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## RESTRUCTURING OF RID/ADR

### Chapter 6.8

Transmitted by the Government of France

The secretariat has received from the Government of France the text of Chapter 6.8 (see document TRANS/WP.15/AC.1/1999/5-OCTI/RID/GT-III/1999/5), revised by the Governments of France and Germany.

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**6.8 REQUIREMENTS FOR THE CONSTRUCTION, EQUIPMENT, TYPE APPROVAL, TESTING AND MARKING OF TANK-WAGONS, WAGONS WITH MOVABLE TANKS/FIXED TANKS (TANK-VEHICLES) (FIXED TANKS), VEHICLES WITH DEMOUNTABLE TANKS AND TANK-CONTAINERS AND TANK SWAP BODIES, WITH SHELLS MADE OF METALLIC MATERIALS, AND BATTERY-WAGONS/BATTERY-VEHICLES AND MULTIPLE ELEMENT GAS CONTAINERS (MEGC)**

**6.8.1 General provisions for application**

**6.8.1.1** The requirements across the whole width of the page apply both to tank-wagons, wagons with movable tanks and battery-wagons/fixed tanks (tank battery-vehicles), (fixed tanks), vehicles with to demountable tanks and battery-vehicles, and to tank-containers, tank swap bodies and MEGC. Those contained in a single column apply only:

to tank-wagons, wagons with movable tanks and battery-wagons/fixed tanks (tank-vehicles), (fixed tanks), vehicles with to demountable tanks and battery-vehicles (left hand column);

tank-containers, tank swap bodies and MEGC (right hand column).

**6.8.1.2** [1.1.1] These requirements shall apply to tank-wagons, wagons with movable tanks and battery-wagons/fixed tanks (tank-vehicles), (fixed tanks), vehicles with demountable tanks and battery-vehicles

tank-containers, tank swap bodies and MEGC

used for the carriage of gaseous, liquid, powdery or granular substances, and to their accessories.

**6.8.1.3** [1.1.2] Section 6.2 sets out the requirements applicable to tank-wagons, wagons with movable tanks/fixed tanks (tank-vehicles), (fixed tanks), vehicles with to demountable tanks, tank-containers, tank swap bodies intended for the carriage of substances of all classes and battery-wagons/battery-vehicles and MEGC for gases of Class 2. Sections 6.8.3 and 6.8.4 contain special requirements supplementing or modifying the requirements of section 6.8.2.

**6.8.1.4** For requirements concerning use of tanks see Chapter 4.3.

**6.8.2 Requirements applicable to all classes**

## 6.8.2.1 Construction

### Basic principles

**6.8.2.1.1** [1.2.2 211 121 (1) 212 121] Shells, their fastenings and their service and structural equipment shall be designed to withstand without loss of contents (other than quantities of gas escaping through any degassing vents):

- static and dynamic stresses in normal conditions of carriage as defined in 6.8.2.1.2;
- prescribed minimum stresses as defined in ~~[1.2.6]~~ 6.8.2.1.15.

**6.8.2.1.2** [RID XI 1.2.8.1] Tank-wagons shall be so constructed as to be capable of withstanding, under the maximum permissible load, the stresses which occur during carriage by rail. As regards these stresses, reference should be made to the tests prescribed by the competent railway authorities.

[ADR 211 127 (1)] The tanks and their fastenings shall be capable of absorbing, under the maximum permissible load, the forces exerted by:

- in the direction of travel: twice the total mass;
- at right angles to the direction of travel: the total mass;
- vertically upwards: the total mass;
- vertically downwards: twice the total mass.

Under these stresses, the stress at the most severely stressed point of the tank and its fastenings shall not exceed the value • defined in 6.8.2.1.16.

[1.2.8.1 212 127 (1)] Tank-containers and their fastenings shall, under the maximum permissible load be capable of absorbing the stresses equal to those exerted by:

- in the direction of travel: twice the total mass;
- horizontally at right angles to the direction of travel: the total mass; (where the direction of travel is not clearly determined, twice the total mass in each direction);
- vertically upwards: the total mass;
- vertically downwards: twice the total mass.

Under each of these forces the safety factors to be observed shall be the following:

- for metals having a clearly-defined yield point: a safety factor of 1.5 in relation to the apparent yield stress; or
- for metals with no clearly-defined point: a safety factor of 1.5 in relation to the guaranteed 0.2% proof stress (1% maximum elongation for austenitic steels).

**6.8.2.1.3** [1.2.8.2 21x127] [1.2.8 212 127] The walls of the shells shall have at least the thickness specified in [~~1.2.8.2 and 1.2.8.2/211 127 (2) to (6)~~ 1.2.8.2 to 1.2.8.5/212 127 (2) to (5)].

6.8.2.1.17 and 6.8.2.1.18 | 6.8.2.1.17 to 6.8.2.1.20.

**6.8.2.1.4** [1.2.1 21x120] Shells shall be designed and constructed in accordance with the provisions of a technical code recognized by the competent authority, in which the material is chosen and the wall thickness determined taking into account maximum and minimum filling and working temperatures, but the following minimum requirements of 6.8.2.1.8 6 to 6.8.2.1.26 shall be met:

**6.8.2.1.5** [1.2.5 21x124] Tanks intended to contain certain dangerous substances shall be provided with additional protection, which may take the form of additional thickness of the shell (such additional thickness being determined in the light of the dangers inherent in the substances concerned or of a protective device (see the special provisions of section 6.8.4).

**6.8.2.1.6** [1.2.1.3 21x120 (3)] Welds shall be skilfully made and shall afford the fullest safety. The execution and checking of welds shall comply with the provisions of 6.8.2.1.23.

**6.8.2.1.7** [XI 1.2.8.5 X 1.2.8.7 211 127 (9) 212 127 (7)] Measures shall be taken to protect shells against the risk of deformation as a result of a negative internal pressure.

#### **Materials for shells**

**6.8.2.1.8** [1.2.1.1 21x120 (1)] Shells shall be made of suitable metallic materials which, unless other temperature ranges are prescribed in the various classes, shall be resistant to brittle fracture and to stress corrosion cracking between -20 C and +50 C.

**6.8.2.1.9** [1.2.1.4 21x120 (4)] The materials of shells tanks or of their protective linings which are in contact with the contents shall not contain substances liable to react dangerously with the contents, to form dangerous compounds, or substantially to weaken the material.

[1.2.1.6 21x120 (6)] If contact between the substance carried and the material used for the construction of the shell entails a progressive decrease in the thickness of the walls, this thickness shall be increased at manufacture by an appropriate amount. This additional thickness to allow for corrosion shall not be taken into consideration in calculating the thickness of the shell walls.

**6.8.2.1.10** [1.2.1.2 21x120 (2)] For welded shells only materials of faultless weldability whose adequate impact strength at an ambient temperature of -20° C can be guaranteed, particularly in the weld seams and the zones adjacent thereto, shall be used.

[**RID** Water-quenched steel may not be used for welded steel shells.] If fine-grained steel is used, the guaranteed value of the yield stress  $R_e$  shall not exceed  $460 \text{ N/mm}^2$  and the **guaranteed** value of the upper limit of ~~guaranteed~~ tensile strength  $R_m$  shall not exceed  $725 \text{ N/mm}^2$ , in accordance with the specifications ~~relating to~~ **of** the material.

**6.8.2.1.11** Ratios of  $R_e/R_m$  exceeding 0.85 are not allowed for steels used in the construction of welded tanks.

$R_e$  = apparent yield stress for steels having a clearly-defined yield point or  
guaranteed 0.2% proof stress for steels with no clearly-defined yield point (1% for austenitic steels)

$R_m$  = ~~minimum~~ tensile strength.

~~The values of  $R_e$  and  $R_m$  to be used shall be specified minimum values according to material standards. If no material standard exists for the metal or alloy in question, the values of  $R_e$  and  $R_m$  used shall be approved by the competent authority or by a body designated by that authority.~~

~~When austenitic steels are used, the specified minimum values according to the material standards may be exceeded by up to 15% if these higher values are attested in the inspection certificate.~~

The values specified in the **inspection** certificate shall be taken as a basis in determining ~~this~~ the  $R_e/R_m$  ratio in each case.

**6.8.2.1.12** [1.2.6.2 21x125 (2)] For steel, the elongation at fracture,<sup>1</sup> in % shall be not less than

$$\frac{10\ 000}{\text{determined tensile strength in N/mm}^2}$$

but in any case for fine-grained steels it shall be not less than 16% and not less than 20% for other steels. For aluminium alloys the elongation at fracture shall be not less than 12%.

#### **Calculation of the wall thickness of the shell**

**6.8.2.1.13** [1.2.3 21x122] The pressure on which the wall thickness of the shell is based shall not be less than the calculation pressure, but the stresses referred to in 6.8.2.1.1 shall also be taken into account, and, if necessary, the following stresses:

**[RID XI 1.2.2]** In the case of wagons in which the tank constitutes a stressed self-supporting member, the shell shall be designed to withstand the stresses thus imposed in addition to stresses from other sources.

**[ADR 211 121 (2)]** In the case of vehicles in which the tank constitutes a stressed self-supporting member, the shell shall be designed to withstand the stresses thus imposed in addition to stresses from other sources.

**6.8.2.1.14** The calculation pressure is in the second cell of the code (see subsection 4.3.1.4) according to column [X] of Table A of Chapter 3.2.

When “G” appears, the following requirements shall apply:

- (1)** **[1.2.4.1 21x123 (1)]** Gravity-discharge shells intended for the carriage of substances having a vapour pressure not exceeding 110 kPa (1.1 bar) (absolute pressure) at 50° C shall be designed for a calculation pressure of twice the static pressure of the substance to be carried but not less than twice the static pressure of water.
- (2)** **[1.2.4.2 21x123 (2)]** Pressure-filled or pressure-discharge shells intended for the carriage of substances having a vapour pressure not exceeding 110 kPa (1.1 bar) (absolute pressure) at 50° C shall be designed for a calculation pressure equal to 1.3 times the filling or discharge pressure.

When the numerical value of the minimum calculation pressure is given (gauge pressure) the shell shall be designed for this pressure which shall not be less than 1.3 times the filling or discharge pressure. The following minimum requirements shall apply in these cases:

- (3)** **[1.2.4.3 21x123 (3)]** Shells intended for the carriage of substances having a vapour pressure of more than 110 kPa (1.1 bar) but not more than 175 kPa (1.75 bar) (absolute pressure) at 50° C shall, whatever their filling or discharge system, be designed for a calculation pressure of not less than 150 kPa (1.5 bar) gauge pressure or 1.3 times the filling or discharge pressure, whichever is the higher.

**-(4)** [1.2.4.4 21x123 (4)] Shells intended for the carriage of substances having a vapour pressure of more than 175 kPa (1.75 bar) (absolute pressure) at 50° C shall, whatever their filling or discharge system, be designed for a calculation pressure equal to 1.3 times the filling or discharge pressure but not less than 0.4 MPa (4 bar) (gauge pressure).

<b>6.8.2.1.15</b> Under the above stresses the stress at the most severely stressed point of the tank shall not exceed the value $\sigma$ defined in [marginal 211 125].	Under each force the safety factors to be complied with shall have the following values:  — for metals having a clearly defined yield point: a safety factor of 1.5 in relation to the apparent yield stress; or  — for metals with no clearly defined yield point: a safety factor of 1.5 in relation to the guaranteed 0.2% proof stress (for austenitic steels a yield stress of 1%).
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At the test pressure, the stress  $\sigma$  (sigma) at the most severely stressed point of the shell shall not exceed the material-dependent limits prescribed below. Allowance shall be made for any weakening due to the welds.

**6.8.2.1.16** [1.2.6.1 21x125 (1)] For all metals and alloys, the stress  $\sigma$  at the test pressure shall be lower than the smaller of the values given by the following formulae:

$$\sigma \leq 0.75 Re \text{ or } \sigma \leq 0.5 Rm$$

where

Re = apparent yield stress, or 0.2% as defined in 6.8.2.1.11 or, in the case of austenitic steels, 1%.

Rm = minimum tensile strength, as defined in 6.8.2.1.11.

The values of Re and Rm to be used shall be specified minimum values according to material standards. If no material standard exists for the metal or alloy in question, the values of Re and Rm used shall be approved by the competent authority or by a body designated by that authority.

When austenitic steels are used, the specified minimum values according to the material standards may be exceeded by up to 15% if these higher values are attested in the inspection certificate.

**Minimum thicknesses**

**6.8.2.1.17** [1.2.8.2 21x127 (2)] The thickness of the cylindrical wall of the shell and of the ends and cover plates shall not be less than the greater of the values determined by the following formulae:

$$e = \frac{P_{ep} x D}{2 x \sigma x \lambda} \text{ mm} \quad \left| \quad e = \frac{P_{cal} x D}{2 x \sigma x \lambda} \text{ (mm)} \right|$$

where:

$P_{ep}$  = test pressure in Mpa

$P_{cal}$  = calculation pressure in MPa as specified in [1.2.4]

$D$  = internal diameter of shell in mm

- = permissible stress, as defined in ~~[1.2.6.1]~~ 6.8.2.1.16 N/mm<sup>2</sup>
- = a coefficient not exceeding or equal to 1, allowing for any weakening due to welds, and linked to the inspection methods defined in 6.8.2.1.23.

~~[XI 1.2.8.4 X 1.2.8.6/211 127 (7) 212 127 (6)]~~ The following values of the coefficient  $\lambda$  (lambda) should be adopted:

~~0.8: where the weld beads are so far as possible inspected visually on both faces and are subjected to a non-destructive spot check with particular attention to connections;~~

~~0.9: where all longitudinal beads throughout their length, all connections, 25% of circular beads, and welds for the assembly of large diameter items of equipment are subjected to non-destructive checks. Beads shall be checked visually on both sides as far as possible;~~

~~1.0: where all beads are subjected to non-destructive checks and are so far as possible inspected visually on both sides. A weld test piece shall be taken.~~

[1.2.8.2/21x127 (2)] The thickness shall in no case be less than that defined in

~~[1.2.8.3/211 127 (3) to (6)]~~ | in [1.2.8.3 and 1.2.8.4/  
6.8.2.1.18 to 6.8.2.1.21. | 212 127 (3) to (5)]. 6.8.2.1.18 to 6.8.2.1.20.



**6.8.2.1.18**

**[RID XI 1.2.8.3]** The walls, ends and cover plates of shells shall be not less than 6 mm thick ~~or for powdery or granular substances not less than 5 mm thick~~ if of mild steel or of equivalent thickness if of another metal. For powdery or granular substances, this thickness may be reduced to not less than 5 mm in the case of mild steel and to an equivalent thickness in the case of other metals.

**[ADR 211 127 (3)]** The walls, ends and cover plates of shells of circular cross-section not more than 1.80 m in diameter<sup>2</sup> other than those referred to in ~~paragraph (6); 6.8.2.1.21,~~ shall not be less than 5 mm thick if of mild steel,<sup>3</sup> or of equivalent thickness if of another metal.

Where the diameter is more than 1.80 m, this thickness shall be increased to 6 mm except in the case of shells intended for the carriage of powdery or granular substances, if the shell is of mild steel, or to an equivalent thickness of another metal.

**[1.2.8.3 212 127 (3)]** The walls, ends and cover plates of shells shall be not less than 5 mm thick if of mild steel<sup>3</sup> (in conformity with the provisions of [1.2.6]) or of equivalent thickness if of another metal. Where the diameter is more than 1.80 m, this thickness shall be increased to 6 mm except in the case of tanks intended for the carriage of powdery or granular substances, if the shell is of mild steel<sup>3</sup> (in conformity with the provisions of [1.2.6]) or to an equivalent thickness if the tank is of another metal.

Whatever the metal used, the thickness of the shell wall shall in no case be less than 3 mm.

“Equivalent thickness” means the thickness obtained by the following formula:<sup>4</sup>

$$e_1 = \frac{21.4 \times e_o}{\sqrt[3]{Rm_1 \times A_1}} \quad \frac{4/}{}$$

**6.8.2.1.19 [RID:] (reserved)**

**[ADR 211 127 (4)]** Where protection of the tank against damage through lateral impact or overturning is provided (see 6.8.2.1.21~~20~~), the competent authority may allow the aforesaid minimum thicknesses to be reduced in proportion to the protection provided; however, the said thicknesses shall not be less than 3 mm in the case of mild steel,<sup>3</sup> or than an

**[1.2.8.4 212 127 (4)]** Where additional protection of the tank against damage is provided, the competent authority may allow the aforesaid minimum thicknesses to be reduced in proportion to the protection provided; however, the said thicknesses shall be not less than 3 mm in the case of mild steel,<sup>3</sup> or than an equivalent thickness in the case of other materials, for shells not more than

equivalent thickness in the case of other materials, for shells not more than 1.80 m in diameter. For shells with a diameter exceeding 1.80 m the aforesaid minimum thickness shall be increased to 4 mm in the case of mild steel<sup>3</sup> and to an equivalent thickness in the case of other metals.

Equivalent thickness means the thickness given by the formula in 6.8.2.1.18.

#### 6.8.2.1.20 [RID:] (reserved)

[ADR 211 127 (5)] For tanks built after 1 January 1990, there is protection against damage as referred to in paragraph (4) 6.8.2.1.19 when the following measures or equivalent measures are adopted:

(a) For tanks intended for the carriage of powdery or granular substances, the protection against damage shall satisfy the competent authority.

(b) For tanks intended for the carriage of other substances, there is protection against damage when:

1. For shells with a circular or elliptical cross-section having a maximum radius of curvature of 2 m, the shell is equipped with strengthening members comprising partitions, surge-plates or external or internal rings, so placed that at least one of the following conditions is met:

- Distance between two adjacent strengthening elements  $\leq 1.75$  m.

1.80 m in diameter. For shells of a diameter exceeding 1.80 m this minimum thickness shall be increased to 4 mm in the case of mild steel,<sup>3</sup> and to an equivalent thickness in the case of other metals.

Equivalent thickness means the thickness given by the formula in 6.8.2.1.18.

~~[1.2.8.5 ADR 212 127 (5)] [ADR (F) For tanks built after 1 January 1990.]~~

[RID] The additional protection referred to under ~~[1.2.8.4] 6.8.2.1.19~~ may consist of: overall external structural protection as in "sandwich" construction where the sheathing is secured to the shell, or a structure in which the tank is supported by a complete skeleton including longitudinal and transverse structural members, or double-wall construction.

Where the tanks are made with double walls, the space between being evacuated of air, the aggregate thickness of the outer metal wall and the shell wall shall correspond to the minimum wall thickness prescribed in ~~[1.2.8.3] 6.8.2.1.18~~, the thickness of the wall of the shell itself being not less than the minimum thickness prescribed in ~~[1.2.8.4] 6.8.2.1.19~~.

Where tanks are made with double walls with an intermediate layer of solid materials at least 50 mm thick, the outer wall shall have a thickness of not less than 0.5 mm if it is made of mild steel<sup>3</sup> or at least 2 mm if it is made of a plastics material reinforced with glass fibre. Solid foam with an impact absorption capacity such as that, for example, of polyurethane foam, may be used as the intermediate layer of solid material.

- Volume contained between two partitions or surge-plates  $\leq 7,500$  l.

The vertical cross-section of a ring, with the associated coupling, shall have a section modulus of at least  $10 \text{ cm}^3$ .

External rings shall not have projecting edges with a radius of less than 2.5 mm.

Partitions and surge-plates shall conform to the requirements of ~~paragraph (7)~~ 6.8.2.1.23.

The thickness of the partitions and surge-plates shall in no case be less than that of the shell.

2. For tanks made with double walls, the space between being evacuated of air, the aggregate thickness of the outer metal wall and the shell wall corresponds to the wall thickness prescribed in 6.8.2.1.18 ~~paragraph (3)~~, and the thickness of the wall of the shell itself is not less than the minimum thickness prescribed in ~~paragraph (4)~~ 6.8.2.1.19.

3. For tanks made with double walls having an intermediate layer of solid materials at least 50 mm thick, the outer wall has a thickness of at least 0.5 mm of mild steel or at least 2 mm of a plastics material reinforced with glass fibre. Solid foam (with an impact absorption capacity like that, for example, of polyurethane (foam) may be used as the intermediate layer of solid material.

4. Tank shells of forms other than in 1, especially box-shaped tanks, are provided, all round the mid-point of their vertical height and over at least 30% of their height with an additional protection designed in such a way as to offer specific resilience at least equal to that of a shell constructed in mild steel<sup>3</sup> of a thickness of 5 mm (for a shell diameter not exceeding 1.80 m) or 6 mm (for a shell diameter exceeding 1.80 m). The additional protection shall be applied in a durable manner to the outside of the shell.

This requirement shall be considered to have been met without further proof of the specific resilience when the additional protection involves the welding of a plate of the same material as the shell to the area to be strengthened, so that the minimum wall thickness is in accordance with ~~paragraph (3)~~ 6.8.2.1.18.

This protection is dependent upon the possible stresses exerted on mild steel shells in the event of an accident, where the ends and walls have a thickness of at least 5 mm for a diameter not exceeding 1.80 m or at least 6 mm for a diameter exceeding 1.80 m. If another metal is used, the equivalent thickness shall be obtained in accordance with the formula in ~~paragraph (3)~~ 6.8.2.1.18.

For demountable tanks this protection is not required when they are protected on all sides by the drop sides of the carrier vehicles.

**6.8.2.1.21 [RID:] (reserved)**

**[RID:] (reserved)**

**[ADR 211 127 (6)]** The thickness of tank shells designed in accordance with ~~marginal 211-123 (1)~~ **6.8.2.1.14 (1)** which either are of not more than 5,000 litres capacity or are divided into leakproof compartments of not more than 5,000 litres unit capacity may be adjusted to a level which, unless prescribed otherwise in the various classes, shall however not be less than the appropriate value shown in the following table:

Maximum radius of curvature of shell (m)	Capacity of shell or shell compartment (m <sup>3</sup> )	Minimum thickness (mm)
		Mild steel
≤ 2	≤ 5.0	3
2 - 3	≤ 3.5	3
	> 3.5 but ≤ 5.0	4

Where a metal other than mild steel is used, the thickness shall be determined by the equivalence formula given in ~~paragraph (3)~~ **6.8.2.1.18**. The thickness of the partitions and surge-plates shall in no case be less than that of the shell.

6.8.2.1.23 [RID:] (reserved)

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[ADR 211 127 (7)] Surge-plates and partitions shall be dished, with a depth of dish of not less than 10 cm, or shall be corrugated, profiled or otherwise reinforced to give equivalent strength. The area of the surge plate shall be at least 70% of the cross-sectional area of the tank in which the surge-plate is fitted.

[RID:] (reserved)

### Other rules of construction for shells

#### Welding and inspection of welds

6.8.2.1.22

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[X] 1.2.8.4x1.2.8.6 211 127 (8) 212 127 (6)] The manufacturer's qualification for performing welding operations shall be one recognized by the competent authority. Welding shall be performed by skilled welders using a welding process whose effectiveness (including any heat treatments required) has been demonstrated by test. Non-destructive tests shall be carried out by radiography or by ultrasound and must confirm that the quality of the welding is appropriate to the stresses.

In determining the thickness of the shell walls in accordance with 6.8.2.1.17, the following values of the coefficient  $\lambda$  (lambda) should be adopted for the weld:

- = 0.8: where the weld beads are so far as possible inspected visually on both faces and are subjected to a non-destructive spot check with particular attention to connections;
- = 0.9: where all longitudinal beads throughout their length, all connections, 25% of circular beads, and welds for the assembly of large-diameter items of equipment are subjected to non-destructive checks. Beads shall be checked visually on both sides as far as possible;
- = 1.0: where all beads are subjected to non-destructive checks and are so far as possible inspected visually on both sides. A weld test-piece shall be taken.

Where the competent authority has doubts regarding the quality of weld beads, it may require additional checks.

**6.8.2.1.23** ~~[RID:] (reserved)~~ | ~~[RID:] (reserved)~~

~~[ADR 211 127 (7)] Surge plates and partitions shall be dished, with a depth of dish of not less than 10 cm, or shall be corrugated, profiled or otherwise reinforced to give equivalent strength. The area of the surge plates shall be at least 70% of the cross-sectional area of the tank in which the surge plate is fitted.~~

**Other rules of construction for shells**

**6.8.2.1.24** [1.2.1.5 21x120 (5)] The protective lining shall be so designed that its leakproofness remains intact, whatever the deformation liable to occur in normal conditions of carriage ~~{(see 1.2.8.1 21x127 (1))}~~ (see 6.8.2.1.2).

**6.8.2.1.25** [XI 1.2.8.6x1.2.8.8 211 127 (10) 212 127 (8)] The thermal insulation shall be so designed as not to hinder access to, or the operation of, filling and discharge devices and safety valves.

**6.8.2.1.26** [3.3.4 21x333] If shells intended for the carriage of flammable liquids having a flash-point of less than 61° C are fitted with non-metallic protective linings (inner layers), the shells and the protective linings shall be so designed that no danger of ignition from electrostatic charges can occur.

**6.8.2.1.27** [RID XI 1.2.7] [X 1.2.7 ADR 212 126] All parts

of a tank-wagon

| of a tank-container

intended for the carriage of liquids having a flash-point of not more than 61° C, flammable gases, or 1361 carbon or 1361 carbon black, Packing Group II,

shall be linked by equipotential connections and

shall be capable of being electrically earthed. Any metal contact capable of causing electrochemical corrosion shall be avoided.

[ADR 211 126] Shells intended for the carriage of liquids having a flash-point of 61° C or below or for the carriage of flammable gases and of 1361 carbon or 1361 carbon black, Packaging Group II, shall be linked to the chassis

by means of at least one good electrical connection. Any metal contact capable of causing electrochemical corrosion shall be avoided. Shells shall be provided with at least one earth fitting clearly marked with the symbol  $\ominus$ , capable of being electrically connected.

**6.8.2.2** Items of equipment

**6.8.2.2.1** ~~[RID:] (reserved)~~

~~[ADR 211 127 (1)] The fastenings of tanks shall be capable of absorbing, under the maximum permissible load, the forces exerted by:~~

~~—— in the direction of travel: twice the total mass;~~

~~—— at right angles to the direction of travel: the total mass;~~

~~—— vertically upwards: the total mass;~~

~~—— vertically downwards: twice the total mass.~~

**[RID:] (reserved)**

**[ADR 211 129] Protection of fittings mounted on the upper part of the tank**

The fittings and accessories mounted on the upper part of the tank shall be protected against damage caused by overturning. This protection may take the form of strengthening rings, protective canopies or transverse or longitudinal members so shaped that effective protection is given.

~~[1.2.8.1 212 127 (1)] The fastenings of tank containers shall, under the maximum permissible load, be capable of absorbing the stresses equal to those exerted by:~~

~~—— in the direction of travel: twice the total mass;~~

~~—— horizontally at right angles to the direction of travel: the total mass; (where the direction of travel is not clearly determined, twice the total mass in each direction);~~

~~—— vertically upwards: the total mass; and~~

~~—— vertically downwards: twice the total mass.~~

**[RID:] (reserved)**



**6.8.2.2.2** [1.2.1.1/21x120 (1)] Suitable non-metallic materials may be used to manufacture equipment and accessories.

[1.3.1 21x130] The items of equipment shall be so arranged as to be protected against the risk of being wrenched off or damaged during carriage or handling. They shall exhibit a suitable degree of safety comparable to that of the shells themselves, and shall in particular:

- be compatible with the substances carried; and
- meet the requirements of ~~{1.2.2}~~ 6.8.2.1.1.

[ADR 211 130] As many operating parts as possible shall be served by the smallest possible number of apertures in the shell wall. The leakproofness of the service equipment including the closure (cover) of the inspection openings shall be ensured even in the event of overturning of the tank-vehicle, demountable tanks and battery-vehicles, taking into account the forces generated by an impact (such as acceleration and dynamic pressure). Limited release of the tank contents due to a pressure peak during the impact is however allowed.

[RID 1.3.1x1] The leakproofness of the service equipment shall be ensured even in the event of the overturning of the tank-wagon.

[RID 1.3.1x212 130] The leakproofness of the service equipment shall be ensured even in the event of the overturning of the tank-container.

The gaskets shall be made of a material compatible with the substance carried and shall be replaced as soon as their effectiveness is impaired, for example as a result of ageing.

Gaskets ensuring the leakproofness of fittings requiring manipulation during normal use of tanks shall be so designed and arranged that manipulation of the fittings incorporating them does not damage them.

**6.8.2.2.3** Each bottom-filling or bottom-discharge opening in tanks intended for the carriage of certain substances indicated by code "A" in column [12] of Table A of Chapter 3.2 (see 4.3.3.1.1. and 4.3.4.1.1) shall be equipped with at least two mutually independent closures, mounted in series, comprising

1. an external stop-valve with piping made of a malleable metal material and

2. a closing device a closure at the end of each stop-valve which may be a screw-threaded plug, a blank flange or an equivalent device.

Each bottom-filling or bottom-discharge opening in tanks intended for the carriage of certain substances indicated by code "B" in column [12] of Table A of Chapter 3.2 (see 4.3.3.1.1 and 4.3.4.1.1) shall be equipped with at least three mutually independent closures, mounted in series, comprising

1. An internal stop-valve, i.e. a stop-valve mounted inside the shell or in a welded flange or companion flange

2. An external stop-valve or a similar device

one at each the end of the each discharge pipe	as near as possible to the shell
--	----------------------------------

and

3. A closure closing device at the end of each discharge pipe, which may be a screw-threaded plug, a blank flange or an equivalent device.

However, in the case of tanks intended for the carriage of certain crystallizable or highly viscous substances and shells fitted with an ebonite or thermoplastic coating, the internal stop-valve may be replaced by an external stop-valve provided with additional protection.

**[1.3.2 21x131]** The internal stop-valve shall be operable from above or from below. Its setting - open or closed - shall so far as possible in each case be capable of being verified from the ground. Internal stop-valve control devices shall be so designed as to prevent any unintended opening through impact or an inadvertent act.

The internal shut-off device shall continue to be effective in the event of damage to the external control device.

In order to avoid any loss of contents in the event of damage to the external discharge fittings (pipes, lateral shut-off devices), the internal stop-valve and its seating shall be protected against the danger of being wrenched off by external stresses or shall be so designed as to resist them. The filling and discharge devices (including flanges or threaded plugs) and protective caps (if any) shall be capable of being secured against any unintended opening.

The position and/or direction of closure of shut-off devices shall be clearly apparent.

Substances assigned to code "C" or "D" in column [12] of Table A of Chapter 3.2 shall not be carried in tanks with bottom openings (see 4.3.3.1.1 and 4.3.4.1.1).

For these tanks all openings shall be situated above the surface level of the liquid. There shall be no pipes or pipe connections below the surface level of the liquid. Cleaning apertures (fist-holes) are, however, permitted in the lower part of the shell for code "C" tanks.

~~The position and/or direction of closure of the valves shall be clearly apparent.~~

- 6.8.2.2.4** **[XI 1.2.8.5x1.2.8.7/211 127 (9) 212 127 (7)]** Unless otherwise prescribed in the provisions of subsection 6.8.4, tanks may have valves to avoid an unacceptable negative internal pressure, without intervening bursting discs.

**[RID XI 1.2.8.5]** For tanks fitted with controlled ventilation (autovent) valves, the connection between the controlled ventilation (autovent) valve and the internal stop-valve shall be so designed that the valves do not open in the event of the deformation of the tank and that even if there is an opening there is no leakage.

- 6.8.2.2.5** **[1.3.3 21x131]** The shell or each of its compartments shall be provided with an opening large enough to permit inspection.
- 6.8.2.2.6** **[1.3.4 21x132]** Tanks intended for the carriage of substances for which all the openings are required to be above the surface level of the liquid may be equipped, in the lower part of the body, with a cleaning aperture (fist-hole). This aperture must be capable of being sealed by a flange so closed as to be leakproof and whose design must be approved by the competent authority or by a body designated by that authority.
- 6.8.2.2.7** **[1.3.5 21x133]** Tanks intended for the carriage of liquids having a vapour pressure of not more than 110 kPa (1.1 bar) (absolute) at 50° C shall have a venting system and a safety device to prevent the contents from spilling out if the shell overturns; otherwise they must conform to the requirements of ~~[1.3.6 or 1.3.7]~~ 6.8.2.2.8 or 6.8.2.2.9.
- 6.8.2.2.8** **[1.3.6 21x134]** Tanks intended for the carriage of liquids having a vapour pressure of more than 110 kPa (1.1 bar) but not exceeding 175 kPa (1.75 bar) (absolute) at 50° C shall have a safety valve set at not less than 150 kPa (1.5 bar) (gauge pressure) and which must be fully open at a pressure not exceeding the test pressure; otherwise they must conform to the requirements of ~~[1.3.7]~~ 6.8.2.2.9.

**6.8.2.2.9** [1.3.7 21x135] Tanks intended for the carriage of liquids having a vapour pressure of more than 175 kPa (1.75 bar) but not exceeding 300 kPa (3 bar) (absolute) at 50° C shall have a safety valve set at not less than 300 kPa (3 bar) gauge pressure and which must be fully open at a pressure not exceeding the test pressure; otherwise they must be hermetically closed.<sup>5</sup>

**6.8.2.2.10** [1.3.8 21x136] No movable parts such as covers, closures, etc., which are liable to come into frictional or percussive contact with aluminium shells intended for the carriage of flammable liquids having a flash-point of or below 61° C or for the carriage of flammable gases may be made of unprotected corrodible steel.

### **6.8.2.3 Type approval**

**6.8.2.3.1** [1.4.1 211 140] [1.4 212 140] The competent authority or a body designated by that authority shall issue in respect of each new type of tank-wagon/tank-vehicle, tank-container, battery-wagon/ battery-vehicle or MEGC a certificate attesting that the prototype, including fastenings, which it has inspected is suitable for the purpose for which it is intended and meets the construction requirements ~~of section 1.2~~ of 6.8.2.1, the equipment requirements ~~of section 1.3~~ of 6.8.2.2 and the special conditions for the classes of substances carried.

The test results [the tank code according to 4.3.3.1.1 or 4.3.4.1.1], the substances and/or the groups of substances for the carriage of which the tank is approved and its type approval number as a prototype shall be specified in a test report. The substances or groups of substances permitted shall be specified in the test report, with their chemical names or the corresponding collective heading, and with their class and classification code.

The approval number shall consist of the distinguishing sign<sup>6</sup> of the State in whose territory the approval was granted and a registration number.

[The specification of the substances and/or groups of substances can be omitted if the special provisions for construction (TC) and equipment (TE), contained in column [x] of Table A of Chapter 3.2 are specified in addition to the tank code.]

With the exception of substances of Class 2 and those referred to in 4.3.4.1.2, groups of substances which it is permitted to carry in the tank on the basis of the tank code specification shall be mentioned in the rationalized approach in subsection 4.3.4.1.

The substances referred to in the test report shall, generally speaking, be compatible with the characteristics of the tank. A reservation shall be included in the test report if it was not possible to investigate this compatibility exhaustively when the type approval was issued.

**6.8.2.3.2** [1.4.2 21x140] If the tanks, battery-wagons/battery-vehicles or MECG are manufactured in series without modification this approval shall be valid for the tanks, battery-wagons/battery-vehicles or MECG manufactured in series or according to the prototype.

#### **6.8.2.4 Tests**

**6.8.2.4.1** [1.5.1 21x150] Shells and their equipment shall either together or separately undergo an initial inspection before being put into service. This inspection shall include:

- a check of conformity to the approved prototype;
- a check of the design characteristics;<sup>7</sup>
- an examination of the internal and external conditions;
- a hydraulic pressure test<sup>8</sup> at the test pressure indicated on the data plate; and
- a check of satisfactory operation of the equipment.

[ADR 211 150] The hydraulic pressure test shall be carried out on the shell as a whole at the pressure indicated [in part II of this Appendix] and separately on each compartment of compartmented shells at a pressure of not less than 1.3 times the maximum working pressure. The leakproofness test shall be carried out separately on each compartment of compartmented shells.

The hydraulic pressure test shall be carried out before the installation of such thermal equipment as may be necessary. If the shells and their equipment are tested separately, they shall be jointly subjected to a leakproofness test after assembly in accordance with [1.1.4.3].

~~[1.2.1.3 21x120 (3)] Shells whose minimum wall thicknesses have been determined in accordance with [1.2.8.3 and 1.2.8.4 211 127 (2) to (6) and 212 127 (3) and (4)] shall be checked by the methods described in the definition of the weld coefficient of 0.8.~~

~~[1.2.8.4 1.2.8.6/21x127 (7), (6)] Non-destructive tests shall be carried out by radiography or by ultrasound and must confirm that the quality of the welding is appropriate to the stresses.~~

~~Where the competent authority has doubts regarding the quality of weld beads, it may require additional checks.~~

**6.8.2.4.2** [1.5.2 21x151] Shells and their equipment shall undergo periodic inspections at fixed intervals. The periodic inspections shall include: an external and internal examination and, as a general rule, a hydraulic pressure test. Sheathing for thermal or other insulation shall be removed only to the extent required for reliable appraisal of the characteristics of the shell.

[ADR 211 151] The hydraulic pressure test shall be carried out on the shell as a whole at the pressure indicated [in Part II of this Appendix], and separately on each compartment of compartmented shells at a pressure of not less than 1.3 times the maximum working pressure.

In the case of tanks intended for the carriage of powdery or granular substances, and with the agreement of the expert approved by the competent authority, the periodic hydraulic pressure tests may be omitted and replaced by leakproofness tests in accordance with [1.1.4.3].

The maximum intervals for inspection shall be eight years [ADR six years].

The maximum intervals for inspections shall be five years.

Empty, uncleaned tanks may be moved after expiration of this period for the purpose of undergoing the test.

**6.8.2.4.3** [1.5.3 21x152] In addition, a leakproofness test of the tank with its equipment in accordance with [1.1.4.3] and a check of the satisfactory operation of all the equipment shall be carried out

at least every four years [ADR three years].

at least every two and a half years

[ADR 211 152 The leakproofness test shall be carried out separately on each compartment of compartmented shells.]

Empty, uncleaned tanks may be moved after expiration of this period, for the purpose of undergoing inspection.

**6.8.2.4.4** [1.5.4 21x153] When the safety of the tank or of its equipment may have been impaired as a result of repairs, alterations or accident, an exceptional check shall be carried out.

**6.8.2.4.5** [1.5.5 211x154] The tests, inspections and checks in accordance with [1.5.1 to 1.5.4] 6.8.2.4.1 to 6.8.2.4.4 shall be carried out by the expert approved by the competent authority. Certificates shall be issued showing the results of these operations. These certificates shall refer to the list of the substances permitted for carriage in this tank or to the tank code in accordance with subsection 6.8.2.3.

### **6.8.2.5 Marking**

**6.8.2.5.1** [1.6.1 21x160] Every tank shall be fitted with a corrosion-resistant metal plate permanently attached to the shell in a place readily accessible for inspection. The following particulars at least shall be marked on the plate by stamping or by any other similar method. These particulars may be engraved directly on the walls of the shell itself, if the walls are so reinforced that the strength of the shell is not impaired:<sup>9</sup>

- approval number;
- manufacturer's name or mark;
- manufacturer's serial number;
- year of manufacture;
- test pressure (gauge pressure);
- capacity - in the case of multiple-element shells, the capacity of each element;
- design temperature (only if above +50° C or below -20° C);
- date (month and year) of initial test and most recent periodic test in accordance with [1.5.1 and 1.5.2];
- stamp of the expert who carried out the tests;

- [name of the] material of the shell [according to the standard] [and reference to materials standards, if available] and, where appropriate, the protective lining.

[**ADR 211 160** test pressure on the shell as a whole and test pressure by compartment in MPa or bar (gauge pressure) where the pressure by compartment is less than the pressure on the shell;]

In addition, the maximum working pressure allowed shall be inscribed on pressure-filled or pressure-discharge shells.

**6.8.2.5.2**

[**1.6.2**] The following particulars shall be inscribed on each side of the tank-wagon (on the tank itself or on a panel):<sup>9</sup>

- name of the operator;
- capacity;
- unladen (tare) mass of tank-wagon;
- load limits according to the characteristics of the wagon and the nature of the lines used; and
- name of the substance or substances accepted for carriage;<sup>10</sup>
- tank code according to 4.3.4.1.1;
- the date (month, year) of the next test in accordance with [marginals 1.5.2, 1.5.3 or with the corresponding marginals of] special requirements for substances accepted for carriage.

In addition, tank-wagons shall bear the prescribed danger labels.

[**ADR 211 161**] The following particulars shall be inscribed on the tank-vehicle itself or on a plate.

[**1.6.2, 212 161**] The following particulars shall be inscribed either on the tank-container itself or on a plate:<sup>9</sup>

- names of owner and of operator;
- capacity of the shell;
- tare;
- maximum permissible laden mass;
- name of substance carried;
- tank code according to 4.3.4.1.1.

In addition, tank-containers shall bear the prescribed danger labels.



These particulars shall not be required in the case of a vehicle carrying demountable tanks:

- name of owner or operator;
- unladen mass; and
- maximum permissible mass.

### 6.8.3 Special requirements applicable to Class 2: Gases

#### 6.8.3.1 Construction of shells

**6.8.3.1.1** [2.2.1.1 21x220 (1)] Shells intended for the carriage of compressed or liquefied gases or gases dissolved under pressure shall be made of steel. In the case of weldless shells, by derogation from ~~[1.2.6.2]~~ 6.8.2.1.12 a minimum elongation at fracture of 14% and also a stress • (~~sigma~~) lower than or equal to limits hereafter given according to the material may be accepted:

(a) When the ratio  $R_e/R_m$  (of the minimum guaranteed characteristics after heat treatment) is higher than 0.66 without exceeding 0.85:

- $\leq 0.75 R_e$ ;

(b) When the ratio  $R_e/R_m$  (of the minimum guaranteed characteristics after heat treatment) is higher than 0.85:

- $\leq 0.5 R_m$ .

**6.8.3.1.2** [2.2.2 21x221] The requirements of 6.8.5 apply to the materials and construction of welded shells.

**6.8.3.1.3** [ADR:] (reserved)  
[2.2.4] For double-walled shells, the wall thickness of the inner receptacle may, notwithstanding the requirements of ~~[1.2.8.3]~~ 6.8.2.1.18, be 3 mm if a metal is used which has good low-temperature performance corresponding to a minimum tensile strength  $R_m = 490 \text{ N/mm}^2$  and a minimum coefficient of elongation  $A = 30\%$ .

If other materials are used, an equivalent minimum wall thickness shall be maintained; this thickness is to

be calculated according to the formula [in footnote 3 4 to 6.8.2.1.18], 1-2.8.3], where  $Rm_0 = 490 \text{ N/mm}^2$  and  $A_0 = 30\%$ .

The outer shell must in this case have a minimum wall thickness of 6 mm where mild steel is concerned. If other materials are used, an equivalent minimum wall thickness shall be maintained, which must be calculated according to the formula given in 1-2.8.3: 6.8.2.1.18.

### Construction of battery-wagons/battery-vehicles and MEGC

**6.8.3.1.4** Cylinders, tubes, pressure drums and bundles of cylinders, as elements of a battery-wagon/battery-vehicle or MEGC, shall be constructed in accordance with Chapter 6.2.

Note 1: Bundles of cylinders which are not elements of a battery-wagon/battery-vehicle or of a MEGC shall be subject to the requirements of Chapter 6.2.

Note 2: Tanks as elements of battery-wagons/battery-vehicles and MEGC shall be constructed in accordance with sub-sections 6.8.2.1 and 6.8.3.1.

**6.8.3.1.5** Elements and their fastenings shall be capable of absorbing under the maximum permissible load the forces defined in 1-2.8.1/21x127(1) 6.8.2.2.1. Under each force the stress at the most severely stressed point of the element and its fastenings shall not exceed the value of  $\sigma$  defined in 2-2.1.2/21x220(2) 6.8.3 for cylinders, tubes, pressure drums and bundles of cylinders and in addition the value of  $\sigma$  defined in 1-2.6.1/21x125 6.8.3.1.1 for tanks. [AC.1/1998/11]

**6.8.3.1.6** [RID: reserved]  
[ADR 211 127 (1)] By derogation from the provisions of 6.8.2.1.3, when the elements are receptacles, the stress at the most severely stressed point of the element and its fastenings shall not exceed the ratios referred to in the relevant standards of section 6.2.2 or, if the members are not designed, constructed and tested in accordance with a standard, the ratios referred to in section 6.2.3.

**6.8.3.2 Items of equipment**

**6.8.3.2.1** [2.3.1 21x230] The discharge pipes of tanks shall be capable of being closed by blank flanges or some other equally reliable device. For tanks intended for the carriage of refrigerated liquefied gases, these blank flanges or other equally reliable devices may be fitted with pressure-release openings of a maximum diameter of 1.5 mm.

**6.8.3.2.2** [2.3.2 21x231] Shells intended for the carriage of liquefied gases may be provided with, in addition to the openings prescribed in {6.8.2.2.4 and 6.8.2.2.5}, openings for the fitting of gauges, thermometers and with bleed holes, as required for their operation and safety.

**6.8.3.2.3** [2.3.2.1 21x232 (1)] Filling and discharge openings of tanks

with a capacity greater than  
[1,000 litres/m<sup>3</sup>]

intended for the carriage of liquefied flammable and/or toxic gases shall be equipped with an instant-closing internal safety device which closes automatically in the event of an unintended movement of the shell or of fire. It shall also be possible to operate the closing device by remote control.

[RID] The device that keeps the internal closure open, e.g. a rail hook, is not a component of the wagon.

**6.8.3.2.4** [2.3.2.2 21x232 (2)] All openings, other than those accommodating safety valves and closed bleed holes, of tanks intended for the carriage of liquefied flammable and/or toxic gases shall, if their nominal diameter is more than 1.5 mm, be equipped with an internal shut-off device.

**6.8.3.2.5** [2.3.2.3 21x232 (3)] By derogation from the provisions of 6.8.2.2.3, tanks intended for the carriage of deeply refrigerated liquefied gases may be equipped with external devices in place of internal devices if the external devices afford protection against external damage at least equivalent to that afforded by the wall of the shell.

**6.8.3.2.6** [2.3.2.4 21x232 (4)] If the tanks are equipped with gauges, the latter shall not be made of a transparent material in direct contact with the substance carried. If there are thermometers, they shall not project directly into the gas or liquid through the shell wall.

**6.8.3.2.7** [2.3.2.6 21x232 (6)] Filling and discharge openings situated in the upper part of tanks shall be equipped with, in addition to what is prescribed in {2.3.2.1} 6.8.3.2.3, a second, external, closing device. This device shall be capable of being closed by a blank flange or some other equally reliable device.

- 6.8.3.2.8** [2.3.3 21x233] Safety valves shall meet the requirements of 6.8.3.2.8 to 6.8.3.2.12 below:
- 6.8.3.2.9** [2.3.3.1 21x233 (1)] Tanks intended for the carriage of compressed and liquefied gases and gases dissolved under pressure, may be fitted with not more than two safety valves whose aggregate clear cross-sectional area of passage at the seating or seatings shall be not less than  $20 \text{ cm}^2$  per  $30 \text{ m}^3$  or part thereof of the tank's capacity. These valves shall be capable of opening automatically under a pressure between 0.9 and 1.0 times the test pressure of the tank to which they are fitted. They shall be of such a type as to resist dynamic stresses, including liquid surge. The use of dead weight or counter weight valves is prohibited.
- 6.8.3.2.10** [2.3.3.1 21x233 (1)] Where tanks are intended for carriage by sea, the provisions of this paragraph shall not prohibit the fitting of safety valves conforming to the regulations governing that mode of transport.<sup>11</sup>
- 6.8.3.2.11** [2.3.3.2 21x233 (2)] Tanks intended for the carriage of refrigerated liquefied gases shall be equipped with two independent safety valves, each so designed as to allow the gases formed by evaporation during normal operation to escape from the tank in such a way that the pressure does not at any time exceed by more than 10% the working pressure indicated on the tank. One of the two safety valves may be replaced by a bursting disc which shall be such as to burst at the test pressure. In the event of loss of the vacuum in a double-walled tank, or of destruction of 20% of the insulation of a single-walled tank, the safety valve and the bursting disc shall permit an outflow such that the pressure in the shell cannot exceed the test pressure.
- 6.8.3.2.12** [2.3.3.3 21x233 (3)] The safety valves of tanks intended for the carriage of refrigerated liquefied gases shall be capable of opening at the working pressure indicated on the tank. They shall be so designed as to function faultlessly even at their lowest working temperature. The reliability of their operation at that temperature shall be established and checked either by testing each valve or by testing a specimen valve of each design-type.
- 6.8.3.2.13** [2.3.4] **Thermal insulation**
- 6.8.3.2.14** [2.3.4.1 21x234 (1)] If tanks intended for the carriage of liquefied gases are equipped with thermal insulation, such insulation shall consist of either:
- a sun shield covering not less than the upper third but not more than the upper half of the tank surface and separated from the shell by an air space at least 4 cm across; or
  - a complete cladding, of adequate thickness, of insulating materials.

**6.8.3.2.15** [2.3.4.2 21x234 (2)] Tanks intended for the carriage of refrigerated liquefied gases shall be thermally insulated. Thermal insulation shall be ensured by means of a continuous sheathing. If the space between the shell and the sheathing is under vacuum (vacuum insulation), the protective sheathing shall be so designed as to withstand without deformation an external pressure of at least 100 kPa (1 bar) (gauge pressure). By derogation from the definition of “calculation pressure” in section 1.2.1, external and internal reinforcing devices may be taken into account in the calculations. If the sheathing is so closed as to be gas-tight, a device shall be provided to prevent any dangerous pressure from developing in the insulating layer in the event of inadequate gas-tightness of the shell or of its items of equipment. The device shall prevent the infiltration of moisture into the heat-insulating sheath.

**6.8.3.2.16** [2.3.4.3 21x234 (3)] Tanks intended for the carriage of liquefied gases having a boiling point below  $-182^{\circ}\text{C}$  at atmospheric pressure shall not include any combustible material either in the thermal insulation or in the means of attachment to the frame.

The means of attachment for vacuum insulated tanks may, with the approval of the competent authority, contain plastics substances between the shell and the sheathing.

**6.8.3.2.17** [2.3.6 21x236] By derogation from the provisions of ~~{1.3.3}~~ 6.8.2.2.5 shells intended for the carriage of deeply-refrigerated liquefied gases need not have an inspection aperture.

#### **Items of equipment for battery-wagons/battery-vehicles and MEGC**

**6.8.3.2.18** The manifold shall be designed for service in a temperature zone of  $-20^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$ .

[TRANS/WP.15/1998/12] [The manifold shall be designed, constructed and installed so as to avoid the risk of damage due to thermal expansion and contraction, mechanical shock and vibration. All piping shall be of suitable metallic material. Welded pipe joints shall be used wherever possible.]

[TRANS/WP.15/1998/12] [Joints in copper tubing shall be brazed or have an equally strong metal union. The melting point of brazing materials shall be no lower than  $525^{\circ}\text{C}$ . The joints shall not decrease the strength of tubing as may happen when cutting threads.]

**6.8.3.2.19** [TRANS/WP.15/1998/12] [Except for 1001 acetylene, the permissible maximum stress  $\sigma$  (~~sigma~~) of the manifolding arrangement at the test pressure of the receptacles shall not exceed 75% of the guaranteed yield stress of the material.

The necessary wall thickness of the manifolding arrangement for the carriage of 1001 acetylene shall be calculated according to an approved code of practice.]

Note: For the yield stress, see 6.8.2.1.11.

The basic provisions of this paragraph shall be deemed to have been complied with if the following standards are applied: [reserved].

- 6.8.3.2.20** ~~[2.3.2.7 21x232 (7)]~~ By derogation from the requirements of ~~[2.3.2.1, 2.3.2.2 and 2.3.2.6]~~ 6.8.3.2.3, 6.8.3.2.4 and 6.8.3.2.7, for cylinders, tubes, pressure drums and bundles of cylinders (frames) forming a battery-wagon/battery-vehicle or MEGC, the required closing devices may be provided for within the manifolding arrangement.
- 6.8.3.2.21** ~~[2.3.5.1/21x235 (2)(a)]~~ If one of the elements is equipped with a safety valve and shut-off devices are provided between the elements, every element shall be so equipped.
- 6.8.3.2.22** ~~[2.3.5.2/21x235 (2)(b)]~~ The filling and discharge devices may be affixed to a manifold.
- 6.8.3.2.23** ~~[2.3.5.3/21x235 (2)(c)]~~ Each element, including each individual cylinder of a bundle, intended for the carriage of toxic gases, shall be capable of being isolated by a shut-off valve.
- 6.8.3.2.24** ~~[2.3.5.5 211 235 (3)]~~ The following requirements apply to ~~demountable tanks/movable elements/demountable tanks:~~<sup>12</sup>
- ~~[ADR 211 235 (3)]~~ The following requirements apply to demountable tanks:
- (a) they shall not be interconnected by a manifold;
  - (b) If they can be rolled, the valves shall be provided with protective caps.
  - (c) [RID] They shall be so fixed on the underframe of the wagon that they cannot move.

**6.8.3.2.25** [2.3.3.1/21x332] If battery-wagons/battery-vehicles or MEGC intended for the carriage of toxic gases are fitted with safety valves, a bursting disc shall be placed before the valve. The arrangement of the bursting disc and safety valve shall be such as to satisfy the competent authority.

**6.8.3.2.26** [2.3.3.1/21x233 (1)] When battery-wagons/battery-vehicles or MEGC are intended for carriage by sea, the provisions of 6.8.3.2.25 shall not prohibit the fitting of safety valves conforming to the regulations governing that mode of transport.<sup>13</sup>

**6.8.3.2.27** [2.3.5.4/21x235 (2) (d)] Receptacles which are elements of a battery-wagon/battery-vehicle or MEGC intended for the carriage of flammable gases shall be combined in groups of not more than 5,000 litres which are capable of being isolated by a shut-off valve.

[2.3.5.4 21x235 (2) (d)] Each element of a battery-wagon/battery-vehicle or MEGC intended for the carriage of gases designated by capital letter F, when consisting of shells as defined in [Appendix XI/X], shall be capable of being isolated by a shut-off valve.

### **6.8.3.3 Type approval**

No special requirements.

### **6.8.3.4 Tests**

**6.8.3.4.1** [2.5.1.2.2 21x250 (2)] The materials of every welded shell with the exception of cylinders, tubes, pressure drums and cylinders as part of bundles of cylinders which are elements

of a battery-wagon/battery-vehicle | of a MEGC

shall be tested according to the method described in section 6.8.5.

**6.8.3.4.2** The basic requirements for the test pressure and minimum test pressures are given in the table of gases and gas mixtures in 4.3.3.2.6.

**6.8.3.4.3** [2.5.3 21x252] The first hydraulic pressure test shall be carried out before the thermal insulation is placed in position.

**6.8.3.4.4** [2.5.4 21x253] The capacity of each tank intended for the carriage of compressed gases filled by mass, or liquefied gases ~~and~~ or gases dissolved under pressure shall be determined, under the supervision of an expert approved by the competent authority, by weighing or volumetric measurement of the quantity of

water which fills the tank; any error in the measurement of tank capacity shall be less than 1%. Determination by a calculation based on the dimensions of the shell is not permitted. The maximum filling masses allowed in accordance with [marginal 219 and 2.5.2.2 and 2.5.2.3] shall be prescribed by an approved expert.

**6.8.3.4.5** [2.5.5 21x254] Checking of the welds shall be carried out in accordance with the lambda-coefficient 1.0 requirements of [~~1.2.8.4 XI 1.2.8.6 X~~] 6.8.2.1.23.

**6.8.3.4.6** [2.5.6 21x255] By derogation from the requirements of [~~1.5~~] 6.8.2.4, the periodic tests shall take place, including the hydraulic pressure test:

<b>6.8.3.4.7</b>	[2.5.6.1 212 255 (1)] Every 4 years [ADR 3 years]		[2.5.6.1 212 255 (1)] Every 2½ years
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in the case of tanks intended for the carriage of 1008 boron trifluoride, 1017 chlorine, 1048 hydrogen bromide, anhydrous, 1050 hydrogen chloride, anhydrous, 1053 hydrogen sulphide, 1067 dinitrogen tetroxide (nitrogen dioxide), 1076 phosgene or 1079 sulphur dioxide;

<b>6.8.3.4.8</b>	[2.5.6.2 21x255 (2)] After 8 years [ADR 6 years]		After 8 years
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of service and thereafter every 12 years in the case of tanks intended for the carriage of compressed gases:

A leakproofness check shall be performed by an approved expert 6 years after each periodic test.

A leakproofness test may be performed, at the request of the competent authority, between any two successive tests.
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**6.8.3.4.9** [2.5.7 21x256] In the case of vacuum-insulated tanks, the hydraulic-pressure test and the check of the internal condition may, with the consent of the approved expert, be replaced by a leakproofness test and measurement of the vacuum.

**6.8.3.4.10** [2.5.8 21x257] If apertures have been made, on the occasion of periodic inspections, in tanks intended for the carriage of liquefied refrigerated gases, the method by which they are hermetically closed before the shells are replaced in service shall be approved by the approved expert and shall ensure the integrity of the shell.

**6.8.3.4.11** [2.5.9 21x258] Leakproofness tests of tanks intended for the carriage of compressed or liquefied gases or gases dissolved under pressure shall be performed at a pressure of not less than 0.4 MPa (4 bar) and not more than 0.8 MPa (8 bar) (gauge pressure).



**Tests for battery-wagons/battery-vehicles and MEGC**

- 6.8.3.4.12** [1.5.1/21x150] The elements of a battery-wagon/battery-vehicle or MEGC and their equipment shall either together or separately undergo an initial inspection before being put into service. This inspection shall include:
- a check of conformity to the approved prototype;
  - a check of the design characteristics;
  - an examination of the internal and external conditions;
  - a hydraulic pressure test<sup>14</sup> at the test pressure indicated on the data plate; and
  - a check of satisfactory operation of the equipment.
- 6.8.3.4.13** [2.5.1/21x250 (1)] Cylinders, tubes and pressure drums and cylinders as part of bundles of cylinders shall be tested according to 6.2.1.4.
- 6.8.3.4.14** [new] The test pressure of the manifold of the battery-wagon/battery-vehicle or MEGC shall be the same as that of the elements of the battery-wagon/battery-vehicle or MEGC. By derogation from this requirement, the test pressure for the manifold of battery-wagons/battery-vehicles or MEGC shall be not less than 300 bar for 1001 acetylene, dissolved.
- 6.8.3.4.15** [1.5.2/21x151] Battery-wagons/battery-vehicles, MEGC and their equipment shall undergo periodic inspections at fixed intervals. The periodic inspections shall include: an external and internal examination, a hydraulic pressure test,<sup>13</sup> a check of satisfactory operation of the equipment and an inspection of the state of the fastenings.
- 6.8.3.4.16** [2.5.6.3/21x255 (3)] Cylinders, tubes and pressure drums and cylinders as part of bundles of cylinders shall undergo periodic tests in accordance with 6.1.1.4. The manifold shall undergo a periodic test in accordance with 6.8.3.4.14.
- 6.8.3.4.17** [1.5.4 21x153] When the safety of the battery-wagon/battery-vehicle or MEGC or of its equipment may have been impaired as a result of repairs, alterations or accident, an exceptional check shall be carried out.
- 6.8.3.4.18** [1.5.5 21x154] The tests, inspections and checks in accordance with 6.8.3.4.19 **12** to 6.8.3.4.22 **17** shall be carried out by the expert approved by the competent authority. Certificates shall be issued showing the results of these operations.

These certificates shall refer to the list of the substances permitted for carriage in this battery-wagon/battery-vehicle or MEGC in accordance with 6.8.2.3.1.

### **6.8.3.5 Marking**

**6.8.3.5.1 [2.6.1 21x260]** The following additional particulars shall be marked by stamping or by any other similar method on the plate prescribed in ~~[1.6.1]~~ 6.8.2.5.1, or directly on the walls of the shell itself if the walls are so reinforced that the strength of the tank is not impaired.

**6.8.3.5.2 [2.6.1.1 21x260 (1)]** On tanks intended for the carriage of only one substance:

- the name of the gas in letters and, in addition for gases classified under an n.o.s. entry, the technical name.<sup>15</sup>

This indication shall be supplemented in the case of tanks intended for the carriage of compressed gases filled by volume (pressure), by an indication of the maximum filling pressure at 15° C permitted for the tank, and in the case of tanks intended for the carriage of compressed gases filled by mass, and of liquefied gases, liquefied refrigerated gases ~~and~~ or gases dissolved under pressure by the maximum permissible load mass in kg and of the filling temperature if below -20° C.

**6.8.3.5.3 [2.6.1.2 21x260 (2)]** On multipurpose tanks:

- the name of the gas in letters and, in addition for gases classified under an n.o.s. entry, the technical name of the gases<sup>15</sup> for whose carriage the tank is approved.

These particulars shall be supplemented by an indication of the maximum permissible load mass in kg for each gas.

**6.8.3.5.4 [2.6.1.3 21x260 (3)]** On tanks intended for the carriage of liquefied refrigerated gases:

- the maximum working pressure allowed.

**6.8.3.5.5 [2.6.1.4 21x260 (4)]** On tanks equipped with thermal insulation:

- the inscription “thermally insulated” or “insulated by vacuum” (or “thermally insulated by vacuum”).

**6.8.3.5.6** [2.6.3 21x262] In addition to the particulars prescribed in [1.6.2] 6.8.2.5.2, the following shall be inscribed on

each side of the tank-wagon or on panels:

the tank-container itself or on a plate:

[ADR:] the tank itself or on a plate

(a) - the tank code according to the expert report (see 6.8.2.3.1) with the actual test pressure of the tank

- the inscription: “minimum filling temperature allowed :...”,

(b) where the tank is intended for the carriage of one substance only:

the name of the gas in letters and, in addition for gases classified under an n.o.s. entry, the technical name;<sup>15</sup>

- for compressed gases which are filled by mass, and for liquefied gases, liquefied refrigerated gases and or gases dissolved under pressure, the maximum permissible load mass in kg;

(c) where the tank is a multipurpose tank:

the name in letters and, for gases classified under an n.o.s. entry, the technical name<sup>14</sup> of all gases to whose carriage the tank is assigned

with an indication of the maximum permissible load mass in kg for each of them;

(d) where the shell is equipped with thermal insulation:

- the inscription “thermally insulated” or “insulated by vacuum” (or “thermally insulated by vacuum”), in an official language of the country of registration and, if that language is not French, German, Italian or English, also in French, German, Italian or English, unless international tariffs or agreements concluded between the railway administrations provide otherwise. [ADR in an official language of the country of registration and also, if that language is not English, French or German, in English, French or German, unless any agreements concluded between the countries concerned in the transport operation provide otherwise.]

**6.8.3.5.7 [XI 2.6.3.1]**

- For compressed gases filled by mass
- for liquefied ~~or liquefied~~ refrigerated gases and
- for gases dissolved under pressure

the load limits in accordance with ~~[1.6.2]~~ 6.8.2.5.2 shall be determined in the light of the maximum permissible load mass of the tank, depending on the substance carried; in the case of multipurpose tanks, the name in full of the particular gas being carried shall be stated together with the load limit on the same folding panel.

**6.8.3.5.8 [XI 2.6.4]** The panels on wagons carrying demountable tanks as referred to in ~~[2.3.5.5]~~ 6.8.3.2.24 need not bear the particulars prescribed in ~~[1.6.2 and 2.6.3]~~ 6.8.2.5.2 and 6.8.3.5.6.

[ADR 211 263] These particulars shall not be required in the case of a vehicle carrying demountable tanks.

**6.8.3.5.9 [XI 2.6.5]** Tanks intended for the carriage of liquefied ~~and~~ or liquefied refrigerated gases shall be marked with an unbroken orange<sup>16</sup> band, about 30 cm wide, encircling the tank at mid-height.

### Marking of battery-wagons/battery-vehicles and MEGC

**6.8.3.5.10 [1.6.1. 21x160]** Every battery-wagon/battery-vehicle and every MEGC shall be fitted with a corrosion-resistant metal plate permanently attached in a place readily accessible for inspection. The following particulars at least shall be marked on the plate by stamping or by any other similar method:

- approval number;
- manufacturer's name or mark;

- manufacturer's serial number;
- year of manufacture;
- test pressure (gauge pressure);<sup>17</sup>
- design temperature (only if above +50° C or below -20° C);
- date (month and year) of initial test and most recent periodic test in accordance with 6.8.4;
- stamp of the expert who carried out the tests.

**6.8.3.5.11**

**[1.6.2]** The following particulars shall be inscribed on each side of the battery-wagon (on a panel):

- name of the owner;
- number of elements;
- total capacity of the elements;<sup>18</sup>
- load limits according to the characteristics of the wagon and the nature of the lines used;
- name of the substance or substances accepted for carriage;<sup>19</sup>
- the date (month, year) of the next test in accordance with 6.8.4.4. and 6.8.4.5 or with the corresponding subsections of special requirements for substances accepted for carriage.

**[ADR 211 161]** The following particulars shall be inscribed on the battery-vehicle itself or on a plate:

- names of owner or of operator;

**[1.6.2. 212 161]** The following particulars shall be inscribed either on the MEGC itself or on a plate:

- names of owner and of operator;
- number of elements;
- total capacity of the elements;<sup>18</sup>
- maximum permissible laden mass;
- name of substance carried **and**  
~~and~~ for MEGC filled by mass:
- tare.

- number of elements;
  - total capacity of the elements;<sup>18</sup>
- and for battery-vehicles filled by mass:
- unladen mass;
  - maximum permissible mass.

**6.8.3.5.12** [2.6.2.1 21x261 (1)] The frame of a battery-wagon/battery-vehicle or MEGC shall bear near the filling point a plate specifying:

- the maximum filling pressure at 15° C allowed for elements intended for compressed gases;
- the name of the gas in letters in accordance with Chapter 3.2 and, in addition for gases classified under an n.o.s. entry, the technical name;<sup>20</sup>

and, in addition, in the case of liquefied gases:

- the permissible maximum load per element.<sup>21</sup>

**6.8.3.5.13** [2.6.2.2 21x261 (2)] Cylinders, tubes and pressure drums, and cylinders as part of bundles of cylinders, shall be marked according to marginal 6.2.1.6.1. These receptacles need not be labelled individually with the danger labels as required in Chapter 5.2.

Battery-wagons/battery-vehicles and MEGC shall be marked according to [Appendix VIII] and labelled according to [marginal 224].

**6.8.3.6** **Requirements for battery-wagons/battery-vehicles and MEGC which are designed, constructed and tested according to standards**

The provisions of 6.8.3.1.4 to 6.8.3.1.6, 6.8.3.2.18 to 6.8.3.2.27, 6.8.3.4.12 to 6.8.3.4.18 shall be deemed to have been complied with if the following relevant standards have been applied:

[reserved]

**[6.8.3.7** **Requirements for battery-wagons/battery-vehicles and MEGC which are not designed, constructed and tested according to standards**

Battery-wagons/battery-vehicles and MEGC which are not designed, constructed and tested in accordance with the standards set out in [sub-section 6.8.3.6] shall

be designed, constructed and tested in accordance with the requirements of a technical code recognized by the competent authority. They shall, however, comply with the minimum requirements of section 6.8.3.]

#### 6.8.4 Special provisions

**Note** [1. For liquids having a flash-point of less than 61° C and for flammable gases, see also 6.8.2.1.26, 6.8.2.1.27 and 6.8.2.2.10].

2. For requirements for receptacles subjected to a pressure test of not less than 1 MPa (10 bar) see section 6.8.5.

The codes of column [13] of Table A of Chapter 3.2 mean:

(a) **Construction (TC)**

**TC1** [4.2.1 21x420 8.2.1 21x820 6°] The requirements of 6.8.5 are applicable to the materials and construction of these shells.

**TC2** [5.2.2 21x521 UN10 TP6] Shells, and their items of equipment, shall be made of aluminium not less than 99.5% pure or of suitable steel not liable to cause hydrogen peroxide to decompose. Where shells are made of aluminium not less than 99.5% pure, the wall thickness need not exceed 15 mm, even where calculation in accordance with [1.2.8.2] gives a higher value.

**TC3** [5.2.3 21x522] The shells shall be made of austenitic steel.

**TC4** [6.2.3 21x622] Shells shall be provided with an enamel or equivalent protective lining if the material of the shell is attacked by chloroacetic acid [of 24° (b)].

**TC5** [8.2.1 21x820 bromine 14° UN TP10] Shells shall be provided with a lead lining not less than 5 mm thick or an equivalent lining.

**TC6** [8.2.2 21x821 nitric acid of 2° (a)] Where the use of aluminium is necessary for tanks, such tanks shall be made of aluminium not less than 99.5% pure; the wall thickness need not exceed 15 mm even where calculation in accordance with [1.2.8.2] gives a higher value.

**TC7** [RID:] (reserved) [21x920] The effective minimum thickness of the walls of shells intended for the carriage of [substances of 20° (c)] shall not be less than 3 mm.

(b) **Items of equipment (TE)**

- TE1** **2.2.3 21x222 gases of [1° to 4°] designated by the letter T; [3.3.3 21x332 3.1.1 3.1.2 3.1.3 4.3.4 21x433 4.1.1 4.1.3 4.1.5 6.3.3 21x632 8.3.3 21x832 8.1.2 9.3.2 21x931 1° and 2°]** If tanks are fitted with safety valves, a bursting disc shall be placed before the valves. The arrangement of the bursting disc and safety valve shall be such as to satisfy the competent authority. [A pressure gauge or another adequate indicator shall be fitted in the space between the bursting disc and the safety valve, enabling detection of any rupture, perforation or leakage of the disc which may disrupt the action of the safety valve] (1998/17).
- TE2** **[3.3.4 21x334 61° (c) 9.3.4 21x933 20°]** The bottom discharge system of tanks may consist of an external pipe with a stop-valve, if it is constructed in a metallic material liable to deformation.
- TE3** **[4.3.3 21x432]** Tanks shall in addition meet the following requirements:  
**[4.3.3.1]** The heating device shall not penetrate into, but shall be exterior to, the body of the shell. However, a pipe used for extracting the phosphorus may be equipped with a heating jacket. The device heating the jacket shall be so regulated as to prevent the temperature of the phosphorus from exceeding the filling temperature of the shell. Other piping shall enter the shell in its upper part; openings shall be situated above the highest permissible level of the phosphorus and be capable of being completely enclosed under lockable caps. **[4.3.3.2]** The tank shall be equipped with a gauging system for verifying the level of the phosphorus and, if water is used as a protective agent, with a fixed gauge mark showing the highest permissible level of the water.
- TE4** **[4.3.5 21x434]** Shells [intended for the carriage of the substances referred to in 4.1.6] shall be equipped with thermal insulation made of materials which are not readily flammable.
- TE5** **[4.3.6 21x435]** If shells [intended for the carriage of substances referred to in 4.1.4] are equipped with thermal insulation, such insulation shall be made of materials which are not readily flammable.
- TE6** **[4.3.7 21x436 4.1.6]** Tanks may be equipped with valves opening automatically inwards or outwards under the effect of a difference of pressure of between 20 kPa and 30 kPa (0.2 bar and 0.3 bar).
- TE7** **[5.3.1 21x530 1° (a) of marginal 501]** For solutions containing more than 60% but not more than 70% hydrogen peroxide, openings below the surface level of the liquid shall be permissible. In this case the shell-discharge system shall be equipped with two mutually independent shut-off devices mounted in series, the first taking the form of a quick-closing internal stop-valve of an approved type and the second that



of a sluice-valve, one at each end of the discharge pipe. A blank flange, or another device providing the same measure of security, shall also be fitted at the outlet of each external sluice-valve. The internal stop-valve shall be such that if the pipe is wrenched off the stop-valve will remain integral with the shell and in the closed position.

- TE8** [5.3.2 21x530 UN10 TP6 501 1°] The connections to the external pipe-sockets of tanks shall be made of materials not liable to cause decomposition of hydrogen peroxide.
- TE9** [5.3.3 21x532 501 1° (a) 20° UN10 TP6 TP16] Tanks shall be fitted in their upper part with a shut-off device preventing any build-up of excess pressure inside the shell due to the decomposition of the substances carried, any leakage of liquid, and any entry of foreign matter into the shell.
- TE10** [5.3.3 5.3.4 21x532 21x533 501 20° UN10 TP17] The shut-off devices of tanks shall be so designed as to preclude obstruction of the devices by solidified ammonium nitrate during carriage. Where tanks are sheathed in thermally-insulating material, the material shall be of an inorganic nature and entirely free from combustible matter.
- TE11** [5.3.3 21x532 8.3.5 21x834 501 1° (b) and (c) - 801 1791 hypochlorite of 61° UN10 TP24 also for 1908 chlorite solution] Shells and their service equipment shall be so designed as to prevent the entry of foreign matter, leakage of liquid or any building up of dangerous excess pressure inside the shell due to the decomposition of the substances carried.
- TE12** [5.3.5 5.3.6.1 to 6 21x534 21x535 5.1.2] Tanks shall be equipped with thermal insulation complying with the requirements of [2.3.4.1]. The sun shield and any part of the tank not covered by it, or the outer sheathing of a complete lagging, shall be painted white or finished in bright metal. The paint shall be cleaned before each transport journey and renewed in case of yellowing or deterioration. The thermal insulation shall be free from combustible matter. Tanks shall be fitted with temperature sensing devices.

[ADR 21x534] If the SADT of the organic peroxide in the tank is 55° C or less, or the tank is constructed of aluminium, the shell shall be completely insulated.

[5.3.6.1 21x536 (1)] Tanks shall be fitted with safety valves and emergency pressure-relief devices. Vacuum-relief devices may also be used. Emergency pressure-relief devices shall operate at pressures determined according to both the properties of the organic peroxide and the construction characteristics of the tank. Fusible elements shall not be permitted in the body of the shell.

**[5.3.6.2 21x536 (2)]** Tanks shall be fitted with spring-loaded safety valves to prevent significant pressure build-up within the shell of the decomposition products and vapours released at a temperature of 50° C. The capacity and start-to-discharge pressure of the safety-valve(s) shall be based on the results of the tests specified in [5.4.2]. The start-to-discharge pressure shall however in no case be such that liquid could escape from the valve(s) if the tank were overturned.

**[5.3.6.3 21x536 (3)]** The emergency-relief devices may be of the spring-loaded or frangible types designed to vent all the decomposition products and vapours evolved during a period of not less than one hour of complete fire-engulfment as calculated by the following formula:

$$q = 70961xFxA^{0.82}$$

where:

q = heat absorption (W)

A = wetted area [m<sup>2</sup>]

F = insulation factor [-]

F = 1 for non-insulated vessels, or

$$F = \frac{U(923 - T_{PO})}{47032} \quad \text{for insulated vessels}$$

where:

K = heat conductivity of insulation layer [W·m<sup>-1</sup>·K<sup>-1</sup>]

L = thickness of insulation layer [m]

U = K/L = heat transfer coefficient of the insulation [W·m<sup>-2</sup>·K<sup>-1</sup>]

T<sub>PO</sub> = temperature of peroxide at relieving conditions [K]

The start-to-discharge pressure of the emergency-relief device(s) shall be higher than that specified in [5.3.6.2] and based on the results of the tests referred to in [5.4.2]. The emergency-relief devices shall be dimensioned in such a way that the maximum pressure in the tank never exceeds the test pressure of the tank.

**Note:** An example of a method to determine the size of emergency-relief devices is given in Appendix 5 of the Manual of Tests and Criteria.

**[5.3.6.4 21x536 (4)]** For tanks equipped with thermal insulation consisting of a complete cladding, the capacity and setting of the emergency-relief device(s) shall be determined assuming a loss of insulation from 1% of the surface area.

**[5.3.6.5 21x536 (5)]** Vacuum-relief devices and spring-loaded safety valves of tanks shall be provided with flame arresters unless the substances to be carried and their decomposition products are non-combustible. Due attention shall be paid to the reduction of the relief capacity caused by the flame arrester.

**TE13 [8.3.4 21x833 sulphur trioxide, stabilized, of 1° (a)]** Tanks shall be thermally insulated and fitted with a heating device on the outside.

**TE14 [9.3.3 21x932 20°]** Tanks shall be equipped with thermal insulation. They may also be equipped with pressure-release devices opening automatically inwards or outwards under the effect of a difference of pressure of between 20 kPa and 30 kPa (0.2 bar and 0.3 bar). The thermal insulation directly in contact with the shell shall have an ignition temperature at least 50° C higher than the maximum temperature for which the tank was designed.

**TE15 [RID XI 3.3.2 3.1.3 XI 6.3.2 6.1.4]**  
Tanks are also considered to be hermetically closed when they are fitted with controlled ventilation (auto-vent) valves which open when pressure loss is 0.4 bar. [ADR:] (reserved)

**TE16 [RID XI 5.3.1 501 1° (a), 3° (a) and 5°]** No part of the tank-wagon may be of wood, unless this is protected by a suitable coating. [ADR:] (reserved)

**TE17 [RID XI 8.3.1]** The following requirements are applicable to movable tanks<sup>22</sup> intended for the carriage of substances [of 6°]:

(a) they shall be so fixed on the underframe of the wagon that they cannot move;

(b) they shall not be interconnected by a manifold;

(c) if they can be rolled, the valves shall be provided with protective caps. [ADR:] (reserved)

**TE18 [ADR 21x934]** Tanks intended for the carriage of substances filled at a temperature higher than 190° C shall be equipped with deflectors placed at right angles to the upper filling openings, so as to avoid a sudden localized increase in wall temperature during filling. [RID:] (reserved)

**TE19 [ADR 211 633] Protection of equipment**

Fittings and accessories mounted in the upper part of the tank:

Such fittings and accessories shall be either:

- inserted in a recessed housing; or
- equipped with an internal safety valve; or
- shielded by a cap, or by transverse and/or longitudinal members, or by other equally effective devices, so profiled that in the event of overturning the fittings and accessories will not be damaged.

Fittings and accessories mounted in the lower part of the tank:

Pipe-sockets, lateral shut-off devices, and all discharge devices shall either be recessed by at least 200 mm from the extreme outer edge of the tank or be protected by a rail having a coefficient of inertia of not less than 20 cm<sup>3</sup> transversally to the direction of travel; their ground clearance shall be not less than 300 mm with the tank full.

Fittings and accessories mounted on the rear face of the tank:

All fittings and accessories mounted on the rear face shall be protected by the bumper prescribed in [marginal 10 220]. Their height above the ground shall be such that they are adequately protected by the bumper.  
**[RID:] (reserved)**

(c) **Type approval (TA)**

**TA1** [5.4.1 21x540 501 2°] Tanks shall not be approved for the carriage of organic substances.

**TA2** [5.4.2 21x541 5.1.1] For the type approval of tanks tests shall be undertaken:

to prove the compatibility of all materials normally in contact with the substance during carriage;

to provide data to facilitate the design of the emergency pressure-relief devices and safety valves taking into account the design characteristics of the tank; and

to establish any special requirements necessary for the safe carriage of the substance.

The test results shall be included in the report for the type approval of the tank.

**[5.1.2 21x511]** This substance may be carried in tank-wagons/fixed or demountable tanks or tank-containers under the conditions laid down by the competent authority of the country of origin, if, on the basis of tests (see marginal 5.4.2 21x541), the competent authority is satisfied that such a transport operation can be carried out safely. RID: If the country of origin is not a COTIF Contracting State, these conditions shall be recognized by the competent authority of the first COTIF Contracting State reached by the consignment. ADR: If the country of origin is not party to ADR, these conditions shall be recognized by the competent authority of the first ADR country reached by the consignment.

[RID UN 3109 and 3110; ADR UN 3109, 3110, 3119, 3120 of Class 5.2]

(d) **Tests (TP)**

Tanks shall be subjected to the initial and periodic hydraulic pressure tests at a pressure depending on their calculation pressure at least equal to the pressure indicated below:

Calculation pressure (bar)	Test pressure (bar)
G	$G^{23}$
1.5	1.5
4	4
10	4
15	4
21	$10^{24} (4)^{25}$

**TP1 [5.5.1 21x550 501 1° 8.5.2 21x851 801 nitric acid of 2° (a)]**

Tanks of pure aluminium need to be subjected to the initial and periodic hydraulic pressure tests at a pressure of only 250 kPa (2.5 bar) (gauge pressure).

**TP2 [8.5.2 21x851 14°]** The condition of the lining of shells shall be inspected every year by an expert approved by the competent authority, who shall inspect the inside of the shell.

**TP3 [ADR 211 451]** By derogation from the requirements of ~~marginal 1.5.2~~ 6.8.2.4.2, periodic inspections shall take place at least every eight years and shall include a thickness check using suitable instruments. For such tanks, the leakproofness test and check for which provision is made in ~~marginal 1.5.3~~ 6.8.2.4.3 shall be carried out at least every four years.

**[RID X 4.5.2 ADR 212 451]** By derogation from the requirements of ~~marginal 1.5.2~~ 6.8.2.4.2, the periodic inspections shall take place at least every eight years and shall include a thickness check using suitable instruments. For such tanks, the leakproofness test and check, for which provision is made in ~~marginal 1.5.3~~ 6.8.2.4.3 shall be carried out at least every four years.

**TP4 [RID 8.5.1 6° and 7°]** The tanks shall be inspected every

4 years | 2½ years,

for resistance to corrosion, by means of suitable instruments (e.g. by ultrasound).

**[ADR:] (reserved)**

**TP5 [8.5.2 21x851 1829]** The periodic tests shall take place at latest every

4 years/ADR: 3 years | 2½ years,

including the hydraulic pressure test.

**TP6 [6.5.1 211 650 1649]** The periodic tests shall be carried out at latest every 4 years/ADR: 3 years, including the hydraulic pressure test.

(e) **Marking (TM)**

**[RID] Note:** These particulars shall be in an official language of the country of approval, and also, if that language is not French, German, Italian or English, in French, German, Italian or English unless the international tariffs or agreements concluded between the railway administrations provide otherwise.

**[ADR] Note:** These particulars shall be in an official language of the country of approval, and also, if that language is not English, French or German, in English, French or German, unless any agreements concluded between the countries concerned in the transport operation provide otherwise.

**TM1 [4.6.1 21x460]** Tanks intended for the carriage of the substances referred to in [4.1.1] shall bear in addition to the particulars prescribed in [1.6.2], the words: “Do not open during carriage. Liable to spontaneous combustion” (see also the Note above).

**TM2 [4.6.1 21x460]** Tanks intended for the carriage of the substances of marginal 471 referred to in 4.1.3 to 4.1.5 shall bear in addition to the particulars prescribed in 1.6.2, the words: “Do not open during carriage. Gives off flammable gases on contact with water” (see also the Note above).

**TM3** [4.6.2 21x461 471 1° (a) 8.6.2 21x861 1829 6° and 14° RID 6.6 3°] Tanks shall also bear, on the plate prescribed in [1.6.1], the names of the approved substances and the maximum permissible load of the tank in kg.

[RID] Loading limits by mass according to [1.6.2] for the substances listed shall be determined taking into account the maximum permissible load of the tank.

**TM4** [5.6.2 21x560 5.1.2] For tanks the following additional particulars shall be marked by stamping or by any other similar method on the plate prescribed in [1.6.2] or directly on the walls of the shell itself, if the walls are so reinforced that the strength of the tank is not impaired: the chemical name with the approved concentration of the substance concerned.

**TM5** [8.6.1 21x860 6° and 14°] Tanks [intended for the carriage of substances of 8.1.1] shall bear, in addition to the particulars referred to in [1.6.2], the date (month, year) of the most recent inspection of the internal condition of the shell.

**TM6** [9.6 21x960 20°] Tanks shall bear on both sides, in addition to the markings stipulated in [1.6.2], the mark reproduced in [Appendix IX, marginal 1910].

**6.8.5** [RID] [11.c] **Requirements concerning the materials and construction of shells of tank-wagons and shells of tank-containers for which a test pressure of at least 1 MPa (10 bar) is prescribed, as well as shells of tank-wagons and shells of tank-containers intended for the carriage of deeply-refrigerated liquefied gases of Class 2**

[ADR] [B.l<sub>d</sub>] **Requirements concerning the materials and construction of fixed welded tanks, demountable welded tanks, and welded shells of tank-containers for which a test pressure of not less than 1 MPa (10 bar) is required, and of fixed welded tanks, demountable welded tanks and welded shells of tank-containers intended for the carriage of deeply-refrigerated liquefied gases of Class 2**

**6.8.5.1** **Materials and shells**

**6.8.5.1.1** (a) [1270] [214 250] Shells intended for the carriage of compressed and liquefied gases and gases dissolved under pressure of Class 2 [UN Nos. 1366, 1370, 1380, 2003, 2005, 2445, 2845, 2870, 3049, 3050, 3051,



3052, 3053, 3076, 3194 and 3203 [substances of Class 4.2, 6° (a), 17° (a), 19° (a) and 31° (a) to 33° (a), or Class 8.6°] and UN Nos. 1052 and 1790 [containing more than 85% hydrogen fluoride of Class 8] shall be made of steel.

(b) [ADR] [RID:] (reserved)

Shells constructed of fine-grained steels for the carriage of:

- substances of Class 2 which are classified as corrosive and [substances of marginal 2201, 4° A]; and
- substances [of marginal 2801, 6°]

shall be heat-treated for thermal stress relief.

- (c) Shells intended for the carriage of deeply-refrigerated liquefied gases of Class 2, shall be made of steel, aluminium, aluminium alloy, copper or copper alloy (e.g. brass). However, shells made of copper or copper alloy shall be allowed only for gases containing no acetylene; ethylene, however, may contain not more than 0.005% acetylene.
- (d) Only materials appropriate to the lowest and highest working temperatures of the shells and of their fittings and accessories may be used.

**6.8.5.1.2**

[1271] [214 251] The following materials shall be allowed for the manufacture of shells:

- (a) steels not subject to brittle fracture at the lowest working temperature (see ~~marginal 6.8.5.2.1~~) are the following: ~~may be used:~~
1. mild steels (except for liquefied refrigerated gases of Class 2);
  2. fine-grained (ADR: unalloyed) steels, down to a temperature of -60° C;
  3. nickel steels (with a nickel content of 0.5 to 9%), down to a temperature of -196° C, depending on the nickel content;
  4. austenitic chrome-nickel steels, down to a temperature of -270° C;
- (b) aluminium not less than 99.5% pure, or aluminium alloys (see ~~marginal 6.8.5.2.2~~);
- (c) deoxidized copper not less than 99.9% pure, or copper alloys having a copper content of over 56% (see ~~marginal 6.8.5.2.3~~).

- 6.8.5.1.3** (a) [1272] [214 252] Shells made of steel, aluminium or aluminium alloys shall be either seamless or welded.
- (b) Shells made of [ADR: austenitic steel], copper or copper alloys may be hard-soldered.
- 6.8.5.1.4** [1273] [214 253] The fittings and accessories may either be screwed to the shells or be secured thereto as follows:
- (a) shells made of steel, aluminium or aluminium alloy: by welding;
- (b) shells made of austenitic steel, of copper or of copper alloy by welding or hard-soldering.
- 6.8.5.1.5** [1274] [214 254] The construction of shells and their attachment to the underframe of the wagon (ADR: to the vehicle, to the underframe) or in the container frame shall be such as to preclude with certainty any such reduction in the temperature of the load-bearing components as would be likely to render them brittle. The means of attachment of shells shall themselves be so designed that even when the shell is at its lowest working temperature they still possess the necessary mechanical properties.

## **6.8.5.2 Test requirements**

### **6.8.5.2.1 Steel shells**

[1275] [214 265] The materials used for the manufacture of shells and the weld beads shall, at their lowest working temperature, but at least at -20° C, meet at least the following requirements as to impact strength.

The tests shall be carried out with test-pieces having a V-shaped notch.

The minimum impact strength (see ~~marginals~~ 6.8.5.3.1 to 6.8.5.3.3) for test-pieces with the longitudinal axis at right angles to the direction of rolling and a V-shaped notch (conforming to ISO R 148) perpendicular to the plate surface, shall be 34 J/cm<sup>2</sup> for mild steel (which, because of existing ISO standards, may be tested with test-pieces having the longitudinal axis in the direction of rolling); fine-grained steel; ferritic alloy steel Ni < 5%, ferritic alloy steel 5% ≤ Ni • ≤ 9%; or austenitic Cr - Ni steel.

In the case of austenitic steels, only the weld bead need be subjected to an impact-strength test.

For working temperatures below -196° C the impact-strength test is not performed at the lowest working temperature, but at -196° C.

**6.8.5.2.2 Shells made of aluminium or aluminium alloy**

[1276] [214 266] The seams of shells shall meet the requirements laid down by the competent authority.

**6.8.5.2.3 Shells made of copper or copper alloy**

[1277] [214 267] It is not necessary to carry out tests to determine whether the impact strength is adequate.

**6.8.5.3 Impact-strength tests**

**6.8.5.3.1** [1278] [214 275] For sheets less than 10 mm but not less than 5 mm thick, test-pieces having a cross-section of 10 mm x e mm, where “e” represents the thickness of the sheet, shall be used. Machining to 7.5 mm or 5 mm is permitted if it is necessary. The minimum value of 34 J/cm<sup>2</sup> shall be required in every case.

**NOTE:** No impact-strength test shall be carried out on sheets less than 5 mm thick, or on their weld seams.

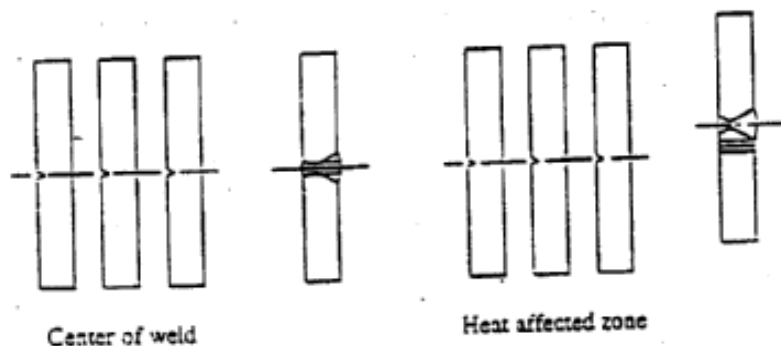
**6.8.5.3.2** (a) [1279] [214 276] For the purpose of testing sheets, the impact strength shall be determined on three test-pieces. Test-pieces shall be taken at right angles to the direction of rolling; however, for mild steel they may be taken in the direction of rolling.

(b) For testing weld seams the test-pieces shall be taken as follows:

**when  $e \leq 10$  mm:**

three test-pieces with the notch at the centre of the weld;

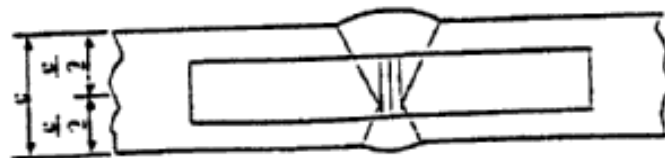
three test-pieces with the notch in the centre of the heat affected zone: (the V-notch to cross the fusion boundary at the centre of the specimen)



when  $10 \text{ mm} < e \leq 20 \text{ mm}$ :

three test-pieces from the centre of the weld;

three test-pieces from the heat affected zone; (the V-notch to cross the fusion boundary at the centre of the specimen)



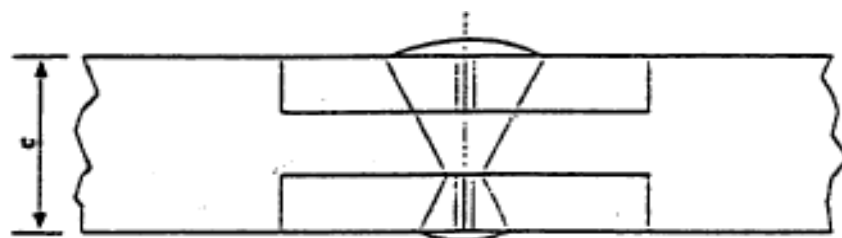
Center of weld



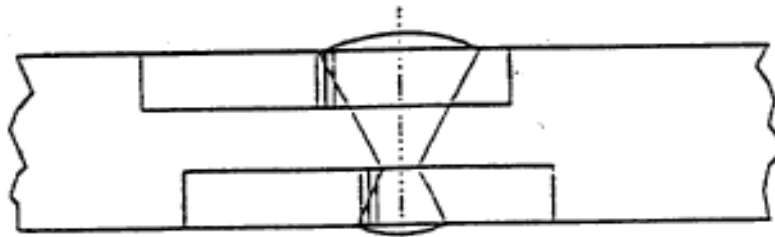
Heat affected zone

when  $e > 20 \text{ mm}$

two sets of three test-pieces, one set on the upper face, one set on the lower face at each of the points indicated below (the V-notch to cross the fusion boundary at the centre of the specimen for those taken from the heat affected zone)



Center of weld



Heat affected zone

- 6.8.5.3.3** (a) [1280] [214 277] For sheets, the average of the three tests shall meet the minimum value of 34 J/cm<sup>2</sup> indicated in ~~marginal~~ 6.8.5.2.1; not more than one of the individual values may be below the minimum value and then not below 24 J/cm<sup>2</sup>.
- (b) For welds, the average value obtained from the three test-pieces taken at the centre of the weld shall not be below the minimum value of 34 J/cm<sup>2</sup>; not more than one of the individual values may be below the minimum value and then not below 24 J/cm<sup>2</sup>.
- (c) For the heat affected zone (the V-notch to cross the fusion boundary at the centre of the specimen) the value obtained from not more than one of the three test-pieces may be below the minimum value of 34 J/cm<sup>2</sup>, though not below 24 J/cm<sup>2</sup>.

**6.8.5.3.4** [1281] [214 278] If the requirements prescribed in ~~marginal~~ 6.8.5.3.3 are not met, one retest only may be done if:

- (a) the average value of the first three tests is below the minimum value of 34 J/cm<sup>2</sup>, or
- (b) more than one of the individual values is less than the minimum value of 34 J/cm<sup>2</sup> but not below 24 J/cm<sup>2</sup>.

**6.8.5.3.5** [1282] [214 279] In a repeated impact test on sheets or welds, none of the individual values may be below 34 J/cm<sup>2</sup>. The average value of all the results of the original test and of the retest should be equal to or more than the minimum of 34 J/cm<sup>2</sup>.

On a repeated impact strength test on the heat-affected zone, none of the individual values may be below 34 J/cm<sup>2</sup>.

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### Endnotes

<sup>1</sup> In the case of sheet metal the axis of the tensile test-piece shall be at right angles to the direction of rolling. The permanent elongation at fracture shall be measured on test-pieces of circular cross-section in which the gauge length  $l$  is equal to five times the diameter  $d$  ( $l = 5d$ ); if test-pieces of rectangular section are used, the gauge length shall be calculated by the formula

$$l = 5,65 \sqrt{F_o},$$

where  $F_o$  indicates the initial cross-section area of the test-piece.

<sup>2</sup> For shells not of a circular cross-section, for example box-shaped or elliptical shells, the indicated diameters shall correspond to those calculated on the basis of a circular cross-section of the same area. For such shapes of cross-section the radius of convexity of the shell wall shall not exceed 2,000 mm at the sides of 3,000 mm at the top and bottom.

<sup>3</sup> For the definitions of “mild steel” and “reference steel” see 1.2.1.

<sup>4</sup> This formula is derived from the general formula:

$$e_1 = e_o \times \sqrt[3]{\frac{Rm_o \times A_o}{Rm_1 \times A_1}}$$

where

$e_o$  = minimum thickness for mild steel according to 6.8.2.1.18 and 6.8.2.1.19;

$Rm_o$  = 370 (minimum tensile strength for reference steel, see definition 1.2.1);

$A_o$  = 27 (minimum elongation for reference steel);

$Rm_1$  = minimum tensile strength of the metal chosen, in  $N/mm^2$ ; and

$A_1$  = minimum elongation of the metal chosen on fracture under tensile stress, in %.

<sup>5</sup> For the definition of “hermetically closed tank” see 1.2.1.

<sup>6</sup> Distinguishing sign for use in international traffic prescribed by the Convention on Road Traffic (Vienna, 1968).

<sup>7</sup> The check of the design characteristics shall also include, for shells requiring a test pressure of 1 MPa (10 bar) or higher, the taking of weld test-pieces (work samples) in accordance with [1.2.8.4] 6.8.2.1.23 and the tests prescribed in Appendix [H.C/B.1d] 6.8.5.

<sup>8</sup> In special cases and with the agreement of the expert approved by the competent authority, the hydraulic pressure test may be replaced by a pressure test using another liquid or gas, where such an operation does not present any danger.

<sup>9</sup> Add the units of measurement after the numerical values.

<sup>10</sup> A collective description covering a group of substances of a similar nature and equally compatible with the characteristics of the tank may be given instead of the name.

<sup>11</sup> These requirements are published in the IMDG Code.

<sup>12</sup> See 1.2.1.

<sup>13</sup> These requirements are published in the IMDG Code.

<sup>14</sup> In special cases and with the agreement of the expert approved by the competent authority, the hydraulic pressure test may be replaced by a pressure test using another liquid or gas, where such an operation does not entail any danger.

<sup>15</sup> Instead of n.o.s. followed by the technical name the use of one of the following names is permitted:

- for 1078 refrigerant gas, n.o.s., of 2° A: mixture F1, mixture F2, mixture F3;
- for 1060 methyl acetylene and propadiene mixtures, stabilized, of 2° F: mixture P1, mixture P2;
- for 1965 hydrocarbon gas mixture, liquefied, n.o.s., of 2° F: mixture A, mixture A01, mixture A02, mixture A0, mixture A1, mixture B1, mixture B2, mixture B, mixture C.

The names customary in the trade and mentioned in [Note 1 of 2° F No. 1965 of [marginal 201] may be used only as a complement.

<sup>16</sup> See [Appendix VIII, marginal 1800 (1), note].

<sup>17</sup> See note 15.

<sup>18</sup> Add the units of measurement after the numerical values.

<sup>19</sup> A collective description covering a group of substances of a similar nature and equally compatible with the characteristics of the tank may be given instead of the name.

<sup>20</sup> The technical name shall be a name currently used in scientific and technical handbooks, journals and texts. Trade names shall not be used for this purpose

Instead of the technical name the use of one of the following names is permitted:

- for 1078 refrigerant gas, n.o.s., ~~of 2° A:~~ mixture F1, mixture F2, mixture F3;
- for 1060 methyl acetylene and propadiene mixtures, stabilized, ~~of 2° F:~~ mixture P1, mixture P2;
- for 1965 hydrocarbon gas mixture, liquefied, n.o.s., ~~of 2° F:~~ mixture A, mixture A0, mixture A1, mixture B, mixture C.

The names customary in the trade and mentioned in Note 1 of 2° F, No. 1965 ~~of marginal 201~~ may be used only as a complement.

<sup>21</sup> Add the units of measurement after the numerical values.

<sup>22</sup> See definition in 1.2.1.

<sup>23</sup> G = minimum calculation pressure according to the general requirements [of marginal 1.2.4] (see subsection 4.3.4.1).

<sup>24</sup> The materials of each of these shells shall be tested according to the method described [in Appendix II C/B.1 (d)] in 6.8.5.

<sup>25</sup> Minimum test pressure for 1744 bromine or 1744 bromine solution.

□□□□