressure receptacle shells”.

In (g), replace “pressure receptacles” with “pressure receptacle shells”.

In (h), both sentences, replace “pressure receptacles” with “pressure receptacle shells”.

In (i) replace “pressure receptacles” with “pressure receptacle shells”.

In (j) replace “pressure receptacles” with “cylinder shells”.

After (j) insert the following new provisions:

“On an adequate sample of closures:

(k) Verification of materials;

(l) Verification of dimensions;

(m) Verification of cleanliness;

(n) Inspection of completed assembly;

(o) Verification of the presence of marks.

For all closures:

(p) Testing for leakproofness”.

6.2.1.5.2 Amend to read as follows:

“6.2.1.5.2 Closed cryogenic receptacles shall be subjected to testing and inspection during and after manufacture in accordance with the applicable design standards or recognized technical codes including the following:

On an adequate sample of inner vessels:

(a) Testing of the mechanical characteristics of the material of construction;

(b) Verification of the minimum wall thickness;

(c) Inspection of the external and internal conditions;

(d) Verification of the conformance with the design standard or code;

(e) Inspection of welds by radiographic, ultrasonic or other suitable non-destructive test method according to the applicable design and construction standard or code.

For all inner vessels:

(f) A hydraulic pressure test. The inner vessel shall meet the acceptance criteria specified in the design and construction technical standard or technical code;

NOTE: *With the agreement of the competent authority, the hydraulic pressure test may be replaced by a test using a gas, where such an operation does not entail any danger.*

(g) Inspection and assessment of manufacturing defects and either repairing them or rendering the inner vessel unserviceable;

(h) An inspection of the marks.

On an adequate sample of closures:

(i) Verification of materials;

(j) Verification of dimensions;

(k) Verification of cleanliness;

(l) Inspection of completed assembly;

(m) Verification of the presence of marks.

For all closures:

(n) Testing for leakproofness.

On an adequate sample of completed closed cryogenic receptacles:

(o) Testing the satisfactory operation of service equipment;

(p) Verification of the conformance with the design standard or code.

For all completed closed cryogenic pressure receptacles:

(q) Testing for leakproofness."

6.2.1.5.3 In the first sentence replace "receptacles" with "pressure receptacle shells".

6.2.1.5.4 Insert the following new paragraph:

"6.2.1.5.4 For bundles of cylinders the cylinder shells and closures shall be subjected to initial inspection and tests specified in 6.2.1.5.1. An adequate sample of frames shall be proof load tested to two times the maximum gross weight of the bundles of cylinders.

Additionally, all manifolds of bundle of cylinders shall undergo a hydraulic pressure test and all the completed bundles of cylinders shall undergo a leakproofness test.

NOTE: *With the agreement of the competent authority, the hydraulic pressure test may be replaced by a test using a gas, where such an operation does not entail any danger."*

6.2.1.6.1 Replace (c) and (d) with the following.

"(c) Checking of the threads either:

(i) if there is evidence of corrosion; or

(ii) if the closures or other service equipment are removed;

(d) A hydraulic pressure test of the pressure receptacle shell and, if necessary, verification of the characteristics of the material by suitable tests;"

In note 2, replace "*cylinders or tubes"* with "*cylinder shells or tube shells"*

Amend note 3 to read as follows:

"***NOTE 3:*** *The check of internal conditions of 6.2.1.6.1 (b) and the hydraulic pressure test of 6.2.1.6.1 (d) may be replaced by ultrasonic examination carried out in accordance with ISO 18119:2018 for seamless steel and seamless aluminium alloy cylinder shells. For a transitional period until 31 December 2024 the standard ISO 10461:2005 +A1:2006 may be used for seamless aluminium alloy cylinders and ISO 6406:2005 may be used for seamless steel cylinder shells for this same purpose.*"

Insert the following new note 4:

"***NOTE 4:*** *For bundles of cylinders the hydraulic test specified in (d) above shall be carried out on the cylinder shells and on the manifold.*"

Replace current (e) and add a new (f) as follows:

"(e) Check of service equipment, if to be reintroduced into service. This check may be carried out separately from the inspection of the pressure receptacle shell; and

(f) A leakproofness test of bundles of cylinders after reassembly."

6.2.1.6.2 Replace "Pressure receptacles" with "Cylinders".

6.2.1.7.2 Amend as follows:

"6.2.1.7.2 A proficiency test of the manufacturers of pressure receptacle shells and the inner vessels of closed cryogenic receptacle shall in all instances be carried out by an inspection body approved by the competent authority of the country of approval. Proficiency testing of manufacturers of closures shall be carried out if the competent authority requires it. This test shall be carried out either during design type approval or during production inspection and certification."

6.2.2 In note 2, after "UN pressure receptacles", delete "and service equipment".

6.2.2.1.1 In the first sentence replace "UN cylinders" with "refillable UN cylinder shells".

In the table, for "ISO 9809-1:2010", in column "Applicable for manufacture", replace "Until further notice" by "Until 31 December 2026". After the entry for "ISO 9809-1:2010", add the following new entry:

ISO 9809-1:2019	Gas cylinders — Design, construction and testing of refillable seamless steel gas cylinders and tubes — Part 1: Quenched and tempered steel cylinders and tubes with tensile strength less than 1 100 MPa	Until further notice

In the table, for "ISO 9809-2:2010", in column "Applicable for manufacture", replace "Until further notice" by "Until 31 December 2026". After the entry for "ISO 9809-2:2010", add the following new entry:

ISO 9809-2:2019	Gas cylinders – Design, construction and testing of refillable seamless steel gas cylinders and tubes – Part 2: Quenched and tempered steel cylinders and tubes with tensile strength greater than or equal to 1 100 MPa	Until further notice

In the table, for "ISO 9809-3:2010", in column "Applicable for manufacture", replace "Until further notice" by "Until 31 December 2026". After the entry for "ISO 9809-3:2010", add the following new entry:

ISO 9809-3:2019	Gas cylinders — Design, construction and testing of refillable seamless steel gas cylinders and tubes — Part 3: Normalized steel cylinders and tubes	Until further notice

In the table, delete the rows for "ISO 11118:1999" and "ISO 11118:2015".

In note 1, after the table, replace "*composite cylinders"* with "*composite cylinder shells*".

In note 2, after the table, in the first sentence, replace "*composite cylinders"* with "*composite cylinder shells*". In the second sentence, replace "*cylinders"* with "*composite cylinder shells*". In the last sentence replace "*cylinder"* with *"cylinder shell".*

6.2.2.1.2 In the first sentence replace "UN tubes" with "UN tube shells".

In the table, in the row for ISO 11515:2013, replace "Until further notice" with "Until 31 December 2026". Add a new row beneath this row as follows:

ISO 11515:2013 + Amd 1:2018	Gas cylinders – Refillable composite reinforced tubes of water capacity between 450 *l* and 3000 *l* – Design, construction and testing	Until further notice

At the end of the table, add the following new entries:

ISO 9809-1:2019	Gas cylinders — Design, construction and testing of refillable seamless steel gas cylinders and tubes — Part 1: Quenched and tempered steel cylinders and tubes with tensile strength less than 1 100 MPa	Until further notice
ISO 9809-2:2019	Gas cylinders – Design, construction and testing of refillable seamless steel gas cylinders and tubes – Part 2:	Until further notice

	Quenched and tempered steel cylinders and tubes with tensile strength greater than or equal to 1 100 MPa	
ISO 9809-3:2019	Gas cylinders — Design, construction and testing of refillable seamless steel gas cylinders and tubes — Part 3: Normalized steel cylinders and tubes	Until further notice

In note 1 after the table, replace "*composite tubes"* with "*composite tube shells*".

In note 2 after the table, in the first sentence, replace "*composite tubes"* with "*composite tube shells*". In the second sentence, replace "*tubes"* with "*composite tube shells*". In the last sentence replace "*tube" with "tube shell".*

6.2.2.1.3 In the first table, for "ISO 9809-1:2010", in column "Applicable for manufacture", replace "Until further notice" by "Until 31 December 2026". After the entry for "ISO 9809-1:2010", add the following new entry:

ISO 9809-1:2019	Gas cylinders — Design, construction and testing of refillable seamless steel gas cylinders and tubes — Part 1: Quenched and tempered steel cylinders and tubes with tensile strength less than 1 100 MPa	Until further notice

In the first table, for "ISO 9809-3:2010", in column "Applicable for manufacture", replace "Until further notice" by "Until 31 December 2026". After the entry for "ISO 9809-3:2010", add the following new entry:

ISO 9809-3:2019	Gas cylinders — Design, construction and testing of refillable seamless steel gas cylinders and tubes — Part 3: Normalized steel cylinders and tubes	Until further notice

6.2.2.1.4 Replace "UN cryogenic receptacles" with "UN closed cryogenic receptacles".

In the table, for "ISO 21029-1:2004", in column "Applicable for manufacture", replace "Until further notice" by "Until 31 December 2026". After the entry for "ISO 21029-1:2004", add the following new entry:

ISO 21029-1:2018 + Amd.1:2019	Cryogenic vessels – Transportable vacuum insulated vessels of not more than 1 000 litres volume – Part 1: Design, fabrication, inspection and tests	Until further notice

6.2.2.1.5 In the table, for "ISO 16111:2008", in column "Applicable for manufacture", replace "Until further notice" by "Until 31 December 2026". After the entry for "ISO 16111:2008", add the following new entry:

ISO 16111:2018	Transportable gas storage devices – Hydrogen absorbed in reversible metal hydride	Until further notice

6.2.2.1.6 In the first sentence, replace "The standard shown below" with "The following standard".

In the second sentence replace "UN cylinder" with "UN cylinder or UN cylinder shell".

In the table, for "ISO 10961:2010", in column "Applicable for manufacture", replace "Until further notice" by "Until 31 December 2026". After the entry for "ISO 10961:2010", add the following new entry:

ISO 10961:2019	Gas cylinders – Cylinder bundles – Design, manufacture, testing and inspection	Until further notice

Replace the current note after the table with the following:

"***NOTE**: Changing one or more cylinders or cylinder shells of the same design type, including the same test pressure, in an existing UN bundle of cylinders does not require a new conformity assessment of the existing bundle. Service equipment of the bundle of cylinders can also be replaced without requiring a new conformity assessment if it complies with the design type approval.*"

6.2.2.1.7 In the table, for “ISO 11513:2011”, in column “Applicable for manufacture”, replace “Until further notice” by “Until 31 December 2026”. After the entry for “ISO 11513:2011”, add the following new entry:

ISO 11513:2019	Gas cylinders – Refillable welded steel cylinders containing materials for sub-atmospheric gas packaging (excluding acetylene) – Design, construction, testing, use and periodic inspection	Until further notice

In the table, for “ISO 9809-1:2010”, in column “Applicable for manufacture”, replace “Until further notice” by “Until 31 December 2026”. After the entry for “ISO 9809-1:2010”, add the following new entry:

ISO 9809-1:2019	Gas cylinders — Design, construction and testing of refillable seamless steel gas cylinders and tubes — Part 1: Quenched and tempered steel cylinders and tubes with tensile strength less than 1 100 MPa	Until further notice

6.2.2.1.8 In the table, in the row for ISO 21172-1:2015, replace “Until further notice” with “Until 31 December 2026”. Add the following new row to the table after ISO 21172-1:2015:

ISO 21172-1:2015 + Amd 1:2018	Gas cylinders – Welded steel pressure drums up to 3 000 litres capacity for the transport of gases – Design and construction – Part 1: Capacities up to 1 000 litres;	Until further notice

6.2.2.1.9 Insert a new paragraph and table as follows:

“6.2.2.1.9 The following standards apply to the design, construction and initial inspection and test of non-refillable UN cylinders except that the inspection requirements related to the conformity assessment system and approval shall be in accordance with 6.2.2.5.

Reference	Title	Applicable for manufacture
ISO 11118:1999	Gas cylinders – Non-refillable metallic gas cylinders – Specification and test methods	Until 31 December 2020
ISO 13340:2001	Transportable gas cylinders – Cylinder valves for non-refillable cylinders – Specification and prototype testing	Until 31 December 2020
ISO 11118:2015	Gas cylinders – Non-refillable metallic gas cylinders – Specification and test methods	Until 31 December 2026
ISO 11118:2015 +Amd.1:2019	Gas cylinders - Non-refillable metallic gas cylinders - Specification and test methods	Until further notice

”

6.2.2.2 In the first sentence delete “pressure receptacle”.

6.2.2.3 Replace the title “***Service equipment***” with “***Closures and their protection***”

Replace the first sentence with “The following standards apply to the design, construction, and initial inspection and test of closures and their protection:”

In the first table, for “ISO 11117:2008 + Cor.1:2009”, in column “Applicable for manufacture”, replace “Until further notice” by “Until 31 December 2026”. After the entry for “ISO 11117:2008 + Cor.1:2009”, add the following new entry:

ISO 11117:2019	Gas cylinders – Valve protection caps and guards – Design, construction and tests	Until further notice

In the first table, delete the row for ISO 13340:2001.

In the first table, for “ISO 17871:2015”, in column “Applicable for manufacture”, replace “Until further notice” by “Until 31 December 2026”. In the column “Title”, Add the following new note under the title:

"***NOTE:*** *This standard shall not be used for flammable gases.*"

In the first table, after the entry for "17871:2015", add the following new entry:

ISO 17871:2020	Gas cylinders – Quick-release cylinder valves – Specification and type testing.	Until further notice

In the second table, for "ISO 16111:2008", in column "Applicable for manufacture", replace "Until further notice" by "Until 31 December 2026". After the entry for "ISO 16111:2008", add the following new entry:

ISO 16111:2018	Transportable gas storage devices – Hydrogen absorbed in reversible metal hydride	Until further notice

6.2.2.4 Amend the first sentence to read "The following standards apply to periodic inspection and testing of UN pressure receptacles:".

In the first table, in the row for ISO 6406:2005, replace "Until further notice" with "Until 31 December 2024". Add the following new row to the table after ISO 6406:2005:

ISO 18119:2018	Gas cylinders – Seamless steel and seamless aluminium-alloy gas cylinders and tubes – Periodic inspection and testing	Until further notice

In the first table, in the row for ISO 10460:2005, replace "Until further notice" with "Until 31 December 2024". Add the following new row to the table after ISO 10460:2005:

ISO 10460:2018	Gas cylinders – Welded aluminium-alloy, carbon and stainless steel gas cylinders – Periodic inspection and testing.	Until further notice

In the first table, in the row for ISO 10461:2005/A1:2006, replace "Until further notice" with "Until 31 December 2024".

In the first table, for "ISO 10462:2013", in column "Applicable for manufacture", replace "Until further notice" by "Until 31 December 2024". After the entry for "ISO 10462:2013", add the following new entry:

ISO 10462:2013 + Amd1:2019	Gas cylinders – Acetylene cylinders – Periodic inspection and maintenance	Until further notice

In the first table, for "ISO 11513:2011", in column "Applicable for manufacture", replace "Until further notice" by "Until 31 December 2024". After the entry for "ISO 11513:2011", add the following new entry:

ISO 11513:2019	Gas cylinders – Refillable welded steel cylinders containing materials for sub-atmospheric gas packaging (excluding acetylene) – Design, construction, testing, use and periodic inspection	Until further notice

Delete the row for ISO 11623:2002.

At the end of the first table, add the following new entry:

ISO 23088:2020	Gas cylinders – Periodic inspection and testing of welded steel pressure drums — Capacities up to 1 000 *l*	Until further notice

In the second table, for "ISO 16111:2008", in column "Applicable for manufacture", replace "Until further notice" by "Until 31 December 2024". After the entry for "ISO 16111:2008", add the following new entry:

ISO 16111:2018	Transportable gas storage devices – Hydrogen absorbed in reversible metal hydride	Until further notice

6.2.2.5 At the beginning of 6.2.2.5 renumber 6.2.2.5.1 as 6.2.2.5.0 and insert the following new Note at the end (after the definition of "Verify").

"***NOTE:*** *In this subsection when separate assessment is used the term pressure receptacle shall refer to pressure receptacle, pressure receptacle shell, inner vessel of the closed cryogenic receptacle or closure, as appropriate.*"

6.2.2.5.1 Insert a new paragraph 6.2.2.5.1 to read as follows:

"6.2.2.5.1 The requirements of 6.2.2.5 shall be used for the conformity assessments of pressure receptacles. Paragraph 6.2.1.4.3 gives details of which parts of pressure receptacles may be conformity assessed separately. However, the requirements of 6.2.2.5 may be replaced by requirements specified by the competent authority in the following cases:

(a) conformity assessment of closures;

(b) conformity assessment of the complete assembly of bundles of cylinders provided the cylinder shells have been conformity assessed in accordance with the requirements of 6.2.2.5; and

(c) conformity assessment of the complete assembly of closed cryogenic receptacles provided the inner vessel has been conformity assessed in accordance with the requirements of 6.2.2.5."

6.2.2.5.4.9 In (c), replace the existing text with: "As required by the pressure receptacle standard or technical code, carry out or supervise the tests of pressure receptacles as required for design type approval;".

Add the following new sentence at the end of the penultimate paragraph: "If it was not possible to evaluate exhaustively the compatibility of the materials of construction with the contents of the pressure receptacle when the certificate was issued, a statement that compatibility assessment was not completed shall be included in the design type approval certificate.".

6.2.2.7 Amend the Note by replacing "*6.2.2.9 and marking*" with "*6.2.2.9, marking*" and inserting at the end "*and marking requirements for closures are given in 6.2.2.11*".

6.2.2.7.1 In the first sentence replace "pressure receptacles" with "pressure receptacle shells and closed cryogenic receptacles".

At the end of the second sentence, delete "on the pressure receptacle".

In the third sentence, after "neck of the pressure receptacle" insert "shell".

6.2.2.7.2 (b) At the end, insert the following new note:

"***NOTE:*** *For acetylene cylinders the standard ISO 3807 shall also be marked.*"

6.2.2.7.2, after (e) Insert the following new note:

"***NOTE:*** *When an acetylene cylinder is conformity assessed in accordance with 6.2.1.4.3 (b) and the inspection bodies for the cylinder shell and the acetylene cylinder are different, their respective marks (d) are required. Only the initial inspection date (e) of the completed acetylene cylinder is required. If the country of approval of the inspection body responsible for the initial inspection and test is different a second mark (c) shall be applied.*"

6.2.2.7.3 (g) In the second sentence, replace "mass of valve, valve cap" with "mass of closure(s), valve protection cap".

6.2.2.7.3 (i) At the end insert the following note:

"***NOTE:*** *When a cylinder shell is intended for use as an acetylene cylinder (including the porous material), the working pressure mark is not required until the acetylene cylinder is completed.*"

6.2.2.7.3 (j) In the first sentence replace "liquefied gases and refrigerated liquefied gases" with "liquefied gases, refrigerated liquefied gases and dissolved gases".

6.2.2.7.3 (k) and (l) Replace paragraphs (k) and (l) with the following.

"(k) In the case of cylinders for UN 1001 acetylene, dissolved:

(i) the tare in kilograms consisting of the total of the mass of the empty cylinder shell, the service equipment (including porous material) not removed during filling, any coating, the solvent and the saturation gas expressed to three significant figures rounded down to the last digit followed by the letters "KG". At least one decimal shall be shown after the decimal point. For pressure receptacles of less than 1 kg, the mass shall be expressed to two significant figures rounded down to the last digit;

(ii) the identity of the porous material (e.g.: name or trademark); and

(iii) the total mass of the filled acetylene cylinder in kilograms followed by the letters "KG";

(l) In the case of cylinders for UN 3374 acetylene, solvent free:

(i) the tare in kilograms consisting of the total of the mass of the empty cylinder shell, the service equipment (including porous material) not removed during filling and any coating expressed to three significant figures rounded down to the last digit followed by the letters "KG". At least one decimal shall be shown after the decimal point. For pressure receptacles of less than 1 kg, the mass shall be expressed to two significant figures rounded down to the last digit;

(ii) the identity of the porous material; and

(iii) the total mass of the filled acetylene cylinder in kilograms followed by the letters "KG";"

6.2.2.7.4 (n) After the existing text insert the following new note:

"***NOTE:*** *For acetylene cylinders, if the manufacturer of the acetylene cylinder and the manufacturer of the cylinder shell are different, only the mark of the manufacturer of the completed acetylene cylinder is required.*"

6.2.2.7.8 Amend to read as follows:

"6.2.2.7.8 The marks in accordance with 6.2.2.7.7 may be engraved on a metallic ring affixed to the cylinder or pressure drum when the valve is installed, and which is removable only by disconnecting the valve from the cylinder or pressure drum."

6.2.2.8 In the title replace "**pressure receptacles**" with "**cylinders**".

6.2.2.8.1 In the first sentence replace "pressure receptacles" with "cylinders" and "pressure receptacle" with "cylinder".

In the second sentence replace "pressure receptacle" with "cylinder".

In the third sentence replace "pressure receptacle" at the first occurrence with "cylinder shell" and at the second occurrence with "cylinder".

In the fourth sentence replace "pressure receptacles" with "cylinders" twice.

In the fifth sentence replace "pressure receptacles" with "cylinders" twice.

6.2.2.8.3 In the note, replace "*pressure receptacles*" with "*cylinders*".

6.2.2.10.1 Replace "cylinders" with "cylinder shells".

Insert a new second sentence as follows: "Individual closures in a bundle of cylinders shall be marked in accordance with 6.2.2.11.".

6.2.2.10.3 (b) In the first sentence replace the phrase in brackets with "cylinder shells and service equipment".

In the second sentence after "tare" delete "mass".

6.2.2.11 Insert a new paragraph 6.2.2.11 as follows:

"**6.2.2.11 Marking of closures for refillable UN pressure receptacles**

For closures the following permanent marks shall be applied clearly and legibly, (e.g. stamped, engraved or etched):

(a) Manufacturer's identification mark;

(b) Design standard or design standard designation;

(c) Date of manufacture (year and month or year and week) and

(d) The identity mark of the inspection body responsible for the initial inspection and test, if applicable.

The valve test pressure shall be marked when it is less than the test pressure which is indicated by the rating of the valve filling connection."

6.2.4 Below the heading, add a new paragraph to read as follows:

"6.2.4.1 The internal pressure of aerosol dispensers at 50 °C shall not exceed 1.2 MPa (12 bar) when using flammable liquefied gases, 1.32 MPa (13.2 bar) when using non-flammable liquefied gases, and 1.5 MPa (15 bar) when using non-flammable compressed or dissolved gases. In case of a mixture of several gases, the stricter limit shall apply."

The existing paragraph below the title becomes 6.2.4.2.

Renumber the following subparagraphs as follows: 6.2.4.1 to 6.2.4.2.1, 6.2.4.1.1 to 6.2.4.2.1.1, 6.2.4.1.2 to 6.2.4.2.1.2, 6.2.4.2 to 6.2.4.2.2, 6.2.4.2.1 to 6.2.4.2.2.1, 6.2.4.2.2 to 6.2.4.2.2.2, 6.2.4.2.2.1 to 6.2.4.2.2.2.1, 6.2.4.2.2.2 to 6.2.4.2.2.2.2, 6.2.4.2.3 to 6.2.4.2.2.3, 6.2.4.2.3.1 to 6.2.4.2.2.3.1, 6.2.4.2.3.2 to 6.2.4.2.2.3.2 and 6.2.4.3 to 6.2.4.2.3.

In the renumbered 6.2.4.2, replace "6.2.4.1" by "6.2.4.2.1" and "6.2.4.2" by "6.2.4.2.2".

In the renumbered 6.2.4.2.2, replace "6.2.4.2.1" by "6.2.4.2.2.1" and "6.2.4.2.2" by "6.2.4.2.2.2".

In the renumbered 6.2.4.2.3, replace "6.2.4.1" by "6.2.4.2.1" and "6.2.4.2" by "6.2.4.2.2".

Chapter 6.3

6.3.2.1 In the second sentence, replace "successfully to withstand the tests" by "to successfully fulfil the requirements".

6.3.2.2 In the Note, replace "*ISO 16106:2006*" by "*ISO 16106:2020*" and delete "*Packaging* –" in the standard's title.

Chapter 6.4

6.4.12.1 In the first sentence, delete "2.7.2.3.1.3, 2.7.2.3.1.4," and after "2.7.2.3.4.2", insert ", 2.7.2.3.4.3".

6.4.12.2 Delete "2.7.2.3.1.3, 2.7.2.3.1.4," and after "2.7.2.3.4.2", insert ", 2.7.2.3.4.3".

6.4.24.1 Amend the heading above 6.4.24.1 to read "Packages not requiring competent authority approval of design under the 1985, 1985 (as amended 1990), 1996, 1996 (revised), 1996 (as amended 2003), 2005, 2009 and 2012 editions of the IAEA Regulations for the Safe Transport of Radioactive Material".

6.4.24.1 (a) Amend to read "Packages that meet the requirements of the 1985 or 1985 (as amended 1990) editions of the IAEA Regulations for the Safe Transport of Radioactive Material:".

6.4.24.1 (b) Amend to read "Packages that meet the requirements of the 1996, 1996 (revised), 1996 (as amended 2003), 2005, 2009 or 2012 editions of the IAEA Regulations for the Safe Transport of Radioactive Material:".

6.4.24.2 Amend the heading above 6.4.24.2 to read "Package designs approved under the 1985, 1985 (as amended 1990), 1996, 1996 (revised), 1996 (as amended

2003), 2005, 2009 and 2012 editions of the IAEA Regulations for the Safe Transport of Radioactive Material".

6.4.24.2 (a) Amend to read "Packagings that were manufactured to a package design approved by the competent authority under the provisions of the 1985 or 1985 (as amended 1990) editions of the IAEA Regulations for the Safe Transport of Radioactive Material may continue to be used provided that all of the following conditions are met:".

6.4.24.2 (b) Amend to read "Packagings that were manufactured to a package design approved by the competent authority under the provisions of the 1996, 1996 (revised), 1996 (as amended 2003), 2005, 2009 or 2012 editions of the IAEA Regulations for the Safe Transport of Radioactive Material may continue to be used provided that all of the following conditions are met:".

6.4.24.3 Replace "Editions of IAEA Safety Series No.6" by "editions of the IAEA Regulations for the Safe Transport of Radioactive Material".

6.4.24.4 Amend to read "No new manufacture of packagings of a package design meeting the provisions of the 1996, 1996 (revised), 1996 (as amended 2003), 2005, 2009 or 2012 editions of the IAEA Regulations for the Safe Transport of Radioactive Material shall be permitted to commence after 31 December 2028.".

6.4.24.5 In the heading above 6.4.24.5, replace "(2009 Edition of IAEA Safety Standard Series No.TS-R-1)" by "(2009 edition of the IAEA Regulations for the Safe Transport of Radioactive Material".

In the paragraph, replace "or (iii) of the 2009 Edition of IAEA Regulations" by "or (iii) of the 2009 edition of the IAEA Regulations".

6.4.24.6 Amend the heading above 6.4.24.6 to read "Special form radioactive material approved under the 1985, 1985 (as amended 1990), 1996, 1996 (revised), 1996 (as amended 2003), 2005, 2009 and 2012 editions of the IAEA Regulations for the Safe Transport of Radioactive Material".

Amend the paragraph to read as follows:

"Special form radioactive material manufactured to a design which had received unilateral approval by the competent authority under the 1985, 1985 (as amended 1990), 1996, 1996 (revised), 1996 (as amended 2003), 2005, 2009 and 2012 editions of the IAEA Regulations for the Safe Transport of Radioactive Material may continue to be used when in compliance with the mandatory management system in accordance with the applicable requirements of 1.5.3.1. There shall be no new manufacture of special form radioactive material to a design that had received unilateral approval by the competent authority under the 1985 or 1985 (as amended 1990) editions of the IAEA Regulations for the Safe Transport of Radioactive Material. No new manufacture of special form radioactive material to a design that had received unilateral approval by the competent authority under the 1996, 1996 (revised), 1996 (as amended 2003), 2005, 2009 and 2012 editions of the IAEA Regulations for the Safe Transport of Radioactive Material shall be permitted to commence after 31 December 2025."

Chapter 6.5

6.5.1.1.2 Amend to read as follows:

"6.5.1.1.2 The requirements for IBCs in 6.5.3 are based on IBCs currently in use. In order to take into account progress in science and technology, there is no objection to the use of IBCs having specifications different from those in 6.5.3 and 6.5.5, provided that they are equally effective, acceptable to the competent authority and able to successfully fulfil the requirements described in 6.5.4 and 6.5.6. Methods of inspection and testing other than those described in these Regulations are acceptable, provided they are equivalent."

6.5.2.1.2 Add a new 6.5.2.1.2 to read as follows:

"6.5.2.1.2 IBCs manufactured from recycled plastics material as defined in 1.2.1 shall be marked "REC". For rigid IBCs this mark shall be placed near the marks prescribed in 6.5.2.1.1. For the inner receptacle of composite IBCs, this mark shall be placed near the marks prescribed in 6.5.2.2.4."

Renumber current 6.5.2.1.2 and 6.5.2.1.3 as 6.5.2.1.3 and 6.5.2.1.4 respectively.

6.5.4.1 In the Note, replace "*ISO 16106:2006*" by "*ISO 16106:2020*" and delete "*Packaging –*" in the standard's title.

6.5.5.3.2 After the first sentence, add the following new sentence: "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.".

6.5.5.3.5 Delete.

6.5.5.4.6 After the first sentence, add the following new sentence: "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.".

6.5.5.4.9 Delete.

Renumber current 6.5.5.4.10 to 6.5.5.4.26 as 6.5.5.4.9 to 6.5.5.4.25.

In renumbered 6.5.5.4.19, replace "6.5.5.4.9" by "6.5.5.4.8".

Chapter 6.6

6.6.1.2 In the Note, replace "*ISO 16106:2006*" by "*ISO 16106:2020*" and delete "*Packaging –*" in the standard's title.

6.6.1.3 In the second sentence, replace "successfully to withstand the tests" by "to successfully fulfil the requirements".

Chapter 6.7

6.7 Add a new note at the beginning of Chapter 6.7 to read as follows:

"***NOTE:*** *The requirements of this Chapter also apply to portable tanks with shells made of fibre-reinforced plastics (FRP) to the extent indicated in Chapter 6.9.*"

6.7.3.8.1.1 Delete footnote 4 and renumber the footnotes in 6.7 accordingly. At the end of 6.7.3.8.1.1, add a new note with the text of the footnote, to read as follows:

"***NOTE:*** *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, e.g. CGA S-1.2-2003 Pressure Relief Device Standards – Part 2 – Cargo and Portable Tanks for Compressed Gases).*"

Chapter 6.9

After Chapter 6.8, add a new Chapter 6.9 to read as follows:

"

CHAPTER 6.9

REQUIREMENTS FOR THE DESIGN, CONSTRUCTION, INSPECTION AND TESTING OF PORTABLE TANKS WITH SHELLS MADE OF FIBRE REINFORCED PLASTICS (FRP) MATERIALS

6.9.1 Application and general requirements

6.9.1.1 The requirements of section 6.9.2 apply to portable tanks with an FRP shell intended for the transport of dangerous goods of Classes or Divisions 1, 3, 5.1, 6.1, 6.2, 8 and 9 by all modes of transport. 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 with FRP shell which meets the definition of a "container" within the terms of that Convention.

6.9.1.2 The requirements of this Chapter do not apply to offshore portable tanks.

6.9.1.3 The requirements of Chapter 4.2, and section 6.7.2 apply to FRP portable tank shells except for those concerning the use of metal materials for the construction of a portable tank shell and additional requirements stated in this Chapter.

6.9.1.4 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 compatibility with substances transported and the ability of the FRP portable tank to withstand impact, loading and fire conditions. For international transport, alternative arrangement FRP portable tanks shall be approved by the applicable competent authorities.

6.9.2 Requirements for the design, construction, inspection and testing of FRP portable tanks

6.9.2.1 ***Definitions***

For the purposes of this section, the definitions of 6.7.2.1 apply except for definitions related to metal materials ("Fine grain steel", "Mild steel" and "Reference steel") for the construction of the shell of a portable tank.

Additionally, the following definitions apply to portable tanks with an FRP shell:

External layer means the part of the shell which is directly exposed to the atmosphere;

Fibre-Reinforced Plastic (FRP) means material consisting of fibrous and/or particulate reinforcement contained within a thermoset or thermoplastic polymer (matrix);

Filament winding means a process for constructing FRP structures in which continuous reinforcements (filament, tape, or other), either previously impregnated with a matrix material or impregnated during winding, are placed over a rotating mandrel. Generally, the shape is a surface of revolution and may include heads;

FRP shell means a closed part of cylindrical shape with an interior volume intended for storage and transport of chemical substances;

FRP tank means a tank constructed with an FRP shell, and heads, with service equipment, safety relief devices and other installed equipment;

Glass transition temperature (Tg) means a characteristic value of the temperature range over which the glass transition takes place;

Hand layup means a process for moulding reinforced plastics in which reinforcement and resin are placed on a mould;

Liner means a layer on the inner surface of an FRP shell preventing contact with the dangerous goods being transported;

Mat means a fibre reinforcement made of random, chopped or twisted fibres bonded together as sheets of various length and thickness;

Parallel shell-sample means an FRP specimen, which must be representative of the shell, constructed in parallel to the shell construction if it is not possible to use cut-outs from the shell itself. The parallel shell-sample may be flat or curved;

Representative sample means a sample cut out from the shell;

Resin infusion means an FRP construction method by which dry reinforcement is placed into a matched mould, single sided mould with vacuum bag, or otherwise, and liquid resin is

supplied to the part through the use of external applied pressure at the inlet and/or application of full or partial vacuum pressure at the vent;

Structural layer means FRP layers of a shell required to sustain the design loads;

Veil means a thin mat with high absorbency used in FRP product plies where polymeric matrix surplus fraction content is required (surface evenness, chemical resistance, leakage-proof, etc.).

6.9.2.2 *General design and construction requirements*

6.9.2.2.1 The requirements of 6.7.1 and 6.7.2.2 apply to FRP portable tanks. For areas of the shell that are made from FRP, the following requirements of Chapter 6.7 are exempt: 6.7.2.2.1, 6.7.2.2.9.1, 6.7.2.2.13 and 6.7.2.2.14. Shells shall be designed and constructed in accordance with the requirements of a pressure vessel code, applicable to FRP materials, recognized by the competent authority.

In addition, the following requirements apply.

6.9.2.2.2 *Manufacturer's quality system*

6.9.2.2.2.1 The quality system shall contain all the elements, requirements, and provisions adopted by the manufacturer. It shall be documented in a systematic and orderly manner in the form of written policies, procedures, and instructions.

6.9.2.2.2.2 The contents shall in particular include adequate descriptions of:

(a) The organizational structure and responsibilities of personnel with regard to design and product quality;

(b) The design control and design verification techniques, processes, and procedures that will be used when designing the portable tanks;

(c) The relevant manufacturing, quality control, quality assurance and process operation instructions that will be used;

(d) Quality records, such as inspection reports, test data and calibration data;

(e) Management reviews to ensure the effective operation of the quality system arising from the audits in accordance with 6.9.2.2.2.4;

(f) The process describing how customer requirements are met;

(g) The process for control of documents and their revision;

(h) The means for control of non-conforming portable tanks, purchased components, in-process and final materials; and

(i) Training programmes and qualification procedures for relevant personnel.

6.9.2.2.2.3 Under the quality system, the following minimum requirements shall be met for each FRP portable tank manufactured:

(a) Use of an inspection and test plan (ITP);

(b) Visual inspections;

(c) Verification of fibre orientation and mass fraction by means of documented control process;

(d) Verification of fibre and resin quality and characteristics by means of certificates or other documentation;

(e) Verification of liner quality and characteristics by means of certificates or other documentation;

(f) Verification of whichever is applicable of formed thermoplastic resin characteristic or degree of cure of thermoset resin, by direct or indirect means (e.g. Barcol test or differential scanning calorimetry) to be determined in accordance with 6.9.2.7.1.2 (h), or by creep testing of a representative sample

or parallel-shell specimen in accordance with 6.9.2.7.1.2 (e) for a period of 100 hours;

(g) Documentation of whichever is applicable of thermoplastic resin forming processes or thermoset resin cure and post-cure processes; and

(h) Retention and archiving of shell samples for future inspection and shell verification (e.g. from manhole cut out) for a period of 5 years.

6.9.2.2.2.4 Audit of the quality system

The quality system shall be initially assessed to determine whether it meets the requirements in 6.9.2.2.2.1 to 6.9.2.2.2.3 to the satisfaction of the competent authority.

The manufacturer shall be notified of the results of the audit. The notification shall contain the conclusions of the audit and any corrective actions required.

Periodic audits shall be carried out, to the satisfaction of the competent authority, to ensure that the manufacturer maintains and applies the quality system. Reports of the periodic audits shall be provided to the manufacturer.

6.9.2.2.2.5 Maintenance of the quality system

The manufacturer shall maintain the quality system as approved in order that it remains adequate and efficient.

The manufacturer shall notify the competent authority that approved the quality system of any intended changes. The proposed changes shall be evaluated to determine whether the amended quality system will still satisfy the requirements in 6.9.2.2.2.1 to 6.9.2.2.2.3.

6.9.2.2.3 *FRP Shells*

6.9.2.2.3.1 FRP shells shall have a secure connection with structural elements of the portable tank frame. FRP shell supports and attachments to the frame shell shall cause no local stress concentrations exceeding the design allowables of the shell structure in accordance with the provisions stated in this Chapter for all operating and test conditions.

6.9.2.2.3.2 Shells shall be made of suitable materials, capable of operating within a minimum design temperature range of -40 °C to +50 °C, unless temperature ranges are specified for specific more severe climatic or operating conditions (e.g. heating elements), by the competent authority of the country where the transport operation is being performed.

6.9.2.2.3.3 If a heating system is installed, it shall comply with 6.7.2.5.12 to 6.7.2.5.15 and with the following requirements:

(a) The maximum operating temperature of the heating elements integrated or connected to the shell shall not exceed the maximum design temperature of the tank;

(b) The heating elements shall be designed, controlled, and utilized so that the temperature of the carried substance cannot exceed the maximum design temperature of the tank or a value at which the internal pressure exceeds MAWP; and

(c) Structures of the tank and its heating elements shall allow examination of the shell with respect to possible effects of overheating.

6.9.2.2.3.4 Shells shall consist of the following functions:

- Liner;
- Structural layer;
- External layer.

NOTE: *The layers may be combined if all applicable functional criteria are met.*

6.9.2.2.3.5 The internal liner is the inner element of the shell 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. Chemical compatibility shall be verified in accordance with 6.9.2.7.1.3.

The internal liner may be an FRP liner or a thermoplastic liner.

6.9.2.2.3.6 FRP liners shall consist of the following two components:

(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 maximum fibre mass content of 30% and have a minimum thickness of 0.25 and a maximum thickness of 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.

6.9.2.2.3.7 If the liner consists of thermoplastic sheets, they shall be welded together in the required shape, using a qualified welding procedure and personnel. Furthermore, welded liners shall have a layer of electrically conductive media placed against the non-liquid contact surface of the welds to facilitate spark testing. Durable bonding between liners and the structural layer shall be achieved by the use of an appropriate method.

6.9.2.2.3.8 The structural layer shall be designed to withstand the design loads according to 6.7.2.2.12, 6.9.2.2.3.1, 6.9.2.3.2, 6.9.2.3.4 and 6.9.2.3.6.

6.9.2.2.3.9 The external layer of resin or paint shall provide adequate protection of the structural layers of the tank from environmental and service exposure, including to UV radiation and salt fog, and occasional splash exposure to cargoes.

6.9.2.2.3.10 Resins

The processing of the resin mixture shall be carried out in compliance with the recommendations of the supplier. These resins can be:

- Unsaturated polyester resins;
- Vinyl ester resins;
- Epoxy resins;
- Phenolic resins;
- Thermoplastic resins.

The resin heat distortion temperature (HDT), determined in accordance with 6.9.2.7.1.1 shall be at least 20 °C higher than the maximum design temperature of the shell as defined in 6.9.2.2.3.2, but shall in any case not be lower than 70 °C.

6.9.2.2.3.11 Reinforcement material

The reinforcement material of the structural layers shall be selected such that they meet the requirements of the structural layer.

For the internal surface liner glass fibres of at a minimum type C or ECR according to ISO 2078:1993 + Amd 1:2015 shall be used. Thermoplastic veils may only be used for the internal liner when their compatibility with the intended contents has been demonstrated.

6.9.2.2.3.12 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.

6.9.2.2.3.13 FRP shells, their attachments and their service and structural equipment shall be designed to withstand the loads mentioned in 6.7.2.2.12, 6.9.2.2.3, 6.9.2.3.2, 6.9.2.3.4 and

6.9.2.3.6 without loss of contents (other than quantities of gas escaping through any degassing vents) during the design lifetime.

6.9.2.2.3.14 Special requirements for the carriage of substances with a flash-point of not more than 60 °C

6.9.2.2.3.14.1 FRP tanks used for the carriage of flammable liquids of Class 3 with a flash-point of not more than 60 °C shall be constructed to ensure the elimination of static electricity from the various component parts to avoid the accumulation of dangerous charges.

6.9.2.2.3.14.2 The electrical surface resistance of the inside and outside of the shell as established by measurements shall not be higher than $10^9\,\Omega$. This may be achieved by the use of additives in the resin or interlaminate conducting sheets, such as metal or carbon network.

6.9.2.2.3.14.3 The discharge resistance to earth as established by measurements shall not be higher than $10^7\,\Omega$.

6.9.2.2.3.14.4 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 Ω.

6.9.2.2.3.14.5 The electrical surface-resistance and discharge resistance shall be measured initially on each manufactured tank or a specimen of the shell in accordance with the procedure recognized by the competent authority. In the event of damage to the shell, requiring repair, the electrical resistance shall be re-measured.

6.9.2.2.3.15 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 6.9.2.7.1.5. Testing may be waived with the agreement of the competent authority, where sufficient proof can be provided by tests with comparable tank designs.

6.9.2.2.3.16 Construction process for FRP shells

6.9.2.2.3.16.1 Filament winding, hand layup, resin infusion, or other appropriate composite production processes shall be used for construction of FRP shells.

6.9.2.2.3.16.2 The weight of the fibre reinforcement shall conform to that set forth in the procedure specification with a tolerance of +10 % and −0 %. One or more of the fibre types specified in 6.9.2.2.3.11 and in the procedure specification shall be used for reinforcement of shells.

6.9.2.2.3.16.3 The resin system shall be one of the resin systems specified in 6.9.2.2.3.10. No filler, pigment, or dye additions shall be used which will interfere with the natural colour of the resin except as permitted by the procedure specification.

6.9.2.3 ***Design criteria***

6.9.2.3.1 FRP 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.

6.9.2.3.2 FRP shells shall be designed and constructed to withstand the test pressure. Specific provisions are laid down for certain substances in the applicable portable tank instruction indicated in column 10 of the Dangerous Goods List and described in 4.2.5, or by a portable tank special provision indicated in column 11 of the Dangerous Goods List and described in 4.2.5.3. The minimum wall thickness of the FRP shell shall not be less than that specified in 6.9.2.4.

6.9.2.3.3 At the specified test pressure the maximum tensile relative deformation measured in mm/mm in the shell shall not result in the formation of microcracks, and therefore not be greater than the first measured point of elongation based fracture or damage of the resin, measured during tensile tests prescribed under 6.9.2.7.1.2 (c).

6.9.2.3.4 For internal test pressure, external design pressure specified in 6.7.2.2.10, static loads specified in 6.7.2.2.12 and static gravity loads caused by the contents with the maximum density specified for the design and at maximum filling degree, failure criteria

(FC) in the longitudinal direction, circumferential direction, and any other in-plane direction of the composite layup shall not exceed the following value:

$$FC \leq \frac{1}{K}$$

where:

$$K = K_0 \times K_1 \times K_2 \times K_3 \times K_4 \times K_5$$

where:

K shall have a minimum value of 4.

K_0 is a strength factor. For the general design the value for K_0 shall be equal to or more than 1.5. The value of K_0 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_2 is a factor related to the deterioration in the material properties due to creep and ageing. It shall be determined by the formula:

$$K_1 = \frac{1}{\alpha\beta}$$

where "α" is the creep factor and "β" is the ageing factor determined in accordance with 6.9.2.7.1.2 (e) and (f), respectively. When used in calculation, factors α and β shall be between 0 and 1.

Alternatively, a conservative value of K_2 = 2 may be applied for the purpose of undertaking the numerical validation exercise in 6.9.2.3.4 (this does not remove the need to perform testing to determine α and β);

K_2 is 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_2 = 1.25 - 0.0125 (HDT - 70) where HDT is the heat distortion temperature of the resin, in °C;

K_3 is a factor related to the fatigue of the material; the value of K_3 = 1.75 shall be used unless otherwise agreed with the competent authority. For the dynamic design as outlined in 6.7.2.2.12 the value of K_3 = 1.1 shall be used;

K_4 is a factor related to resin curing and has the following values:

1.0 where curing is carried out in accordance with an approved and documented process, and the quality system described under 6.9.2.2.2 includes verification of degree of cure for each FRP portable tank using a direct measurement approach, such as differential scanning calorimetry (DSC) determined via ISO 11357-2:2016, as per 6.9.2.7.1.2 (i);

1.1 where thermoplastic resin forming or thermoset resin curing is carried out in accordance with an approved and documented process, and the quality system described under 6.9.2.2.2 includes verification of whichever is applicable formed thermoplastic resin characteristics or degree of cure of thermoset resin, for each FRP portable tank using an indirect measurement approach as per 6.9.2.7.1.2 (h), such as Barcol testing via ASTM D2583:2013-03 or EN 59:2016, HDT via ISO 75-1:2013, thermo-mechanical analysis (TMA) via ISO 11359-1:2014, or dynamic thermo-mechanical analysis (DMA) via ISO 6721-11:2019;

1.5 in other cases.

K_5 is a factor related to the portable tank instruction in 4.2.5.2.6:

1.0 for T1to T19;

1.33 for T20;

1.67 for T21 to T22.

A design validation exercise using numerical analysis and a suitable composite failure criterion is to be undertaken to verify that the plies in the shell are below the allowables. Suitable composite failure criteria include, but are not limited to, Tsai-Wu, Tsai-Hill, Hashin, Yamada-Sun, Strain Invariant Failure Theory, Maximum Strain, or Maximum Stress. Other relations for the strength criteria are allowed upon agreement with the competent authority. The method and results of this design validation exercise are to be submitted to the competent authority.

The allowables are to be determined using experiments to derive parameters required by the chosen failure criteria combined with factor of safety K, the strength values measured as per 6.9.2.7.1.2 (c), and the maximum elongation strain criteria prescribed in 6.9.2.3.5. The analysis of joints is to be undertaken in accordance with the allowables determined in 6.9.2.3.7 and the strength values measured as per 6.9.2.7.1.2 (g). Buckling is to be considered in accordance with 6.9.2.3.6. Design of openings and metallic inclusions is to be considered in accordance with 6.9.2.3.8.

6.9.2.3.5 At any of the stresses as defined in 6.7.2.2.12 and 6.9.2.3.4, the resulting elongation in any direction shall not exceed the value indicated in the following table or one tenth of the elongation at fracture of the resin determined by ISO 527-2:2012, whichever is lower.

Examples of known limits are presented in the table below.

Type of resin	**Maximum strain in tension (%)**
Unsaturated polyester or phenolic	0.2
Vinylester	0.25
Epoxy	0.3
Thermoplastic	See 6.9.2.3.3

6.9.2.3.6 For the external design pressure the minimum safety factor for linear buckling analysis of the shell shall be as defined in the applicable pressure vessel code but not less than three.

6.9.2.3.7 The adhesive bondlines and/or overlay laminates used in the joints, including the end joints, connection between the equipment and shell, the joints of the surge plates and the partitions with the shell shall be capable of withstanding the loads of 6.7.2.2.12, 6.9.2.2.3.1, 6.9.2.3.2, 6.9.2.3.4 and 6.9.2.3.6. In order to avoid concentrations of stresses in the overlay lamination, the applied taper 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:

$$\tau = \gamma \frac{Q}{l} \leq \frac{\tau_R}{K}$$

where:

τ_R is the interlaminar shear strength according to ISO 14130:1997 and Cor 1:2003;

Q is the load per unit width of the interconnection;

K is the safety factor determined as per 6.9.2.3.4;

l is the length of the overlay laminate;

γ is the notch factor relating average joint stress to peak joint stress at failure initiation location.

Other calculation methods for the joints are allowed following approval with the competent authority.

6.9.2.3.8 Metallic flanges and their closures are permitted to be used in FRP shells, under design requirements of 6.7.2. Openings in the FRP shell shall be reinforced to provide at least the same safety factors against the static and dynamic stresses as specified in 6.7.2.2.12, 6.9.2.3.2, 6.9.2.3.4 and 6.9.2.3.6 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.

If metallic flanges or componentry are integrated into the FRP shell using bonding, then the characterisation method stated in 6.9.2.3.7 shall apply to the joint between the metal and FRP. If the metallic flanges or componentry are fixed in an alternative fashion, e.g. threaded fastener connections, then the appropriate provisions of the relevant pressure vessel standard shall apply.

6.9.2.3.9 Check calculations of the strength of the shell shall be performed by finite element method simulating the shell layups, joints within FRP shell, joints ~~of~~ between the FRP shell and the container frame, and openings. Treatment of singularities shall be undertaken using an appropriate method according to the applicable pressure vessel code.

6.9.2.4 ***Minimum wall thickness of the shell***

6.9.2.4.1 Minimum thickness of the FRP shell shall be confirmed by check calculations of the strength of the shell considering strength requirements given in 6.9.2.3.4.

6.9.2.4.2 Minimum thickness of the FRP shell structural layers shall be determined in accordance with 6.9.2.3.4, however, in any case the minimum thickness of the structural layers shall be at least 3 mm.

6.9.2.5 ***Equipment components for portable tanks with FRP shell***

Service equipment, bottom openings, pressure relief devices, gauging devices, supports, frameworks, lifting and tie-down attachments of portable tanks shall meet the requirements of 6.7.2.5 to 6.7.2.17. If any other metallic features are required to be integrated into the FRP shell, then the provisions of 6.9.2.3.8 shall apply.

6.9.2.6 ***Design approval***

6.9.2.6.1 Design approval of FRP portable tanks shall be as per 6.7.2.18 requirements. The following additional requirements apply to FRP portable tanks.

6.9.2.6.2 The prototype test report for the purpose of the design approval shall additionally include the following:

(a) Results of the material tests used for FRP shell fabrication in accordance with 6.9.2.7.1 requirements;

(b) Results of the ball drop test in accordance with the requirements of 6.9.2.7.1.4.

(c) Results the fire resistance test in accordance with provisions of 6.9.2.7.1.5.

6.9.2.6.3 A service life inspection programme shall be established, which shall be a part of the operation manual, to monitor the condition of the tank at periodic inspections. The inspection programme shall focus on the critical stress locations identified in the design analysis performed under 6.9.2.3.4. The inspection method shall take into account the potential damage mode at the critical stress location (e.g, tensile stress or interlaminate stress). The inspection shall be a combination of visual and non-destructive testing (e.g., acoustic emissions, ultrasonic evaluation, thermographic). For heating elements, the service life inspection programme shall allow an examination of the shell or its representative locations to take into account the effects of overheating.

6.9.2.6.4 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.

6.9.2.6.4.1 The prototype shall be inspected for compliance with the design type specification. This shall include an internal and external inspection and measurement of the main dimensions.

6.9.2.6.4.2 The prototype, equipped with strain gauges at all locations of high strain, as identified by the design validation exercise in accordance with 6.9.2.3.4, shall be subjected to the following loads and the strain shall be recorded:

(a) Filled with water to the maximum filling degree. The measuring results shall be used to calibrate the design calculations according to 6.9.2.3.4;

(b) Filled with water to the maximum filling degree and subjected to static loads in all three directions mounted by the base corner castings without additional mass applied external to the shell. For comparison with the design calculation according to 6.9.2.3.4 the strains recorded shall be extrapolated in relation to the quotient of the accelerations required in 6.7.2.2.12 and measured;

(c) Filled with water and subjected to the specified test pressure. Under this load, the shell shall exhibit no visual damage or leakage.

The stress corresponding to the measured strain level shall not exceed the minimum factor of safety calculated in 6.9.2.3.4 under any of these loading conditions.

6.9.2.7 ***Additional provisions applicable to FRP portable tanks***

6.9.2.7.1 *Material testing*

6.9.2.7.1.1 Resins

Resin tensile elongation shall be determined in accordance with ISO 527-2:2012. The heat distortion temperature (HDT) of the resin shall be determined in accordance with ISO 75-1:2013.

6.9.2.7.1.2 Shell samples

Prior to testing, all coatings shall be removed from the samples. If shell samples are not possible then parallel shell samples may be used. The tests shall cover:

(a) Thickness of the laminates of the central shell wall and the ends;

(b) Mass content and composition of composite reinforcement by ISO 1172:1996 or ISO 14127:2008, as well as orientation and arrangement of reinforcement layers;

(c) Tensile strength, elongation at fracture and modulus of elasticity according to ISO 527-4:1997 or ISO 527-5:2009 for the circumferential and longitudinal directions of the shell. For areas of the FRP shell, tests shall be performed on representative laminates in accordance with ISO 527-4:1997 or ISO 527-5:2009, to permit evaluation of the suitability of safety factor (K). A minimum of six specimens per measure of tensile strength shall be used, and the tensile strength shall be taken as the average minus two standard deviations;

(d) Bending deflection and strength shall be established by the three-point or four-point bending test according to ISO 14125:1998 + Amd 1:2011 using a sample with a minimum width of 50 mm and a support distance of at least 20 times the wall thickness. A minimum of five specimens shall be used.

(e) Creep factor α shall be determined by taking the average result of at least two specimens with the configuration described in (d), subject to creep in three-point or four-point bending, at the maximum design temperature nominated under 6.9.2.2.4, for a period of 1 000 hours. The following test is to be undertaken for each specimen:

(i) Place specimen into bending apparatus, unloaded, in oven set to maximum design temperature and allow to acclimatise for a period of not less than 60 minutes;

(ii) Load specimen bending in accordance with ISO 14125:1998 + Amd 1:2011 at flexural stress equal to the strength determined in (d) divided by four. Maintain mechanical load at maximum design temperature without interruption for not less than 1 000 hours;

(iii) Measure the initial deflection six minutes after full load application in (e) (ii). Specimen shall remain loaded in test rig;

(iv) Measure the final deflection 1 000 hours after full load application in (e) (ii); and

(v) Calculate the creep factor α by dividing the initial deflection from (e) (iii) by the final deflection from (e) (iv).

(f) Ageing factor β shall be determined by taking the average result of at least two specimens with the configuration described in (d), subject to loading in static three-point or four-point bending, in conjunction with immersion in water at the maximum design temperature nominated under 6.9.2.2.4 for a period of 1 000 hours. The following test is to be undertaken for each specimen:

(i) Prior to testing or conditioning, specimens shall be dried in an oven at 80 °C for a period of 24 hours;

(ii) The specimen shall be loaded in three-point or four-point bending at ambient temperature, in accordance with to ISO 14125:1998 + Amd 1:2011, at the flexural stress level equal to the strength determined in (d) divided by four. Measure the initial deflection 6 minutes after full load application. Remove specimen from test rig;

(iii) Immerse unloaded specimen in water at the maximum design temperature for a period of not less than 1 000 hours without interruption to the water conditioning period. When conditioning period has lapsed, remove specimens, keep damp at ambient temperature, and complete (f) (iv) within three days;

(iv) The specimen shall be subject to second round of static loading, in a manner identical to (f) (ii). Measure the final deflection six minutes after full load application. Remove specimen from test rig; and

(v) Calculate the ageing factor β by dividing the initial deflection from (f) (ii) by the final deflection from (f) (iv).

(g) The interlaminar shear strength of the joints shall be measured by testing representative samples in accordance with ISO 14130:1997;

(h) The efficiency of whichever is applicable of thermoplastic resin forming characteristics or thermoset resin cure and post-cure processes for laminates are to be determined using one or more of the following methods:

(i) Direct measurement formed thermoplastic resin characteristics or thermoset resin degree of cure: glass transition temperature (Tg) or melting temperature (Tm) determined using differential scanning calorimetry (DSC) via ISO 11357-2:2016; or

(ii) Indirect measurement of formed thermoplastic resin or thermoset resin degree of cure:

- HDT via ISO 75-1:2013;
- Tg or T_m using thermo-mechanical analysis (TMA) via ISO 11359-1:2014;
- Dynamic thermo-mechanical analysis (DMA) via ISO 6721-11:2019:
- Barcol testing via ASTM D2583:2013-03 or EN 59:2016.

6.9.2.7.1.3 The chemical compatibility of the liner and chemical contact surfaces of service equipment with the substances to be carried shall be demonstrated by one of the following methods. 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.

(a) 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 1 000 hours at 50 °C or the maximum temperature at which a particular substance is approved for transport. 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;

(b) Certified and documented data of positive experiences on the compatibility of filling substances in question with the materials of the shell with which they come into contact at given temperatures, times and other relevant service conditions;

(c) Technical data published in relevant literature, standards or other sources, acceptable to the competent authority;

(d) Upon agreement with the competent authority other methods of chemical compatibility verification may be used.

6.9.2.7.1.4 Ball drop test as per EN 976-1:1997

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.

6.9.2.7.1.5 Fire resistance test

6.9.2.7.1.5.1 A representative prototype tank 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 fire shall be equivalent to a theoretical fire with a flame temperature of 800 °C, emissivity of 0.9 and to the tank a heat transfer coefficient of 10 W/(m²K) and surface absorptivity of 0.8. A minimum net heat flux of 75 kW/m² shall be calibrated according to ISO 21843:2018. 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.

6.9.2.8 ***Inspection and testing***

6.9.2.8.1 Inspection and testing of portable FRP tanks shall be carried out as per provisions of 6.7.2.19. In addition, welded thermoplastic liners shall be spark tested under a suitable standard, after pressure tests performed in accordance with the periodic inspections specified in 6.7.2.19.4.

6.9.2.8.2 In addition, the initial and periodic inspections shall follow the service life inspection programme and any associated inspection methods per 6.9.2.6.3.

6.9.2.8.3 The initial inspection and test shall verify that construction of the tank is made in accordance with the quality system required by 6.9.2.2.2.

6.9.2.8.4 Additionally, during inspection of the shell the position of the areas heated by heating elements shall be indicated or marked, be available on design drawings or shall be made visible by a suitable technique (e.g. infrared). Examination of the shell shall take into account the effects of overheating, corrosion, erosion, overpressure and mechanical overloading.

6.9.2.9 ***Retention of samples***

Shell samples (e.g. from manhole cut out) for each tank manufactured shall be maintained for future inspection and shell verification for a period of five years from the date of the initial inspection and test and until successful completion of the required five-year periodic inspection.

6.9.2.10 ***Marking***

6.9.2.10.1 The requirements of 6.7.2.20.1 apply to portable tanks with an FRP shell except those of 6.7.2.20.1 (f) (ii).

6.9.2.10.2 The information required in 6.7.2.20.1 (f) (i) shall be “Shell structural material: Fibre-reinforced plastic”, the reinforcement fibre e.g. “Reinforcement: E-glass”, and resin e.g. “Resin: Vinyl Ester”.

6.9.2.10.3 Requirements of provision 6.7.2.20.2 apply to portable tank with an FRP shell.”

Chapter 7.1

7.1.1.6 Replace “The interior and exterior” by “The interior and the exterior”. After the existing paragraph add the following new text:

“ The cargo transport unit shall be checked to ensure it is structurally serviceable, that it is free of possible residues incompatible with the cargo and that the interior floor, walls and ceiling, where applicable, are free from protrusions or deterioration that could affect the cargo inside and that freight containers are free of damages that affect the weather-tight integrity of the container, when required.

Structurally serviceable means that the cargo transport unit is free from major defects in its structural components. Structural components of cargo transport units for multimodal purpose are e.g. top and bottom side rails, top and bottom end rails, corner posts, corner fittings and, for freight containers, door sill, door header and floor cross members. Major defects include:

(a) Bends, cracks or breaks in structural or supporting members, or any damage to service or operational equipment that affect the integrity of the unit;

(b) Any distortion of the over-all configuration or any damage to lifting attachments or handling equipment interface features great enough to prevent proper alignment of handling equipment, mounting and securing on chassis, vehicle or wagon, or insertion into ships' cells; and, where applicable;

(c) Door hinges, door seals and hardware that are seized, twisted, broken, missing or otherwise inoperative.

NOTE: *For filling portable tanks and MEGCs, see Chapter 4.2. For filling bulk containers, see Chapter 4.3.*”

7.1.3.3.1 Delete 7.1.3.3.1 and renumber 7.1.3.3.2 accordingly.

7.1.5.3.2 (a) Replace “the word "STABILIZED"” by “the words "TEMPERATURE CONTROLLED"”.

7.1.5.3.2 (b) Delete footnote 1.

Table of correspondence between the IAEA regulations and the Model Regulations

In the title of the “Table of correspondence between paragraph numbers in the IAEA regulations…” replace “PARAGRPAPH NUMBERS” by “PARAGRAPHS, TABLES AND FIGURES” and replace “THE IAEA REGULATIONS FOR THE SAFE TRANSPORT OF RADIOACTIVE MATERIAL (2018 EDITION – SSR-6 (Rev. 1))” by “THE 2018 EDITION OF THE IAEA REGULATIONS FOR THE SAFE TRANSPORT OF RADIOACTIVE MATERIAL”. Add a heading above the first table to read “Correspondence between paragraphs”. In the header row of the first table, replace “SSR-6” by “IAEA” and “UN” by “Model regulations”. Replace the joint heading above the second and third tables by a heading above the second table reading “Correspondence between tables” and a heading above the third table reading “Correspondence between figures”. In the header row of the

second table, replace “SSR-6 Table” by “IAEA” and replace “UN Model Regulations” by “Model regulations”. In the header row of the third table, replace “SSR-6 Figure” by “IAEA” and replace “UN Model Regulations” by “Model regulations”.