



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

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Addendum

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¹ For practical reasons, these annexes have been published as an addendum with the symbol ST/SG/AC.10/C.3/126/Add.1.



I. Draft amendments to the twenty-third revised edition of the Recommendations on the Transport of Dangerous Goods, Model Regulations (ST/SG/AC.10/1/Rev.23)

Chapter 1.2

1.2.1 The amendment to the definition of “*Bulk container*” does not apply to the English version.

(Reference document: informal document INF.38)

In the definition of “*Net explosive mass (NEM)*”, after “(NEQ)”, replace the comma by “or” and after “(NEQ)”, delete “, or net explosive weight (NEW)”.

(Reference document: ST/SG/AC.10/C.3/2023/51)

Insert the following new definitions in alphabetical order:

“*Pressure volume product (pV-product)* means the value resulting from multiplying the (usable) water capacity of a containment with its relevant maximum pressure during filling and usage (e.g. test pressure or charging pressure) as referenced for the relevant kind of containment. It is expressed in bar litres.”

“*Usable water capacity* means the water capacity of salvage pressure receptacles remaining after the installation of equipment into a salvage pressure receptacle, which is necessary for e.g., opening or drilling a stored pressure receptacle inside a closed salvage pressure receptacle. The usable water capacity may be lower than the water capacity originally approved and marked. It is expressed in litres.”

(Reference document: informal document INF.52, proposal 4, with editorial amendments by the secretariat)

Chapter 2.0

2.0.5.2 In the second sentence, replace “Lithium cells and batteries” by “Lithium metal, lithium ion and sodium ion cells and batteries”. In the third sentence, replace “Lithium cells or batteries” by “Lithium metal, lithium ion or sodium ion cells or batteries” (twice).

(Reference document: ST/SG/AC.10/C.3/2023/57)

Chapter 2.5

2.5.3.2.4 In the table, add the following new entries:

tert-AMYL PEROXYPIVALATE	≤ 72	≥ 28				OP7	+10 °C	+15 °C	3115	
1,2,4,5,7,8-HEXOXONANE, 3,6,9-TRIMETHYL-3,6,9-tris (Ethyl and Propyl) derivatives	≤ 41	≥ 59				OP7			3105	35)

After the table, add the following new remark:

“35) Available oxygen ≤ 7.3 %.”

(Reference document: ST/SG/AC.10/C.3/2023/36)

Chapter 2.9

2.9.4 In the first paragraph, replace “contained in equipment” by “contained in articles, engines, equipment or vehicles” and amend the end to read “... in any

form may be transported under the appropriate entry if they meet the following provisions:”.

Add a new (h) to read as follows:

- “(h) Hybrid batteries, containing both lithium ion cells and sodium ion cells (see special provision 410 of chapter 3.3), shall meet the following conditions:
- (i) The lithium ion cells and sodium ion cells are electrically connected;
 - (ii) The battery has been tested as a lithium ion battery in accordance with 2.9.4 (a);
 - (iii) Each component lithium ion and sodium ion cell of the battery shall be of a type proved to meet the respective testing requirements of the *Manual of Tests and Criteria*, part III, sub-section 38.3.”

(Reference document: ST/SG/AC.10/C.3/2023/23, as amended and ST/SG/AC.10/C.3/2023/53, as amended)

2.9.5 In the first paragraph, replace “contained in equipment” by “contained in articles, engines, equipment or vehicles” and amend the end to read “... as electrolyte, may be transported under the appropriate entry if they meet the following provisions:”. Delete the introductory sentence before the subparagraphs.

(Reference document: ST/SG/AC.10/C.3/2023/23, as amended)

Chapter 3.2, dangerous goods list

For UN Nos. 1040, 1041 and 3300, in column (4), add “8”.

(Reference document: ST/SG/AC.10/C.3/2023/39, proposal 1)

For UN 1727, in column (4), add “6.1”.

(Reference document: ST/SG/AC.10/C.3/2023/42, as amended)

For UN 2020, amend column (2) to read “CHLOROPHENOLS, TOXIC, SOLID, N.O.S.” [and in column (6), add “274”].

(Reference document: informal document INF.55)

For UN 2021, amend column (2) to read “CHLOROPHENOLS, TOXIC, LIQUID, N.O.S.” [and in column (6), add “274”].

(Reference document: informal document INF.55)

For UN 2029, in column (6), add “132” and in column (9), add “PP5” against “P001”.

(Reference document: informal document INF.27)

For UN Nos. 3480, 3481, 3551 and 3552, in column (6), add “410”.

(Reference document: ST/SG/AC.10/C.3/2023/53)

Add the following new entries:

(1)	(2)	(3)	(4)	(5)	(6)	(7a)	(7b)	(8)	(9)	(10)	(11)
3561	CHLOROPHENOLS, CORROSIVE, TOXIC, SOLID, N.O.S.	8	6.1	II	[274]	1 kg	E2	P002 IBC08	B2, B4	T3	TP33
3562	CHLOROPHENOLS, CORROSIVE, SOLID, N.O.S.	8		II		1 kg	E2	P002 IBC08	B2, B4	T3	TP33

(Reference document: informal document INF.55, as amended)

Chapter 3.3

SP 188 In (c), replace “and (g)” by “, (g) and (h) if applicable”.

(Reference document: ST/SG/AC.10/C.3/2023/53)

In (f):

- In the first sentence, replace “lithium or sodium battery mark” by “battery mark”.
- In the note, replace “(lithium battery mark)” by “(battery mark)”.
- In the last paragraph, first sentence, replace “lithium or sodium battery mark” by “battery mark”.

(Reference document: ST/SG/AC.10/C.3/2023/57)

SP 277 In the first sentence, after “value”, add “for the purposes of exemptions in chapter 3.4”.

(Reference document: informal document INF.40)

SP 310 At the end of the first paragraph, replace “and (g)” by “, (g), (h) (ii) if applicable and (h) (iii) if applicable for lithium cells or batteries, and shall meet the provisions of 2.9.5 with the exception of 2.9.5 (a) and 2.9.4 (e) (vii) (as referred to in 2.9.5 (e)) for sodium ion cells or batteries”.

(Reference document: ST/SG/AC.10/C.3/2023/53 and informal document INF.58)

SP 360 Before the last sentence, add the following new sentence: “Vehicles powered only by hybrid batteries containing both lithium ion cells and sodium ion cells in accordance with 2.9.4 (h) shall be assigned to the entry UN 3556 VEHICLE, LITHIUM ION BATTERY POWERED.”.

In the last sentence, after “lithium batteries”, add “or hybrid batteries containing both lithium ion cells and sodium ion cells in accordance with 2.9.4 (h)”.

(Reference document: ST/SG/AC.10/C.3/2023/53, as amended)

SP 363 In (f), second sentence, replace “and (g)” by “, (g), (h) (ii) if applicable and (h) (iii) if applicable”.

(Reference document: ST/SG/AC.10/C.3/2023/53)

SP 379 In (d) (i), after “ISO 11114-1:2020”, add “+ Amd 1:2023”.

(Reference document: ST/SG/AC.10/C.3/2023/46, as amended)

SP 387 In the second sentence, replace “capacity” by watt-hour rating”.

(Additional amendment based on an oral proposal)

SP 388 In the second and third paragraphs, in the second sentence, replace “sodium batteries, lithium metal batteries or lithium ion batteries” by “metallic sodium batteries, sodium alloy batteries, lithium metal batteries, lithium ion batteries, hybrid batteries containing both lithium ion cells and sodium ion cells in accordance with 2.9.4 (h) or sodium ion batteries”.

In the sixth paragraph, add a new second sentence to read “Vehicles powered only by hybrid batteries containing both lithium ion cells and sodium ion cells in accordance with 2.9.4 (h) shall be assigned to the entry UN 3556 VEHICLE, LITHIUM ION BATTERY POWERED.”.

In the ninth paragraph, second sentence, replace “and (g)” by “, (g), (h) (ii) if applicable and (h) (iii) if applicable”.

(Reference document: ST/SG/AC.10/C.3/2023/53, as amended)

SP 389 In the first paragraph, first sentence, after “lithium ion batteries”, replace “or” by a comma and after “lithium metal batteries”, add “or hybrid batteries containing both lithium ion cells and sodium ion cells in accordance with 2.9.4 (h)”.

In the first paragraph, second sentence, replace “(g)” by (h)”.

(Reference document: ST/SG/AC.10/C.3/2023/53, as amended)

SP 400 In (a), replace “shall be” by “is”. In (c), replace “shall be” by “is”. In (d), replace “shall be” by “is”. In (e), first sentence, replace “shall be” by “are”. In (e), second sentence, replace “shall be” by “is”. In (f), replace “shall only contain” by “only contains”.

(Reference document: informal document INF.13)

SP 406 Replace “This entry” by “Substances under this entry”.

(Reference document: informal document INF.13)

SP 407 In (b), replace “shall be” by “is”. In (c), replace “shall be” by “is” and “shall not” by “do not”. In (d), replace “shall be” by “is”.

(Reference document: informal document INF.13)

Add the following new special provision:

“410 Hybrid batteries in conformity with 2.9.4 (h) containing both lithium ion cells and sodium ion cells shall be assigned to UN Nos. 3480 or 3481, as appropriate. When such batteries are transported in accordance with special provision 188, the watt-hour rating of all batteries shall not exceed 100 Wh and shall be marked on the outside case.”

(Reference document: ST/SG/AC.10/C.3/2023/53, as amended)

Alphabetical index

Delete the entry for “Dichlorophenol”.

For “CHLOROPHENOLS, LIQUID”, amend column “Name and description” to read “CHLOROPHENOLS, TOXIC, LIQUID, N.O.S.”.

For “CHLOROPHENOLS, SOLID”, amend column “Name and description” to read “CHLOROPHENOLS, TOXIC, SOLID, N.O.S.”.

Add the following new entries in alphabetical order:

CHLOROPHENOLS, CORROSIVE, TOXIC, SOLID, N.O.S.	8	3561
CHLOROPHENOLS, CORROSIVE, SOLID, N.O.S.	8	3562

(Reference document: informal document INF.55)

Chapter 4.1

4.1.1.19.3 In (c), first sentence, replace “and volume” by “, in usable water capacity and in pressure volume product”.

(Reference document: informal document INF.52, proposal 1, with editorial amendments by the secretariat)

4.1.4.1, P001 In PP5, replace “UN 1204” by “UN Nos. 1204 and 2029”.

(Reference document: informal document INF.27)

- 4.1.4.1, P006 In (5), first sentence, after “lithium cells or batteries”, add “or sodium ion cells or batteries” (twice) and replace “have not met” by “has not met”.

(Reference document: ST/SG/AC.10/C.3/2023/57 and informal document INF.13)

- 4.1.4.2, IBC520 For UN 3119, add a new entry to read as follows:

	tert-Butyl peroxy-2-ethylhexanoate, not more than 52 %, in diluent type A	31HA1 31A	1 000 1 250	+30 °C +30 °C	+35 °C +35 °C
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(Reference document: ST/SG/AC.10/C.3/2023/36, as amended)

- 4.1.4.3, LP03 In (4), first sentence, after “lithium cells or batteries”, add “or sodium ion cells or batteries” (twice).

(Reference document: ST/SG/AC.10/C.3/2023/57)

- 4.1.6.1.2 In the second sentence, after “ISO 11114-1:2020”, add “+ Amd 1:2023”.

(Reference document: ST/SG/AC.10/C.3/2023/46, as amended)

Chapter 4.2

- 4.2.6 At the end, add the following new paragraph:

“Portable tanks manufactured prior to 1 January 2027 which were marked in accordance with the requirements of 6.7.4.15.1 (i) (iv) applicable in the twenty second revised edition of the Model Regulations may continue to be used.”

(Reference documents: informal document INF.54, as amended)

Chapter 5.2

- 5.2.1.9 Amend the heading to read “**Battery mark**”.

In figure 5.2.5, amend the heading to read “**Battery mark**”.

(Reference document: ST/SG/AC.10/C.3/2023/57)

- 5.2.1.9.1 Replace “provision 188” by “provisions 188 or 400”.

(Reference document: ST/SG/AC.10/C.3/2023/43)

- 5.2.1.9 Add a new 5.2.1.9.3 to read as follows:

“5.2.1.9.3 When both the battery mark and labels in accordance with 5.2.2.2 other than model No. 9A are required, the battery mark shall be located on the same surface as the labels if the package dimensions are adequate.”

(Reference documents: ST/SG/AC.10/C.3/2023/57 and informal document INF.53, editorially amended)

- 5.2.2.1.13.1 In the second sentence, replace “lithium or sodium ion batteries” by “lithium batteries or sodium ion batteries” and replace “lithium or sodium ion battery mark” by “battery mark”. In the third sentence, replace “lithium or sodium ion batteries” by “lithium batteries or sodium ion batteries”.

(Reference document: ST/SG/AC.10/C.3/2023/57)

Chapter 5.5

- 5.5.4.1 The amendment does not apply to the English version.

(Reference document: informal document INF.38)

Chapter 6.1

6.1.4.12.1 In the second sentence, replace “ISO 535:2014” by “ISO 535:2023”.

(Reference document: ST/SG/AC.10/C.3/2023/31)

Chapter 6.2

6.2.1.5.1 In (g), before “technical code”, add “recognized”.

(Reference document: informal document INF.40, as amended)

6.2.1.5.2 In (d), (e) and (f), before “technical code”, add “recognized”. In (p), before “code”, add “recognized technical”.

(Reference document: informal document INF.40)

6.2.2.1.2 In the table, in the row for ISO 11515:2013 + Amd 1:2018, in column “Applicable for manufacture”, replace “Until further notice” by “Until 31 December 2030”. Add a new row beneath this row as follows:

ISO 11515:2022	Gas cylinders – Refillable composite reinforced tubes of water capacity between 450 l and 3000 l – Design, construction and testing	Until further notice
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(Reference document: ST/SG/AC.10/C.3/2023/21, proposal 1)

6.2.2.2 In the table, in the row for ISO 11114-1:2020, in the first column, after “ISO 11114-1:2020”, add “+ Amd 1:2023”.

(Reference document: ST/SG/AC.10/C.3/2023/46, as amended)

6.2.2.3 In the first table, in the row for ISO 14246:2014 + Amd 1:2017, in column “Applicable for manufacture”, replace “Until further notice” by “Until 31 December 2030”. Add a new row beneath this row as follows:

ISO 14246:2022	Gas cylinders — Cylinder valves — Manufacturing tests and examinations	Until further notice
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(Reference document: ST/SG/AC.10/C.3/2023/21, proposal 2)

6.2.2.4 In the first table, in the row for ISO 22434:2006, in column “Applicable”, replace “Until further notice” by “Until 31 December 2028”. Add a new row beneath this row as follows:

ISO 22434:2022	Gas cylinders - Inspection and maintenance of valves <i>NOTE: These requirements may be met at times other than at the periodic inspection and test of UN cylinders</i>	Until further notice
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(Reference document: ST/SG/AC.10/C.3/2023/21, proposal 3)

6.2.2.7.4 In (p), after “ISO 11114-1:2020”, add “+ Amd 1:2023”.

(Reference document: ST/SG/AC.10/C.3/2023/46, as amended)

6.2.2.9.2 In (j), after “ISO 11114-1:2020”, add “+ Amd 1:2023”.

(Reference document: ST/SG/AC.10/C.3/2023/46, as amended)

6.2.3.5 In the second paragraph, before the last sentence, add the following:

“This indication of authorized pressure receptacles shall contain the following information:

- (a) The test pressure to which the salvage pressure receptacle can be loaded at maximum temperature, which limits the storage of pressure receptacles filled with liquified gases.

- (b) The usable water capacity and the maximum pV-product authorized for stored pressure receptacles, which limits the storage of pressure receptacles filled with compressed gases. The value of this maximum pV-product is the lowest value of either of the following:
- (i) the general limit of the pV-product of 1.5 million bar litres; or
 - (ii) the pV-product of the salvage pressure receptacle based on the test pressure to which it is allowed to be loaded at maximum temperature and its usable water capacity.”

The last sentence of the second paragraph becomes a new paragraph. At the end of this sentence, add “in the approval certificate”.

In the last paragraph, amend the last sentence to read as follows:

“The marking of the salvage pressure receptacle shall include the usable water capacity, the test pressure and the maximum pressure volume product. This mark shall start with the letters "PVP", followed by the pV-product and the units. The pV-product shall include a space in front of the last 3 digits of the value. The units "BAR" and "L" shall be separated by a dot. For harmonised readability and to avoid subsequent manipulation, the mark shall not contain more spaces. An example of the PVP mark is given below:

PVP1500 000BAR.L”

At the end, replace the existing note by the following note:

“NOTE: *Salvage pressure receptacles with a water capacity of not more than 3000 litres may continue to be used without bearing the additional PVP mark until 31 December 2030.”*

(Reference document: informal document INF.52, proposals 2 and 3, with editorial amendments by the secretariat)

Chapter 6.5

- 6.5.2.1.1 In (g), first sentence, replace “stacking test load” by “superimposed stacking test mass”.

(Reference document: ST/SG/AC.10/C.3/2023/50, as amended)

- 6.5.2.1.3 In the first example, first sentence, replace “stacking test load” by “superimposed stacking test mass”.

(Reference document: ST/SG/AC.10/C.3/2023/50, as amended)

- 6.5.2.2.2 In the first sentence, replace “stacking load” by “superimposed stacking mass”.

(Reference document: ST/SG/AC.10/C.3/2023/50)

- 6.5.4.16 In the second sentence, replace “ISO 535:2014” by “ISO 535:2023”.

(Reference document: ST/SG/AC.10/C.3/2023/31)

- 6.5.5.3 In the second sentence, replace “ISO 535:2014” by “ISO 535:2023”.

(Reference document: ST/SG/AC.10/C.3/2023/31)

- 6.5.6.4 Replace “load to be placed on the IBC” by “mass placed on the IBC surface to create the superimposed test load”.

(Reference document: ST/SG/AC.10/C.3/2023/50)

Chapter 6.6

- 6.6.3.1 In (g), first sentence, replace “stacking test load” by “superimposed stacking test mass”.

(Reference document: ST/SG/AC.10/C.3/2023/50, as amended)

6.6.3.2 In the first and second examples, replace “stacking load” by “superimposed stacking test mass”.

(Reference document: ST/SG/AC.10/C.3/2023/50)

6.6.3.3 In the first sentence, replace “stacking load” by “superimposed stacking mass”.

(Reference document: ST/SG/AC.10/C.3/2023/50, as amended)

6.6.4.4.1 In the second sentence, replace “ISO 535:2014” by “ISO 535:2023”.

(Reference document: ST/SG/AC.10/C.3/2023/31)

6.6.5.3.3.4 Replace “load to be placed on the large packaging” by “mass placed on the large packaging surface to create the superimposed test load”.

(Reference document: ST/SG/AC.10/C.3/2023/50, consequential amendment)

Chapter 6.7

6.7.2.1 In the definition of “*Portable tank*”, in the last sentence, delete “, non-metallic tanks”.

(Reference document: ST/SG/AC.10/C.3/2023/41, proposal 2, as amended, consequential amendment)

[6.7.2.5.11 After “metals”, add “or fibre reinforced plastic (FRP) in accordance with section 6.9.3”.]

(Reference document: informal document INF.49)

6.7.5.2.4 In (a), after “ISO 11114-1:2020”, add “+ Amd 1:2023”.

(Reference document: ST/SG/AC.10/C.3/2023/46, as amended)

Chapter 6.8

6.8.4.1 The amendment does not apply to the English version.

(Reference document: informal document INF.38)

6.8.5.5.1 In (g), replace “stacking test load” by “superimposed stacking test mass”.

(Reference document: ST/SG/AC.10/C.3/2023/50, as amended)

Chapter 6.9

[6.9.1 Add a new 6.9.1.5 to read as follows:

“6.9.1.5 The requirements of section 6.9.3 are applied to FRP service equipment for portable tanks with shells made of metallic or FRP materials intended for the carriage of dangerous goods of Classes or Divisions 1, 3, 5.1, 6.1, 6.2, 8 and 9 by all modes of transport.”]

(Reference document: informal document INF.49)

6.9.2.4.6.2 The amendment does not apply to the English version.

(Editorial amendment)

6.9.2.5 In the heading, replace “*portable tanks with FRP shell*” by “*FRP portable tanks*”.

In the text under the heading, in the first sentence, [delete “bottom openings, pressure relief devices, gauging devices,”] and replace “portable tanks” by “FRP portable tanks”.

[At the end, add a new sentence to read: “FRP service equipment in accordance with section 6.9.3 may be used.”.]

(Reference documents: ST/SG/AC.10/C.3/2023/41, proposal 6, as amended and informal document INF.49)

6.9.2.6.4 Replace “tank” with “FRP portable tank”.

(Reference document: ST/SG/AC.10/C.3/2023/41, proposal 7)

6.9.2.8.3 Replace “tank” with “FRP portable tank”.

(Reference document: ST/SG/AC.10/C.3/2023/41, proposal 9)

6.9.2.8.4 Replace “shell” with “FRP shell” (twice).

(Reference document: ST/SG/AC.10/C.3/2023/41, proposal 10)

6.9.2.9 Replace “shell” by “FRP shell” (twice) and “tank” by “FRP portable tank”.

(Reference document: ST/SG/AC.10/C.3/2023/41, proposal 11)

6.9.2.10.2 Replace “Shell” with “FRP shell”.

(Reference document: ST/SG/AC.10/C.3/2023/41, proposal 12)

[Add a new 6.9.3 to read as follows:

6.9.3 Requirements for design, construction, inspection and testing of FRP service equipment for portables tanks

6.9.3.1 Definitions

For the purposes of this section, the definitions in 6.7.2.1 and 6.9.2.1 apply except for definitions related to metal materials for the construction of the service equipment of portable tanks.

Additionally, the following definitions apply to FRP service equipment.

FRP service equipment means service equipment as defined in 6.7.2.1 made of FRP materials including parts fabricated from other materials, as gate and seal assemblies, metallic parts, e.g. springs, fixings, applicable to both metallic and FRP shells of the portable tanks.

Injection moulding means a process of melting plastic pellets (thermosetting/thermoplastic polymers) and mixing with reinforcement agents like chopped glass fibres. Then, the mixture is metered into a mould with the help of high-pressure pumps or injection cylinders, which fills and solidifies to produce the final product.

Compression moulding means a process for producing composite parts in a wide range of volumes typically employing a matched metal tool in a heated (normally hydraulic) press to consolidate sheet materials or moulding compounds under pressure.

Reinforced reaction injection moulding (RRIM) means a process of mixing of two or more resins together in the mixing chamber to form a thermosetting polymer under high pressure. Reinforcement agents like glass fibres are added to the mixture. Then, the resin mixture is metered into a mould with the help of high-pressure pumps or injection cylinders.

Coupon-sample means an FRP sample fabricated and tested in accordance with national or international standards to determine design allowables.

Inspection-sample means a sample cut out from the FRP service equipment to establish the conformity of the serial FRP device to the prototype.

FRP constituents means reinforcement fibres or particles, thermoset or thermoplastic polymer (matrix), adhesives, and additives.

6.9.3.2 General design and construction requirements

6.9.3.2.1 For the purposes of this section, the requirements of 6.7.2.2.11, 6.7.2.5.1 to 6.7.2.5.6, 6.7.2.5.10, 6.7.2.6.3, 6.7.2.8.2, 6.7.2.8.3, 6.7.2.9, 6.7.2.12, 6.7.2.14 and 6.7.2.15 shall be applied to FRP service equipment including metallic parts (springs, fixings, etc.). FRP service equipment shall be designed and constructed in accordance with the

requirements of a pressure vessel code and national and international standards, applicable to FRP materials and recognized by the competent authority.

6.9.3.2.2 *Manufacturer's quality system*

6.9.3.2.2.1 FRP service equipment manufacturers shall have a documented quality system ensuring conformity of every item of the serial production of FRP service equipment to the approved prototype. The quality assurance program shall be submitted to the competent authority for approval. All manufacturer's suppliers of material and components for FRP service equipment shall have a documented quality system. The quality system shall be developed in compliance with the general principles of international and national quality standards.

6.9.3.2.2.2 The applicable provisions of 6.9.2.2.2 shall apply to FRP service equipment manufacturer's quality system.

6.9.3.2.3 *FRP service equipment*

6.9.3.2.3.1 FRP service equipment shall have appropriate rigid joints to the portable tank shell. The connections shall cause no local stress concentrations exceeding the design allowables for all operating and test conditions.

6.9.3.2.3.2 FRP service equipment 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.

6.9.3.2.3.3 FRP service equipment shall be designed and manufactured to withstand a test pressure that is not less than 1.5 times MAWP. Stop valves, piping devices and pipefittings intended for filling or discharging shall be designed and manufactured to withstand a pressure that is not less than 4 times MAWP. Specific provisions are stated substances in the applicable portable tank instruction indicated in column 10 of the Dangerous Goods List and described in 4.2.5, or by the portable tank special provision indicated in column 11 of the Dangerous Goods List and described in 4.2.5.3.

6.9.3.2.3.4 FRP service equipment shall withstand vibration, service impacts, exposure to substance temperature and environmental effects.

6.9.3.2.3.5 Design calculations for FRP service equipment and its joints to the portable tank shell shall be performed by the finite element method or another method recognized by the competent authority.

6.9.3.2.3.6 FRP service equipment shall meet the same requirements as given in 6.9.2.2.3.14 for the carriage of substances with a flash point of not more than 60 °C.

6.9.3.2.4 *Materials*

6.9.3.2.4.1 Resins

The processing of the resin mixture shall be carried out in strict compliance with the recommendations of the supplier. This concerns mainly the use of hardeners, initiators and accelerators. The resins can be:

- (a) Unsaturated polyester resins;
- (b) Vinyl ester resins;
- (c) Epoxy resins;
- (d) Phenolic resins; or
- (e) Thermoplastic resins.

The heat distortion temperature (HDT) of the resin and FRP, determined in accordance with standard ISO 75-1:2020 shall be at least 20°C higher than the maximum service temperature of the tank, but shall in any case not be lower than 70°C.

6.9.3.2.4.2 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 FRP service equipment, such as fillers, colours, pigments, etc. shall not cause weakening of the material, taking into account lifetime and temperature expectancy of the design.

6.9.3.2.4.3 Reinforcement fibres

Reinforcement fibres shall be chopped or continuous fibres of several types.

6.9.3.2.4.4 FRP service equipment shall be manufactured by compression moulding, injection moulding, reinforced reaction injection moulding or hand lay-up. Other manufacturing technologies may be applied with the agreement of the competent authority.

6.9.3.3 Design criteria

6.9.3.3.1 FRP service equipment shall be of a design capable of being stress-analyzed mathematically or experimentally by resistance strain gauges, or by other methods approved by the competent authority.

6.9.3.3.2 FRP service equipment shall be designed and manufactured to withstand the test pressures specified in 6.9.3.2.3.3.

6.9.3.3.3 At the specified test pressure, the maximum tensile relative deformation measured in mm/mm in the FRP service equipment 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 the tensile tests prescribed under 6.9.2.7.1.2 (c) and 6.9.3.4.1.1.

6.9.3.3.4 For the internal test pressure specified in 6.9.3.2.3.3, the failure criterion (FC) 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, K_1, K_2, K_3, K_4 are given in 6.9.2.3.4.

K_5 is a factor related to the deterioration in the material properties due to effects of salt fog spray and ultraviolet exposure. It shall be determined by the formula:

$$K_5 = \frac{\sigma_n}{\sigma_{eff}}$$

where:

σ_n is the nominal (under normal conditions) tensile strength of the FRP material and σ_{eff} is the tensile strength of the material after consecutive salt fog exposure in accordance with ISO 12944-2:2017, ISO 12944-6:2018, 168 hours at (35 ± 2) °C and ultraviolet exposure in accordance with ISO 4892-2, 168 hours at (23 ± 2) °C.

σ_{eff} is the minimum of $(\sigma_{eff1}, \sigma_{eff2}, \dots, \sigma_{effk})$, where 1, 2, ... k are identifiers of substances approved for transportation by the given portable tank. If a protective coating is used, the samples with the coating shall be fabricated and tested.

A design validation exercise using numerical analysis and a suitable composite failure criterion is to be undertaken to verify that stresses in the FRP service equipment are below the allowables. Suitable composite failure criteria include, but are not limited to strain invariant failure theory, maximum strain, or maximum stress. Other relations for the strength criterion are allowed upon agreement with the competent authority. The method, a proof of suitability for the chosen failure criterion with a list of relevant experiments for all parameters

used in the chosen failure criterion, and results of this design validation exercise are to be submitted to the competent authority.

The parameters used in the chosen failure criterion are to be determined using the relevant experiments and the maximum strain in tension prescribed in 6.9.2.3.5, combined with factor of safety K . At least all experiments defined in 6.9.3.4.2 shall be performed.

6.9.3.3.5 Check calculations of the strength for FRP service equipment and its joints to the portable tank shell shall be performed by finite element method. Treatment of singularities shall be undertaken using an appropriate method according to the applicable pressure vessel code.

6.9.3.4 *Material testing*

6.9.3.4.1 *Resins*

Where neat resin specimens are used for the materials testing set out in 6.9.3.4.1.1 and 6.9.3.4.1.2, the resin shall be processed in the same manner as when it is used in a composite material, taking into account mix ratios, resin additives, post-cure, and any other parameters deemed relevant to cure.

6.9.3.4.1.1 Resin tensile elongation shall be tested according to ISO 527-2:2012.

6.9.3.4.1.2 Heat distortion temperature shall be tested according to ISO 75-1:2020.

6.9.3.4.2 *Coupon-samples*

Coupon-samples shall be manufactured by the same technology as the appropriate FRP service equipment.

6.9.3.4.2.1 Ultimate tensile strength and elongation shall be tested according to ISO 527-4:2021 or ISO 527-5:2021 according to reinforcing fibres and layups.

6.9.3.4.2.2 Determination of compressive properties shall be tested in the in-plane direction according to ISO 14126:1999 + Cor 1:2001.

6.9.3.4.2.3 Determination of the in-plane shear stress/strain response and shear modulus shall be tested according to ISO 20337:2018.

6.9.3.4.2.4 Mass density shall be tested according to ISO 1183-1:2019.

6.9.3.4.2.5 Mass content and composition of the reinforcement fibres shall be tested according to ISO 1172:1996 or ISO 14127:2008. The fibre mass content of the coupon-samples shall be between 90 % and 100 % of the minimum fibre mass content specified for the appropriate FRP service equipment and obtained from testing of the inspection-samples.

6.9.3.4.2.6 Heat distortion temperature shall be tested according to ISO 75-1:2020, ISO 75-2:2013, ISO 75-3:2004 according to reinforcing fibres and layups.

6.9.3.4.2.7 Hardness shall be tested according to ISO 868:2003.

6.9.3.4.2.8 Creep factor α shall be measured according to procedure prescribed by 6.9.2.7.1.2 (e). The test samples shall be taken according to ISO 14125:1998.

6.9.3.4.2.9 Aging factor β shall be determined according to the procedure prescribed by 6.9.2.7.1.2 (f). The test samples shall be taken according to ISO 14125:1998. This testing may be undertaken on either pristine samples or on samples pre-subjected to salt fog spray exposure conditioning as outlined in 6.9.3.2.4.10.

6.9.3.4.2.10 Salt fog exposure test shall be determined in accordance with ISO 12944-2:2017, ISO 12944-6:2018, 168 hours at $+(35 \pm 2)$ °C.

6.9.3.4.2.11 Ultraviolet exposure test shall be determined in accordance with ISO 4892-2:2013, 168 hours at $+(23 \pm 2)$ °C.

6.9.3.4.2.12 The chemical compatibility with the transported substances shall be tested according to 6.9.2.7.1.3.

6.9.3.4.3 *Additional material tests*

The additional material tests shall be carried out for determination of material properties required for design calculation.

6.9.3.4.3.1 Flexural strength shall be measured according to ISO 14125:1998.

6.9.3.4.3.2 Bearing test shall be determined according to ISO 12815:2013.

6.9.3.4.4 *Inspection-samples*

Prior to testing all coatings shall be removed from the samples. The tests shall cover 6.9.3.4.2.1 to 6.9.3.4.2.8.

6.9.3.5 *Design approval*

6.9.3.5.1 The competent authority or its authorized body shall issue the type approval certificate for FRP service equipment. This certificate shall attest that the design has been surveyed by the authority and is suitable for its intended purpose and meets the requirements of this chapter. The certificate shall have a reference that prototype testing was carried out according to 6.9.3.5.2, the information on the substances allowed for transportation, body and seal materials and certificate number.

6.9.3.5.2 The FRP service equipment prototype test report shall include at least the following:

- (a) Results of the material tests used for fabrication of FRP service equipment in accordance with 6.9.3.4.1 to 6.9.3.4.3.
- (b) Results of tests according to ISO 4126-1:2013 for the appropriate relief devices.
- (c) Results of the pressure tests carried out in accordance with relevant ISO standards, where applicable, or according to procedure approved by the competent authority. The test pressure shall not be less than the pressure defined in 6.9.3.2.3.3.
- (d) A representative prototype of FRP service equipment shall be subjected to the fire test prescribed in the *Manual of Tests and Criteria*, part IV, section 42.
- (e) Results of the electrical resistance tests according to a procedure recognized by the competent authority.
- (f) Results of the other tests prescribed in applicable pressure equipment standards or codes in agreement with the competent authority.

6.9.3.5.3 A service life inspection program shall be established, which shall be a part of the operation manual, to monitor the condition of the FRP service equipment at periodic inspections. The service life inspection program shall be approved by the competent authority.

6.9.3.6 *Inspection and testing*

6.9.3.6.1 FRP service equipment shall be inspected and tested before being put into service. The initial inspection and test after manufacture shall include a check of the design characteristics and an external examination of FRP service equipment with due regard to the substances to be transported, and a pressure test. Before putting the FRP service equipment into service, a leakproofness test and a test of the satisfactory operation shall also be performed. Relief valves shall be tested for opening/closing pressure before installation. The initial inspection and testing program shall be approved by the competent authority.

6.9.3.6.2 Periodic inspection and testing of FRP service equipment shall be carried out during inspection of the portable tank according to 6.7.2.19.2, 6.7.2.19.4, and 6.7.2.19.5 or 6.9.2.8.1 according to the service life inspection program approved by the competent authority.

6.9.3.6.3 The inspections and tests in 6.9.3.6.1 and 6.9.3.6.2 shall be performed or witnessed by an expert approved by the competent authority.

6.9.3.6.4 Repair work of FRP service equipment shall be limited to replacement of damaged components by components covered by the type approval of the service equipment.

6.9.3.7 Marking6.9.3.7.1 *Marking of relief devices*

Each relief device shall be marked as follows:

- (a) name of the manufacturer and the serial number of the equipment;
- (b) name of body and seal materials;
- (c) type approval certificate number;
- (d) the pressure at which the device is set to discharge (MPa or bar);
- (e) the allowable tolerance at the discharge pressure for spring-loaded devices;
- (f) the rated flow capacity of spring-loaded pressure relief devices under normal conditions (external pressure is 1 bar and ambient temperature is 0 °C) in standard (normal) cubic meters of air per second, m³/s (determined according to 6.7.2.13.2);
- (g) cross-sectional area of spring-loaded pressure relief devices, mm²;
- (h) maximum allowable working pressure (MAWP), MPa or bar;
- (i) external design pressure (if relevant), MPa or bar; and
- (j) design temperature range.

6.9.3.7.2 *Marking of stop valves*

Each stop valves shall be marked as follows:

- (a) name of the manufacturer and the serial number of the equipment;
- (b) name of body and seal materials;
- (c) type approval certificate number;
- (d) designation of the stop device;
- (e) nominal diameter, mm;
- (f) maximum allowable working pressure (MAWP), MPa or bar;
- (g) test pressure, MPa or bar;
- (h) direction of medium flow; and
- (i) design temperature range.”]

(Reference document: informal document INF.49)

Chapter 7.1

7.1.7.2.3 The amendment does not apply to the English version.

(Reference document: informal document INF.38)

Modifications to ST/SG/AC.10/C.3/124/Add.1, annex 1

1.2.1 Delete the square brackets.

In the modification to the definition of “*Bundle of cylinders*”, modify the new sentence to read: “. The test pressure volume product taking into account the total water capacity of all pressure receptacles in the bundle shall not exceed 1.5 million bar litres.”.

(Reference document: informal document INF.52, proposals 4 and 5)

6.9.2.1 Delete the square brackets and modify the definition of “FRP portable tank” to read as follows:

“FRP portable tank means a portable tank, as defined in 6.7.2.1, with an FRP shell;”

(Reference document: ST/SG/AC.10/C.3/2023/41, proposal 2, as amended)

6.9.2.2.3.14.1 Delete the square brackets.

(Reference document: ST/SG/AC.10/C.3/2023/41, proposal 3)

6.9.2.8.1 Delete the square brackets and modify the amendment to read as follows:

“6.9.2.8.1 In the first sentence, replace “portable FRP tanks” by “FRP portable tanks”.”

(Reference document: ST/SG/AC.10/C.3/2023/41, proposal 4)

II. Modifications to the seventh version of the Guiding Principles for the Development of the Model Regulations on the Transport of Dangerous Goods [English only]

Part 4, C.2 In table 4.3, in the entry for Division 2.1, in column “Notes”, in the first sentence, after “UN”, add “Nos. 1041,”.

(Reference document: ST/SG/AC.10/C.3/2023/39, proposal 2, as amended)

III. Corrections to the twenty-third revised edition of the Recommendations on the Transport of Dangerous Goods, Model Regulations (ST/SG/AC.10/1/Rev.23)

Chapter 2.5, 2.5.3.2.4, table, METHYL ETHYL KETONE PEROXIDE(S), column “Packing Method”

For OP8 read OP7

(Reference document: informal document INF.46)

Chapter 6.2, 6.2.2.11, note

Not applicable to English

(Reference document: informal document INF.43)

IV. Draft amendments to the eighth revised edition of the Manual of Tests and Criteria (ST/SG/AC.10/11/Rev.8)

Section 11

11.6.1.3.1 In the fifth sentence, replace “weight” by “mass”.

(Reference document: ST/SG/AC.10/C.3/2023/44)

Section 12

12.6.1.3.1 In the fifth sentence, replace “weight” by “mass”.

(Reference document: ST/SG/AC.10/C.3/2023/44)

Section 13

13.4.1.3.1 The amendment does not apply to the English version.

(Reference document: ST/SG/AC.10/C.3/2023/44)

13.4.2.2.2 The amendment does not apply to the English version.

(Reference document: ST/SG/AC.10/C.3/2023/44)

Section 23

23.4.1.3.1 The first amendment does not apply to the English version. In the fifth sentence, replace “weight” by “mass”.

(Reference document: ST/SG/AC.10/C.3/2023/44)

Section 26

26.4.1.2.1 In the third sentence, replace “weight” by “mass”.

(Reference document: ST/SG/AC.10/C.3/2023/44)

Section 28

28.4.2.2.2.3 In the second sentence, replace “weight” by “mass”.

(Reference document: ST/SG/AC.10/C.3/2023/44)

Section 40

[40.1.1 After “schemes for”, add a colon, transfer the rest of the text to a new indent (a) and, at the end, replace the full stop with “; and”. Add a new (b) as follows:

“(b) the requirements to the fire resistance test of service equipment made from fibre reinforced plastic (FRP) for portable tanks (see section 42 of this *Manual* and 6.9.2.7.1.5 and 6.9.3.5.2 (d) of the *Model Regulations*).”]

(Reference document: informal document INF.49)

Section 42

[Add a new section 42 to read as follows:

“ **SECTION 42**

FIRE RESISTANCE TEST OF FIBRE REINFORCED PLASTICS (FRP) SERVICE EQUIPMENT FOR PORTABLE TANKS

42.1 General

42.1.1 This test method is intended to prove the fire resistance of FRP service equipment for portable tanks which meet the requirements of 6.7.2 or 6.9.2 of the *Model Regulations*.

42.1.2 The representative prototype of FRP service equipment meeting the definition of 6.9.3.1 of the *Model Regulations* shall be subjected to and satisfy the requirements of the fire resistance test. The fire resistance test shall be conducted by test facilities approved by the competent authorities.

42.2 Definitions

Test specimen means an instance of FRP service equipment including gate and seal assemblies subjected to the fire resistance test.

Relevant definitions of standard ISO 21843:2018 and chapters 6.7.2, 6.9.2 and 6.9.3 of the *Model Regulations* are applicable to this section.

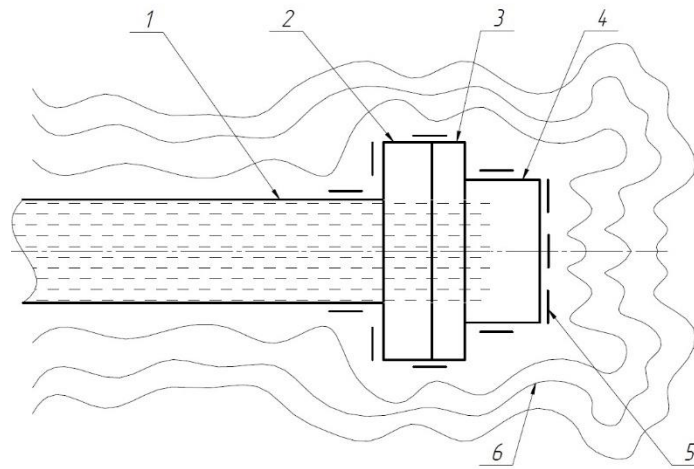
42.3 Test method

42.3.1 The fire resistance test is carried out for the test specimen installed in a closed position, filled with water with initial temperature of $20 \pm 5^\circ\text{C}$ under maximum allowable working pressure (MAWP, 6.7.2.1 of the *Model Regulations*), and exposures to flame for at least 30 minutes. Pressure relief devices are subjected to pressure, which is 10% below nominal pressure set to discharge (6.7.2.9.2 of the *Model Regulations*). The test specimen shall be completely engulfed in the flame including the gate and seal assemblies. The general test scheme is given in figure 42.3.1. If the test specimen is a part of equipment which is not intended to be the outermost closure in a multi-closure system (such as a valve), then the test specimen may be equipped with a blind flange, at its outermost interface which would otherwise be exposed to flame during the test.

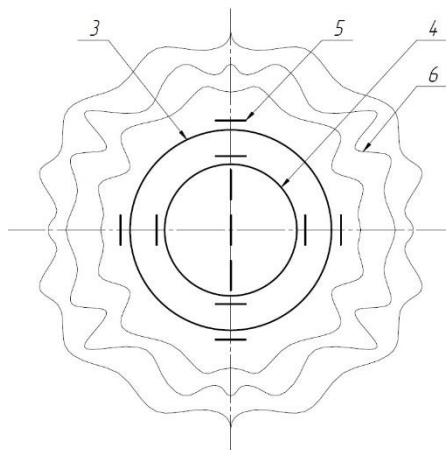
42.3.2 The fire exposure parameters shall comply with paragraph 6.9.2.7.1.5.1 of the *Model Regulations*. The fire shall be equivalent to a theoretical fire with a flame temperature of 800°C , emissivity of 0.9 and a minimum net heat flux of 75 kW/m^2 calibrated according to ISO 21843:2018.

42.3.3 The intensity of heat exposure shall be measured using temperature and heat flux sensors in accordance with the requirements of ISO 21843-2018.

42.3.4 After the fire exposure and cooling the test specimen is subjected to leakproofness test under MAWP.

Figure 42.3.1: Fire resistance test scheme

A



B

(A) Side view	(B) End-face view
(1) Pressure system with water supply	(2) Fixture to join the test specimen to the pressure system
(3) Flange of the test specimen	(4) Test specimen
(5) Temperature and heat flow measuring system	(6) Flame

42.4 Test apparatus**42.4.1 General requirements**

42.4.1.1 The fire resistance test bed shall include:

- (a) a fire chamber with dimensions sufficient to accommodate the test specimen and the temperature and heat flux measuring system;
- (b) a fuel supply and combustion system;
- (c) a pressure system with water supply ((1) in figure 42.3.1);
- (d) a fixture to join the test specimen to the test bed ((2) in figure 42.3.1); and
- (e) a temperature and heat flux measuring system ((5) in figure 42.3.1) according to ISO 21843:2018.

42.4.1.2 The specific types of testing equipment can be modified and supplemented in accordance with the requirements of the testing laboratory.

42.4.1.3 The test bed facilities shall not expose the test specimen to external influences that can affect the test results.

42.4.1.4 The heat regime shall be provided by burning liquid fuel or gas.

42.4.1.5 The test bed shall ensure uniform flame coverage of the test specimen.

42.4.1.6 The firing chamber shall provide a horizontal gap between any part of the test specimen and its own shell of at least 150 mm.

42.4.1.7 The fire source (nozzles) shall be at least 150 mm away from the test specimen and temperature sensors and shall provide sufficient power to ensure that the test specimen is completely engulfed in flame.

42.4.1.8 The fuel supply and combustion system shall be controlled.

42.4.2 Requirements of the measuring system

42.4.2.1 During the test the following parameters shall be measured:

- (a) temperature and heat flux on the surface of the test specimen;
- (b) internal pressure during fire and cooling (pressure gauge records);
- (c) leakproofness of the test specimen.

42.4.2.2 The general scheme of installation of the test specimen and temperature and heat flow sensors is shown in figure 42.3.1. Measurement errors shall not be more than:

- ± 3 % when measuring pressures;
- ± 5 % when measuring temperature and heat flux;
- ± 2 % when measuring time.

42.5 Test procedure

42.5.1 The temperature and heat flux sensors shall be installed and calibrated according to ISO 21843:2018.

42.5.2 Before the test, the test specimen and attachments shall be completely filled with water.

42.5.3 After the system is completely filled with water, the system shall be loaded with MAWP at a temperature of 20 °C. Then the leakproofness of the test specimen and pipelines shall be checked.

42.5.4 The fuel supply to the burners shall be opened, ignited and the flame be adjusted with a control valve. The fire parameters shall be maintained in accordance with 42.3.2 at least for 30 minutes. The temperature and heat flux are recorded every 30 seconds with separate records for each sensor during the test.

42.5.5 The fuel supply shall be turned off after the test (at least 30 minutes).

42.5.6 The test specimen shall be removed after complete cooling (wall temperature less than 50 °C). Then the test specimen shall be subjected to leakproofness test at MAWP.

42.5.7 At least 3 "open-closed" cycles (if any) shall be performed for pressure relief devices.

42.6 Performance criteria

42.6.1 The test specimen shall demonstrate leakproofness under MAWP after fire exposure. At least 3 "open-closed" cycles (if any) shall be performed for pressure relief devices. If this condition is met, the test specimen is considered to have passed the fire resistance test.

42.7 Test report

The test report shall contain:

- (a) the name of the organization conducting the tests;
- (b) the name of the manufacturer of the FRP service equipment;
- (c) the date of the fire resistance tests;
- (d) a description of the FRP service equipment, including dimensions, weight, diameter of the gate section, body and lid materials, seal material, marking;
- (e) a recording of the controlled parameters according to 42.4.2.1 and the results of their processing and analysis;
- (f) the results of visual observations;
- (g) a description of the damage or failure (if any);
- (h) the start time of the test (i.e., the ignition of the burners);
- (i) the conclusion on the compliance or non-compliance of the FRP service equipment with the requirements of 42.6.

42.8 Safety requirements

As the fire resistance test of the FRP service equipment is potentially dangerous, the safety of personnel shall be assured. Considering the possibility of damage and failure of the test, protective screens and other appropriate means to protect personnel shall be used.”]

(Reference document: informal document INF.49)

Appendix 7

A7.2.2 The first amendment does not apply to the English version. In (d), replace “weighing” by “with a mass”.

(Reference document: ST/SG/AC.10/C.3/2023/44)

Appendix 10

A10.3.2.2.1 In the first sentence, replace “weighing” by “with a mass”.

(Reference document: ST/SG/AC.10/C.3/2023/44)

The additional amendments to the Spanish version in ST/SG/AC.10/C.3/2023/44 were adopted.