



**Committee of Experts on the Transport of Dangerous Goods
and on the Globally Harmonized System of Classification
and Labelling of Chemicals****Sub-Committee of Experts on the Transport of Dangerous Goods****Fifty-fifth session**

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Item 6 (d) of the provisional agenda

**Miscellaneous proposals for amendments to the Model Regulations
on the Transport of Dangerous Goods: Portable tanks****Inclusion of the new section 6.9.4 “Requirements for design,
construction, inspection and testing of fibre reinforced plastic
(FRP) valves, relief devices and manholes for portable tanks”****Submitted by the Russian Federation*****General**

1. During the fifty-second session of the Sub-Committee, the Russian Federation submitted document ST/SG/AC.10/C.3/2017/40 on the new Chapter 6.9 “Provisions for design, manufacture, inspection and testing of portable tanks with polymer composite material (PCM) vessel intended for transport of substances of classes 3, 5 (Division 5.1), 6 (Divisions 6.1, and 6.2), 8 and 9.”
2. During the fifty-third and fifty-fourth sessions of the Sub-Committee, the informal working group on fibre-reinforced plastics (FRP) portable tanks agreed and worked on sections 6.9.1 (Application and general provisions) and 6.9.2 (Provisions for the design, construction, inspection and testing of portable tanks with shells made of Fibre Reinforced Plastics (FPR) materials intended for the transport of substances of classes 3, 5 (division 5.1), 6 (divisions 6.1 and 6.2), 8 and 9.
3. Noting the discussion in the informal working group on FRP portable tanks and at the plenary, the Russian Federation has recently proposed to discuss the additional section 6.9.3 “Requirements to the design, manufacture, inspection and testing of portable tanks with

* In accordance with the programme of work of the Sub-Committee for 2019-2020 approved by the Committee at its ninth session (see ST/SG/AC.10/C.3/108, paragraph 141 and ST/SG/AC.10/46, paragraph 14).

PCM vessel intended for carriage of non-refrigerated liquefied gas of maximum permissible working pressure 20.0 bar and less”.

4. Keeping in mind that at present, valves, relief devices and manholes made of metallic materials are installed in all types of portable tanks, the Russian Federation would like to bring to the attention of the Sub-Committee the fact that these devices have shorter service life in comparison with the service life of the tank itself in long-haul transport and intensive trans-shipment of the transported substances, especially when transporting corrosive substances.

5. The Russian Federation believes that using FRP materials in the construction of the mentioned service equipment leads to an increase of its service life and a reduction of repair and replacement costs.

6. The Russian Federation has acquired certain experience in using FRP materials for the construction of valves, relief devices and manholes as well as on their repair and inspection.

7. In view of the above, the Russian Federation would like to start discussions on the development of the a new section 6.9.4: “Requirements for design, construction, inspection and testing of fibre reinforced plastic (FRP) valves, relief devises and manholes for portable tanks”.

Requested actions

8. The Russian Federation invites the Sub-Committee to:
- (a) review the proposed draft of section 6.9.4: “Requirements for design, construction, inspection and testing of fibre reinforced plastic (FRP) valves, relief devices and manholes for portable tanks”;
 - (b) invite interested experts to contribute to its development;
 - (c) entrust the development of sections 6.9.3 and 6.9.4 to an informal working group.

Annex

“6.9.4 Requirements for design, construction, inspection and testing of fibre reinforced plastic (FRP) valves, relief devices and manholes for portable tanks

6.9.4.1 Definitions

Compression molding 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 at relatively high pressures.

Coupon-specimen means a FRP specimen constructed and tested in accordance with national and/or international standards to determine design allowable;

Design pressure means the pressure to be used in calculations required by a recognized pressure-vessel code. The design pressure shall be not less than the highest of the following pressures:

- (a) The maximum effective gauge pressure allowed in the shell during filling or discharge; or
- (b) The sum of:
 - (i) the absolute vapour pressure (in bar) of the substance at 65°C (or at the highest temperature during filling, discharge or transport for substances which are filled, discharged or transported over 65°C), minus 1 bar;
 - (ii) the partial pressure (in bar) of air or other gases in the ullage space, being determined by a maximum ullage temperature of 65°C and a liquid expansion due to an increase in mean bulk temperature of $t_r - t_f$ (t_f = filling temperature, usually 15°C; t_r = 50°C, maximum mean bulk temperature); and
 - (iii) a head pressure determined on the basis of the static forces specified in 6.7.2.2.12, but not less than 0.35 bar.
- (c) Two thirds of the minimum test pressure specified in the applicable portable tank instruction in 4.2.5.2.6;

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

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

FRP devices means valves, relief devices and manholes made of FRP for portable tanks.

Injection molding means a process of melting plastic pellets (thermosetting/ thermoplastic polymers) that once malleable enough, are injected at pressure into a mould cavity, which fills and solidifies to produce the final product.

Inspection-specimen means a sample cut out from the FRP device to establish the identity of serial FRP device to the prototype.

Leakproofness test means a test using gas, subjecting the shell and its service equipment to an effective internal pressure of not less than 25% of the Maximum Allowable Working Pressure (MAWP);

Maximum allowable working pressure (MAWP) means a pressure that shall be not less than the highest of the following pressures measured at the top of the shell while in operating position:

- (a) the maximum effective gauge pressure allowed in the shell during filling or discharge; or
- (b) the maximum effective gauge pressure to which the shell is designed, which shall be not less than the sum of:

Safety factor means a ratio of a failure load to the load applied to the FRP device.

Test pressure means the maximum gauge pressure at the top of the shell during the hydraulic pressure test, equal to not less than 1.5 times the design pressure. The minimum test pressure for portable tanks intended for specific substances is specified in the applicable portable tank instruction in 4.2.5.2.6.

6.9.4.2 *Materials*

6.9.4.2.1 *Raw materials and components*

6.9.4.2.1.1 FRP constituents compatible with the transported substances at operating temperatures from -400C to + 500C shall be used for manufacturing of FRP devices. Provisions to the constituents for other operating temperatures are specially considered by the competent authority.

6.9.4.2.1.2 A material of the FRP devices shall provide the long-term chemical resistance to the transported substances, prevent any dangerous reaction with the substances or the formation of dangerous compounds and weakening of the FRP device due to the diffusion of substances through the device.

6.9.4.2.1.3 A material of the FRP devices shall provide the long-term resistance to ultraviolet radiation and salt fog. Additionally, it shall prevent accumulation of electric charges according to 6.9.4.2.2.9 for the transport of flammable liquids.

6.9.4.2.1.4 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.

6.9.4.2.1.4.1 These resins can be:

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

6.9.4.2.1.4.2 The heat distortion temperature (HDT) of the resin, determined in accordance with ISO 75-1:2013 and ISO 75-2:2013 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.

6.9.4.2.1.4.3 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.

- 6.9.4.2.1.5 Reinforcement fibres
The reinforcement fibres shall be short-chopped fibres of several types.
- 6.9.4.2.1.6 FRP devices shall be manufactured by compression molding or injection molding. Other manufacturing technologies may be applied with the agreement of the competent authority.
- 6.9.4.2.2 *General design and construction provisions*
- 6.9.4.2.2.1 The provisions of 6.7.2.2.11, 6.7.2.5.1, 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 and 6.7.2.13 shall be applied to FRP devices.
- 6.9.4.2.2.2 FRP devices shall have a rigid appropriate joints to the portable tank shell. The connections shall cause no dangerous local stress concentrations exceeding the design allowable for all operating and test conditions.
- 6.9.4.2.2.3 FRP devices shall be designed and constructed to withstand the test pressure which is not less than 1.5 times the design pressure. Specific provisions are stated for certain substances in the applicable portable tank instruction indicated in column 13 of the Dangerous Goods List and described in 4.2.5, or by the portable tank special provision indicated in column 14 of the Dangerous Goods List and described in 4.2.5.3.
- 6.9.4.2.2.4 The failure internal pressure shall be not less than the highest of the following pressures:
- (a) Four of the MAWP;
 - (b) Four of the pressure to which the FRP device may be exposed during operation when the pump or other devices are operated with the exception of pressure relief devices.
- 6.9.4.2.2.5 The FRP devices shall withstand vibration, service impacts, exposure to substance temperature and the environment effects.
- 6.9.4.2.2.6 Design calculations for FRP devices and its joints to the portable tank shell shall be performed by finite element method.
- 6.9.4.2.2.7 The strength of bolted and glued joints of the FRP devices to the portable tank shell shall be confirmed by testing of the tank according to 6.7.2.3.2.
- 6.9.4.2.2.8 Special requirements for the carriage of substances with a flash-point of not more than 60°C.
- 6.9.4.2.2.8.1 The FRP devices installed to the portable tanks used for the carriage of flammable liquids of class 3 with a flash-point of not more than 60°C shall be constructed so as to ensure the elimination of static electricity from the various component parts so as to avoid the accumulation of dangerous charges.
- 6.9.4.2.2.8.2 The electrical surface resistance of the FRP devices as established by measurements shall not be higher than 109 ohms. This may be achieved using additives in the resin such as metal or carbon network.
- 6.9.4.2.2.8.3 The discharge resistance to earth as established by measurements shall not be higher than 107 ohms.
- 6.9.4.2.2.8.4 The electrical resistance between the FRP devices and the portable tank shell contacting to each other shall not exceed 10 ohms.
- 6.9.4.2.3 *Inspection and testing*
- 6.9.4.2.3.1 Material testing

6.9.4.2.3.1.1 Resins

Resin tensile elongation shall be determined in accordance with ISO 527-2:2012, heat distortion temperature – according to ISO 75-1:2013.

6.9.4.2.3.1.2 Coupon-specimens

6.9.4.2.3.1.2.1 The following strength properties shall be determined:

- Ultimate tensile strength according to ISO 527-4;
- Ultimate compressive strength according to ISO 14126;
- Ultimate flexural strength according to ISO 178.

The strength properties shall be determined using specimens manufactured by the same technology as applied to the appropriate FRP device.

6.9.4.2.3.1.2.2 Mass density according to ISO 1183–1.

6.9.4.2.3.1.2.3 Mass content and composition of the reinforcement fibres according to ISO 1172. The fibre mass content of the coupon-specimens shall be between 90% and 100% of the minimum fibre mass content specified for the appropriate FRP device.

6.9.4.2.3.1.2.4 The additional material tests may be conducted for determination of material properties required for design calculation.

6.9.4.2.3.1.2.5 The chemical compatibility of FRP material with the transported substances shall be confirmed according to ISO 175.

6.9.4.2.3.1.2.6 Hardness according to ISO 868.

6.9.4.2.3.1.3 Inspection-specimens.

Prior to testing all coatings shall be removed from the specimens. The tests shall cover:

6.9.4.2.3.1.3.1 Mass density according to ISO 1183–1.

6.9.4.2.3.1.3.2 Mass content and composition of the reinforcement fibres according to ISO 1172.

6.9.4.2.3.1.3.3 The chemical compatibility of FRP materials with the transported substances shall be confirmed according to ISO 175. Upon agreement with the competent authority other methods for verification of chemical compatibility may be used.

6.9.4.2.3.1.3.4 Hardness according to ISO 868.

6.9.4.2.3.1.4 Testing of FRP devices

6.9.4.2.3.1.4.1 The pressure test shall be conducted by method agreed with the competent authority. This method shall cover general requirements of ISO 5208.

6.9.4.2.3.1.4.2 The leakproofness test shall be conducted by method agreed with the competent authority. This method shall cover general requirements of ISO 5208.

6.9.4.2.3.1.4.3 The FRP devices shall be exposed to the fire resistance test according to resolution IMO A.753(18).
