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6.7 REQUIREMENTS FOR (RID) TANK-WAGONS, MOVABLE TANKS, BATTERY-WAGONS/(ADR) TANK-VEHICLES, DEMOUNTABLE TANKS, BATTERY-VEHICLES AND TANK-CONTAINERS WITH SHELLS MADE OF METALLIC MATERIALS

Different requirements are established for

Tank-wagons	Tank-containers
Note. For the purposes of RID battery-wagons and wagons with movable tanks are also considered to be tank-wagons.	**Note.** For the purposes of RID swap body tanks are considered to be tank-containers.
Note. For the purposes of ADR battery-vehicles and vehicles with demountable tanks are also considered to be tank-vehicles [fixed tanks].	
[1.1.1.] These requirements shall apply to tank-wagons used for the carriage of liquid, gaseous, powdery or granular substances.	**[1.1.1]** These requirements shall apply to tank-containers of a capacity of more than 0.45 m^3 which are used for the carriage of liquid, gaseous, powdery or granular substances, and to their accessories.

[1.1.2] Section 6.7.1 [present Part 1] sets out the requirements applicable to tank-wagons/tank-containers intended for the carriage of substances of all classes. Sections 672 and 673 [Parts 2 to 9] contains particular requirements supplementing or modifying the requirements of section 6.7.1 [Part 1].
Note. For requirements concerning use, see Chapter 4.2.

6.7.1 Requirements applicable to all classes

6.7.1.1 Construction

6.7.1.1.1 **[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 shall be met:

6.7.1.1.2 **[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. However, suitable non-metallic materials may be used to manufacture equipment and accessories.

6.7.1.1.3 **[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 Re shall not exceed 460 N/mm^2 and the value of the upper limit of guaranteed tensile strength Rm shall not exceed 725 N/mm^2, in accordance with the specifications relating to the material.]

6.7.1.1.4 **[1.2.1.3 21x120 (3)]** Welds shall be skilfully made and shall afford the fullest safety. For the execution and checking of weld beads, see also 6.7.1.1.29. 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.

6.7.1.1.5 **[1.2.1.4 21x120 (4)]** The materials of shells 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.

6.7.1.1.6 **[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 [marginal 212 127 (1)].

6.7.1.1.7 **[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.

6.7.1.1.8 **[1.2.2 211 121 (1) 212 121]** Shells, their attachments and their service and structural equipment shall be designed to withstand without loss of contents (other than quantities of gas escaping through any degassing vents):

- static and dynamic stresses in normal conditions of carriage;
- prescribed minimum stresses as defined in 1.2.6 and 1.2.8.

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

6.7.1.1.10 **[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 1.2.2 shall also be taken into account.

6.7.1.1.11 **[1.2.4 21x123]** Unless specially prescribed otherwise in the various classes, the following particulars shall be taken into account in the design of shells:

6.7.1.1.12 **[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) 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.

6.7.1.1.13 **[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 50E C shall be designed for a calculation pressure equal to 1.3 times the filling or discharge pressure.

6.7.1.1.14 **[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 50E 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.

6.7.1.1.15 **[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 50E C shall, whatever their filling or discharge system, be designed for a calculation pressure equal to 1.3 times the filling or discharge pressure but not less than 0.4 MPa (4 bar) (gauge pressure).

6.7.1.1.16 **[RID 1.2.5]** Tank wagons intended to contain certain dangerous substances shall be provided with special protection, which shall be determined for the various classes.

[ADR 21x124] Tank-containers 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: see the relevant classes) or of a protective device.

[RID 1.2.5 212 124] Tank-containers 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: see the relevant classes) or of a protective device.

6.7.1.1.17 **[1.2.6 21x125]** At the test pressure, the stress F (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.

6.7.1.1.18 **[1.2.6.1 21x125(1)]** For all metals and alloys, the stress F at the test pressure shall be lower than the smaller of the values given by the following formulae:

$$F \leq 0.75\ Re \quad \text{or} \quad F \leq 0.5\ Rm$$

where

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

Rm = minimum tensile strength.

Ratios of Re/Rm exceeding 0.85 are not allowed for steels used in the construction of welded tanks.

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.

The values specified in the certificate shall be taken as a basis in determining the Re/Rm ratio in each case.

6.7.1.1.19 **[1.2.6.2 21x125(2)]** For steel, the elongation at fracture, 1/ 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%.

6.7.1.1.20	**[RID XI 1.2.7]** All parts of tank-wagons intended for the carriage of liquids having a flash-point of not more than 61E C and for the carriage of flammable gases, 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 61E C or below or for the carriage of flammable gases, 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 2, capable of being electrically connected.	**[X 1.2.7 ADR 212 126]** All parts of a tank-container intended for the carriage of liquids having a flash-point of not more than 61E C, or for the carriage of flammable gases, shall be capable of being electrically earthed. Any metal contact which might encourage electrochemical corrosion shall be avoided.
6.7.1.1.21	**[1.2.8 211 127]** Shells and their fastenings shall withstand the stresses specified in 1.2.8.1 below, and the wall thicknesses of shells shall be at least as determined in accordance with 1.2.8.2 to 1.2.8.5 below.	**[1.2.8 212 127]** Tank-containers shall be capable of withstanding the stresses specified in 1.2.8.1 and the wall thickness of the shells shall be at least that prescribed in 1.2.8.2 to 1.2.8.5 below.

1/ In the case of sheet metal the axis of the tensile test piece shall be at right angles to the direction of rolling. The permanent elongation at fracture shall be measured on test pieces of circular cross section in which the gauge length 1 is equal to five times the diameter d (1=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.

6.7.1.1.22 **[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 shells 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 the stresses defined above, the stress at the most severely stressed point of the shell and its fastenings shall not exceed the value F defined in marginal 211 125.

[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; and
- vertically downwards: twice the total mass.

Under each force the safety factors to be complied with shall be the following:

- for metals having a clearly-defined yield point: a safety factor of 1.5 in relation to the guaranteed 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, and in the case of austenitic steels the 1% maximum elongation.

6.7.1.1.23 **[1.2.8.2 21 x 127(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:

$$e = \frac{P_{ep} \times D}{2 \times F \times 8} \quad (mm) \qquad e = \frac{P_{cal} \times D}{2 \times F \times 8} \quad (mm)$$

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
F	=	permissible stress, as defined in 1.2.6.1 N/mm^2
8	=	a coefficient not exceeding or equal to 1, allowing for any weakening due to welds.

The thickness shall in no case be less than that defined in 1.2.8.3 and 1.2.8.4.

6.7.1.1.24 **[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.

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

Where the diameter is more than 1.80 m, this thickness shall be increased to 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 not more than 1.80 m in diameter shall be not less than 5 mm thick if of mild steel (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 shells intended for the carriage of powdery or granular substances, if the shell is of mild steel (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:

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

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

3/ "Mild steel" means a steel having a minimum breaking strength between 360 and 440 N/mm^2.

4/ This formula is derived from the general formula:

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

where

Rm_o = 360
A_o = 27 for the reference mild 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 %.

6.7.1.1.25 **[ADR 211127 (4)]** Where protection of the shell against damage through lateral impact or overturning 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 not be less than 3 mm in the case of mild steel, or than an equivalent thickness in the case of other materials, for shells not more than 1.80 m in diameter. For shells with a diameter exceeding 1.80 m the aforesaid minimum thickness shall be increased to 4 mm in the case of mild steel and to an equivalent thickness in the case of other metal.

[1.2.8.4 212127 (4)] Where protection of the shell 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, or than an equivalent thickness in the case of other materials, for shells not more than 1.80 m in diameter. For shells of a diameter exceeding 1.80 m this minimum thickness shall be increased to 4 mm in the case of mild steel and to an equivalent thickness in the case of other metals.

Equivalent thickness means the thickness obtained by the following formula:

$$e_1 ' \frac{21.4 \times e_o}{\sqrt[3]{Rm_1 \times A_1}}$$

6.7.1.1.26 **[ADR 211127 (5)]** For tanks built after 1 January 1990, there is protection against damage as referred to in paragraph (4) when the following measures or equivalent measures are adopted:

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

(b) For shells 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 ≤ 1.75 m.

- Volume contained between two partitions or surge plates ≤ 7,500 l.

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

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

[1.2.8.5 ADR 212127 (5)][ADR For tanks built after 1 January 1990]. The protection referred to under 1.2.8.4 may consist of overall external structural protection as in “sandwich” construction where the sheathing is secured to the shell, or a structure in which the shell is supported by a complete skeleton including longitudinal and transverse structural members, or double-wall construction.

Where the shells 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, the thickness of the wall of the shell itself being not less than the minimum thickness prescribed in 1.2.8.4.

Where shells 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 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.

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

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

2. For shells 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 paragraph (3), and the thickness of the wall of the shell itself is not less than the minimum thickness prescribed in paragraph (4).

3. For shells 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 plastic material reinforced with glass fibre. Solid foam (with an impact absorption capacity like that, for example, of polyurethane foam) may be used as the intermediate layer of solid material.

4. Shells of forms other than in 1, especially box-shaped 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 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).

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) [6.7.1.1.24].

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

6.7.1.1.27 **[ADR 211127** (6)] The thickness of tank shells designed in accordance with marginal 211 123 (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^3)	Minimum thickness (mm)
		Mild steel
≤ 2	≤ 5.0	3
2 - 3	≤ 3.5	3
	> 3.5 but ≤ 5.0	4

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

6.7.1.1.28 **[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.

6.7.1.1.29 **[XI 1.2.8.4 X 1.2.8.6 211127 (8) 212127 (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 1.2.8.2, the following values of the coefficient 8(lambda) should be adopted for the welds:

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.

6.7.1.1.30 **[XI 1.2.8.5 X 1.2.8.7 211127 (9) 212127 (7)]** Measures shall be taken to protect shells against the risk of deformation as a result of a negative internal pressure. Unless otherwise prescribed in the special provisions for the individual classes, these shells may have valves to avoid an unacceptable negative internal pressure, without intervening bursting discs.

6.7.1.1.31 **[XI 1.2.8.6 X 1.2.8.8 211127 (10) 212127 (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.

6.7.1.1.32 [**ADR 211 128]** The overall width of the ground-level bearing surface (distance between the outer points of contact with the ground of the right-hand tyre and the left-hand tyre of the same axle) shall be at least equal to 90% of the height of the centre of gravity of the laden tank-vehicle. In an articulated vehicle the mass on the axles of the load-carrying unit of the laden semi-trailer shall not exceed 60% of the nominal total laden mass of the complete articulated vehicle.

6.7.1.1.33 **[ADR 211 129]** The fittings and accessories mounted on the upper part of the shell shall be protected against damage caused by overturning. This protection may take the form of strengthening rings, protective canopies or transverse or longitudinal members so shaped that effective protection is given.

6.7.1.2 Items of equipment

6.7.1.2.1 **[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 marginal 1.2.2.

[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 shall be ensured even in the event of overturning of the shell. 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 shells, shall be so designed and arranged that manipulation of the fittings incorporating them does not damage them.

6.7.1.2.2 **[1.3.2 21x131]** Every bottom-discharge shell, and in the case of compartmented bottom-discharge shells every compartment, shall be equipped with two mutually independent shut-off devices, the first being an internal stop-valve 5/ fixed directly together with its seating to the shell and the second being a sluice-valve or other equivalent device, mounted in series, one at each end of the discharge pipe-socket. The bottom discharge of shells intended for the carriage of powdery or granular substances may be constituted by external piping with a stop-valve if it is made of a malleable metallic material. In addition, the openings of the shells shall be capable of being closed by means of screw-threaded plugs, blank flanges or other equally effective devices. The internal stop-valve shall be operable from above or from below. If possible, the setting - open or closed - of the internal stop-valve shall be capable of being verified from the ground in both cases. The controls of the internal stop-valve shall be so designed as to prevent any inadvertent opening through impact or unconsidered action. The internal shut-off device must continue to be effective in the event of damage to the external control.

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

The position and/or direction of closure of the sluice-valves must be clearly apparent.

6.7.1.2.3 **[1.3.3 21x131]** The shell or each of its compartments shall be provided with an opening large enough to permit inspection.

5/ However, in the case of shells intended for the carriage of certain cristallizable or highly viscous substances, deeply refrigerated liquefied gases 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.

6.7.1.2.4 **[1.3.4 21x132]** Shells 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.

6.7.1.2.5 **[1.3.5 21x133]** Shells intended for the carriage of liquids having a vapour pressure of not more than 110 kPa (1.1 bar) (absolute) at 50E 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.

6.7.1.2.6 **[1.3.6 21x134]** Shells 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 50E 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.

6.7.1.2.7 **[1.3.7 21x135]** Shells 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 50E 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. 6/

6.7.1.2.8 **[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 61E C or for the carriage of flammable gases may be made of unprotected corrodible steel.

6.7.1.3 **Type approval**

6.7.1.3.1 **[1.4.1 211x140]** The competent authority or a body designated by that authority shall issue in respect of each new type of tank a certificate attesting that the prototype tank-wagon, including the shell fastenings which it has surveyed, is suitable for the purpose for which it is intended and meets the construction requirements [of section 1.2], the equipment requirements [of section 1.3] and the conditions peculiar to the classes of substances carried. The test results, the substances and/or the groups of substances for the carriage of which the tank is approved and its type approval number shall be entered in a test report.

[1.4 212 140] The competent authority or a body designated by that authority shall issue in respect of each new type of tank-container a certificate attesting that the prototype tank-container, 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], the equipment requirements [of section 1.3] and the special conditions for the classes of substances carried. The test results, the substances and/or the groups of substances for the carriage of which the tank-container is approved and its type approval number as a prototype shall be specified in a test report. The approval number shall consist of the distinguishing sign 7/ of the State in whose territory the approval was granted, and a registration number.

6/ "Hermetically closed shells", see 1.2.1 (37).

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

The substances of a group of substances shall be of similar kind and equally compatible with the characteristics of the shell. The substances or groups of substances permitted shall be specified in the test report, with their chemical names or the corresponding collective heading in the list of substances [and their class and item number].

6.7.1.3.2 **[1.4.2 211 140]** This approval shall be valid for tanks manufactured according to this prototype without modification.

[1.4. 212 140] If the tank-containers are manufactured in series without modification, this approval shall be valid for the entire series.

6.7.1.4 **Tests**

6.7.1.4.1 **[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, 8/ an external and internal examination, a hydraulic pressure test 9/ 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 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.

6.7.1.4.2 **[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.

In the case of shells 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.

8/ The check of the design characteristics shall also include, for shells requiring a test pressure of 1 MPa (10 bar) or higher, the taking of weld test pieces (work samples) in accordance with 1.2.8.4 and the tests prescribed in Appendix II.C.

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

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

Shells empty, uncleaned, may be moved after expiration of the period for undergoing the test.

6.7.1.4.3 **[1.5.3 21x152**] In addition, a leakproofness test of the shell 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 211 152** The leafproofness test shall be carried out separately on each compartment of compartmented shells.]	at least every two and a half years.

Empty, uncleaned shells may be moved after expiration of this period, for undergoing inspection.

6.7.1.4.4 **[1.5.4 21x153]** When the safety of the shell or of its equipment may have been impaired as a result of repairs, alterations or accident, an exceptional check shall be carried out.

6.7.1.4.5 **[1.5.5 211x154** The tests, inspections and checks in accordance with [1.5.1 to 1.5.4] 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 shell in accordance with [marginal 1.4].

6.7.1.5 **Marking**

6.7.1.5.1 **[1.6.1 21x160]** Every shell 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: 10/

- approval number;
- manufacturer's name or mark;
- manufacturer's serial number;
- year of manufacture;

10/ The units of measurement should be indicated after numerical values.

- 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;

- material of the shell 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.

6.7.1.5.2

[1.6.2] The following particulars shall be inscribed on each side of the tank wagon (on the shell itself or on a panel): 11/

- name of the owner;

- 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; 12/

- 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.

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

- names of owner and of operator;

- capacity of the shell;

- tare;

- the maximum permissible laden mass; and

- name of substance carried.

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

11/ Add the units of measurement after the numerical values.

12/ A collective description covering a group of substances of a similar nature and equally compatible with the characteristics of the shell may be given instead of the name.

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

6.7.2 Requirements applicable to Class 2: Gases

6.7.2.1 Construction

6.7.2.1.1 **[2.2.1.1 21x220 (1)]** Shells intended for the carriage of substances of 1°, 2° or 4° shall be made of steel. In the case of weldless shells, by derogation from 1.2.6.2 a minimum elongation at fracture of 14% and also a stress F (sigma) lower than or equal to limits hereafter given according to the material may be accepted:

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

F # 0.75 Re;

(b) When the ratio Re/Rm of the minimum guaranteed characteristics after heat treatment is higher than 0.85:

F # 0.5 Rm.

6.7.2.1.2 **[2.2.2 21x221]** The requirements of Appendix II C apply to the materials and construction of welded shells.

6.7.2.1.3 **[2.2.4]** For double-walled shells, the wall thickness of the inner receptacle may, notwithstanding the requirements of 1.2.8.3, be 3 mm if a metal is used which has good low-temperature performance corresponding to a minimum tensile strength Rm = 490 N/mm^2 and a minimum coefficient of elongation A = 30%.

If other metals are used, an equivalent minimum wall thickness shall be maintained; this thickness is to be calculated according to the formula in footnote 3 to 1.2.8.3, where Rm_0 = 490 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.

6.7.2.2 Items of equipment

6.7.2.2.1 **[2.3.1 21x230]** The discharge pipes of shells shall be capable of being closed by blank flanges or some other equally reliable device. For shells intended for the carriage of gases of 3°, these blank flanges or other equally reliable devices may be fitted with pressure-release openings of a maximum diameter of 1.5 mm.

6.7.2.2.2 **[2.3.2 21x231]** Shells intended for the carriage of liquefied gases may be provided with, in addition to the openings prescribed in 6.7.3.1 and 6.7.3.2, openings for the fitting of gauges, including pressure gauges, and thermometers and with bleed holes, as required for their operation and safety.

6.7.2.2.3

[2.3.2.1 211 232 (1)] Filling and discharge openings of shells 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.

[2.3.2.1 212 232 (1)] Filling and discharge openings of shells 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 tank-container or of fire. It shall also be possible to operate the closing device by remote control.

6.7.2.2.4 **[2.3.2.2 21x232 (2)]** All openings, other than those accommodating safety valves and than closed bleed holes, of shells 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.

6.7.2.2.5 **[2.3.2.3 21x232 (3)]** By derogation from the provisions of 2.3.2.1 and 2.3.2.2, shells intended for the carriage of deeply refrigerated flammable and/or toxic 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.

6.7.2.2.6 **[2.3.2.4 21x232 (4)]** If the shells 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.

6.7.2.2.7 **[2.3.2.6 21x232 (6)]** Filling and discharge openings situated in the upper part of shells shall be equipped with, in addition to what is prescribed in 2.3.2.1, a second, external, closing device. This device shall be capable of being closed by a blank flange or some other equally reliable device.

6.7.2.2.8 **[2.3.3 21x233]** Safety valves shall meet the requirements of 2.3.3.1 to 2.3.3.3 below:

6.7.2.2.9 **[2.3.3.1 21x233 (1)]** Shells intended for the carriage of gases of 1°, 2° or 4° may be fitted with not more than two safety valves whose aggregate clear cross-sectional area of passage at the seating or seatings shall be not less than 20 cm^2 per 30 m^3 or part thereof of the receptacle'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 shell 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.

6.7.2.2.10 **[2.3.3.1 21x233 (1)]** Where tank-vehicles 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. 13/

6.7.2.2.11 **[2.3.3.2 21x233 (2)]** Shells intended for the carriage of gases of 3° 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 shell in such a way that the pressure does not at any time exceed by more than 10% the working pressure indicated on the shell. 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 shell, or of destruction of 20% of the insulation of a single-walled shell, the safety valve and the bursting disc shall permit an outflow such that the pressure in the shell cannot exceed the test pressure.

6.7.2.2.12 **[2.3.3.3 21x233 (3)]** The safety valves of shells intended for the carriage of gases of 3° shall be capable of opening at the working pressure indicated on the shell. 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.

6.7.2.2.13 **[2.3.4] Thermal insulation**

6.7.2.2.14 **[2.3.4.1 21x234 (1)]** If shells intended for the carriage of gases of 2° 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 shell 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.

6.7.2.2.15 **[2.3.4.2 21x234 (2)]** Shells intended for the carriage of gases of 3° 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 1.1.4.2, 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.

6.7.2.2.16 **[2.3.4.3 21x234 (3)]** Shells intended for the carriage of liquefied gases having a boiling point below -182° C at atmospheric pressure shall not include any combustible material either in the thermal insulation or in the means of attachment to the frame.

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

6.7.2.2.17 **[2.3.6 21x236]** By derogation from the provisions of 1.3.3 shells intended for the carriage of deeply-refrigerated liquefied gases need not have an inspection aperture.

13/ These requirements are published in the IMDG Code.

6.7.2.3 Tests

6.7.2.3.1 **[2.5.1.2 21x250 (2)]** The materials of every welded shell, with the exception of receptacles and cylinders as part of bundles of cylinders, which are elements of a battery-vehicle, shall be tested according to the method described in Appendix II C.

6.7.2.3.2 **[2.5.2]** The test pressure values shall be as follows:

6.7.2.3.3 **[2.5.2.1 21x251 (1)]** The test pressure for shells intended for the carriage of gases of 1° having a critical temperature below -50° C shall be at least one and one-half times the filling pressure at 15° C.

6.7.2.3.4 **[2.5.2.2 21x251 (2)]** The test pressure for shells intended for the carriage of:

- gases of 1° having a critical temperature of -50° C or above; and
- gases of 2° having a critical temperature below 70° C
- gases of 4°

shall be such that, when the shell is filled to the maximum mass of the contents per litre of capacity, the pressure reached in the shell by the substance at 55° C for shells with thermal insulation or 65° C for shells without thermal insulation does not exceed the test pressure.

6.7.2.3.5 **[2.5.2.3 21x251 (3)]** The test pressure for shells intended for the carriage of gases of 2° having a critical temperature of 70° C or above will be:

(a) If the shell is equipped with thermal insulation, at least equal to the vapour pressure, reduced by 0.1 MPa (1 bar) of the liquid at 60° C, but not less than 1 MPa (10 bar);

(b) If the shell is not equipped with thermal insulation, at least equal to the vapour pressure, reduced by 0.1 MPa (1 bar), of the liquid at 65° C, but not less than 1 MPa (10 bar).

The maximum permissible mass of contents per litre of capacity is calculated as follows:

maximum permissible mass of
contents per litre of capacity = 0.95 x density of the liquid phase at 50° C (in kg/l);

moreover the vapour phase shall not disappear below 60° C.

If the shells are not more than 1.5 metre in diameter the values of the test pressure and maximum permissible mass of contents per litre of capacity conforming to marginal 219 (d) shall be applicable.

6.7.2.3.6 **[2.5.2.4 21x251 (4)]** The test pressure for shells intended for the carriage of gases of 3° shall be not less than 1.3 times the maximum permitted working pressure indicated on the shell, but not less than 300 kPa (3 bar) (gauge pressure); for shells with vacuum insulation the test pressure shall be not less than 1.3 times the maximum permitted working pressure increased by 100 kPA (1 bar).

6.7.2.3.7 [2.5.2.5 21x251 (5)] Minimum test pressure of the shells and as far as applicable, maximum permissible mass of contents per litre of capacity.

In the case of gases and gas mixtures classified under n.o.s. entries, the values of the test pressure and maximum permissible mass of contents per litre of capacity shall be prescribed by the expert approved by the competent authority.

When shells for gases of 1° or 2° having a critical temperature of -50° C or above and below 70° C have been subjected to a test pressure lower than shown in the table, and the shells are fitted with thermal insulation, a lower maximum load may be prescribed by the expert approved by the competent authority, provided that the pressure reached in the shell by the substance at 55° C does not exceed the test pressure stamped on the shell.

NOTE: *1076 Phosgene of 1067 Dinitrogen tetroxide (nitrogen dioxide) and 1001 Acetylene, dissolved, shall only be authorized for transport in multiple-element tank-containers.*

Item No. and group	UN No.	Identification number and name (R...) = (Refrigerant gas R...)	Minimum test pressure for shells				Maximum permissible mass of contents per litre of capacity
			With thermal insulation		Without thermal insulation		
			Mpa	bar	Mpa	bar	kg
(a)		(b)	(c)	(d)	(e)	(f)	(g)
4 F	1001	Acetylene, dissolved	Only in multiple-element battery-wagons/ tank-containers				
1 A	1002	Air, compressed	See marginal 2.5.2.1				
3 O	1003	Air, refrigerated liquid	See marginal 2.5.2.4				
2 TC	1005	Ammonia, anhydrous	2.6	26	2.9	29	0.53
1 A	1006	Argon, compressed	See marginal 2.5.2.1				
1 TC	1008	Boron trifluoride, compressed	22.5 30	225 300	22.5 30	225 300	O.715 0.86
2 A	1009	Bromotrifluoromethane (R13B1)	12	120	 4.2 12 25	 42 120 250	1.50 1.13 1.44 1.60
2 F	1010	1,3-butadiene, inhibited or 1,2-butadiene, inhibited or mixtures of 1,3-butadiene and hydrocarbons, inhibited	1 1 1	10 10 10	1 1 1	10 10 10	0.55 0.59 0.50
2 F	1011	Butane	1	10	1	10	0.51

			Mpa	bar	Mpa	bar	kg
(a)		(b)	(c)	(d)	(e)	(f)	(g)
2 F	1012	1-butylene or trans-2-butylene or cis-2-butylene or butylenes mixture	1 1 1 1	10 10 10 10	1 1 1 1	10 10 10 10	0.53 0.54 0.55 0.50
2 A	1013	Carbon dioxide	19 22.5	190 225	 19 25	 190 250	0.73 0.78 0.66 0.75
1 O	1014	Carbon dioxide and oxygen mixture, compressed	See marginal 2.5.2.1				
2 A	1015	Carbon dioxide and nitrous oxide mixture	See marginal 2.5.2.2. or 2.5.2.3				
1 TF	1016	Carbon monoxide, compressed	See marginal 2.5.2.1				
2 TC	1017	Chlorine	1.7	17	1.9	19	1.25
2 A	1018	Chlorodifluoromethane (R22)	2.4	24	2.6	26	1.03
2 A	1020	Chloropentafluoroethane (R115)	2	20	2.3	23	1.08
2 A	1021	1-chloro-1,2,2,2-tetrafluoroethane (R124)	1	10	1.1	11	1.2
2 A	1022	Chlorotrifluoromethane (R13)	12 22.5	120 225	 10 12 19 25	 100 120 190 250	0.96 1.12 0.83 0.90 1.04 1.10
1 TF	1023	Coal gas, compressed	See marginal 2.5.2.1				
2 TF	1026	Cyanogen	10	100	10	100	0.70
2 F	1027	Cyclopropane	1.6	 1.6	1.8	 1.8	0.53
2 A	1028	Dichlorofluoromethane (R12)	1.5	15	1.6	16	1.15
2 A	1029	Dichlorofluoromethane (R21)	1	10	1	10	1.23
2 F	1030	1,1-difluoroethane (R152a)	1.4	14	1.6	16	0.79
2 F	1032	Dimethylamine, anhydrous	1	10	1	10	0.59
2 F	1033	Dimethyl ether	1.4	14	1.6	16	0.58
2 F	1035	Ethane	12	120	 9.5 12 30	 95 120 300	0.32 0.25 0.29 0.39

			Mpa	bar	Mpa	bar	kg
(a)		(b)	(c)	(d)	(e)	(f)	(g)
2 F	1036	Ethylamine	1	10	1	10	0.61
2 F	1037	Ethyl chloride	1	10	1	10	0.8
3 F	1038	Ethylene, refrigerated liquid	See marginal 2.5.2.4				
2 F	1039	Ethyl methyl ether	1	10	1	10	0.64
2 TF	1040	Ethylene oxide with nitrogen up to a total pressure of 1 MPa (10 bar) at 50 EC	1.5	15	1.5	15	0.78
2 F	1041	Ethylene oxide and carbon dioxide mixture, with more than 9% ethylene oxide but not more than 87%	2.4	24	2.6	26	0.73
1 A	1046	Helium, compressed	See marginal 2.5.2.1				
2 TC	1048	Hydrogen bromide, anhydrous	5	50	5.5	55	1.54
1 F	1049	Hydrogen, compressed	See marginal 2.5.2.1				
2 TC	1050	Hydrogen chloride, anhydrous	12	120	 10 12 15 20	 100 120 150 200	0.69 0.30 0.56 0.67 0.74
2 TF	1053	Hydrogen sulphide	4.5	45	5	50	0.67
2 F	1055	Isobutylene	1	10	1	10	0.52
1 A	1056	Krypton, compressed	See marginal 2.5.2.1				
2 A	1058	Liquefied gases, non-flammable, charged with nitrogen, carbon dioxide or air	1.5 x filling pressure See marginal 2.5.2.2. or 2.5.2.3				
2 F	1060	Methylacetylene and propadiene mixture, stabilized	See marginal 2.5.2.2 or 2.5.2.3				
		Mixture P1	2.5	25	2.8	28	0.49
		Mixture P2	2.2	22	2.3	23	0.47
		Propadiene with 1% to 4% methylacetylene	2.2	22	2.2	22	0.50
2 F	1061	Methylamine, anhydrous	1	10	1.1	11	0.58
2 T	1062	Methyl bromide	1	10	1	10	1.51
2 F	1063	Methyl chloride (R40)	1.3	13	1.5	15	0.81
2 TF	1064	Methyl mercaptan	1	10	1	10	0.78

			Mpa	bar	Mpa	bar	kg
(a)		(b)	(c)	(d)	(e)	(f)	(g)
1 A	1065	Neon, compressed	See marginal 2.5.2.1				
1 A	1066	Nitrogen, compressed	See marginal 2.5.2.1				
2 TOC	1067	Dinitrogen tetroxyde (nitrogen dioxide)	Only in multiple-element battery-wagons/ tank-containers				
2 O	1070	Nitrous oxide	22.5	225	 18 22.5 25	 180 225 250	0.78 0.68 0.74 0.75
1 TF	1071	Oil gas, compressed	See marginal 2.5.2.1				
1 O	1072	Oxygen, compressed	See marginal 2.5.2.1				
3 O	1073	Oxygen, refrigerated liquid	See marginal 2.5.2.4				
2 TC	1076	Phosgene	Only in multiple-element battery-wagons/ tank-containers				
2 F	1077	Propylene	2.5	25	2.7	27	0.43
2 A	1078	Refrigerant gases, n.o.s. such as Mixture F1 Mixture F2 Mixture F3	 1 1.5 2.4	 10 15 24	 1.1 1.6 2.7	 11 16 27	 1.23 1.15 1.03
		Other mixtures	See marginal 2.5.2.2. or 2.5.2.3				
2 TC	1079	Sulphur dioxide	1	10	1.2	12	1.23
2 A	1080	Sulphur hexafluoride	12	120	 7 14 16	 70 140 160	1.34 1.04 1.33 1.37
2 TF	1082	Trifluorochloroethylene, inhibited	1.5	15	1.7	17	1.13
2 F	1083	Trimethylamine, anhydrous	1	10	1	10	0.56
2 F	1085	Vinyl bromide, inhibited	1	10	1	10	1.37
2 F	1086	Vinyl chloride, inhibited	1	10	1.1	11	0.81
2 F	1087	Vinyl methyl ether, inhibited	1	10	1	10	0.67
1 T	1612	Hexaethyl tetraphosphate and compressed gas mixture	See marginal 2.5.2.1				
2 TOC	1749	Chlorine trifluoride	3	30	3	30	1.40
2 A	1858	Hexafluoropropylene (R1216)	1.7	17	1.9	19	1.11

			Mpa	bar	Mpa	bar	kg
(a)		(b)	(c)	(d)	(e)	(f)	(g)
1 TC	1859	Silicon tetrafluoride, compressed	20 30	200 300	20 30	200 300	0.74 1.10
2 F	1860	Vinyl fluoride, inhibited	12 22.5	120 225	 25	 250	0.58 0.65 0.64
2 F	1912	Methyl chloride and methylene chloride mixture	1.3	13	1.5	15	0.81
3 A	1913	Neon, refrigerated liquid	See marginal 2.5.2.4				
3 A	1951	Argon, refrigerated liquid	See marginal 2.5.2.4				
2 A	1952	Ethylene oxide and carbon dioxide mixture with not more than 9% ethylene oxide	19 25	190 250	19 25	190 250	0.66 0.75
1 TF	1953	Compressed gas, toxic, flammable, n.o.s.	See marginal 2.5.2.1 or 2.5.2.2				
1 F	1954	Compressed gas, flammable, n.o.s.	See marginal 2.5.2.1 or 2.5.2.2				
1 T	1955	Compressed gas, toxic, n.o.s.	See marginal 2.5.2.1 or 2.5.2.2				
1 A	1956	Compressed gas, n.o.s.	See marginal 2.5.2.1. or 2.5.2.2				
1 F	1957	Deuterium, compressed	See marginal 2.5.2.1				
2 A	1958	1,2-dichloro-1,1,2,2-tetrafluoroethene (R114)	1	10	1	10	1.3
2 F	1959	1,1-difluoroethylene (R1132a)	12 22.5	120 225	 25	 250	0.66 0.78 0.77
3 F	1961	Ethane, refrigerated liquid	See marginal 2.5.2.4				
1 F	1962	Ethylene, compressed	12 22.5	120 225	 22.5 30	 225 300	0.25 0.36 0.34 0.37
3 A	1963	Helium, refrigerated liquid	See marginal 2.5.2.4				
1 F	1964	Hydrocarbon gas mixture, compressed, n.o.s.	See marginal 2.5.2.1 or 2.5.2.2				

			Mpa	bar	Mpa	bar	kg
(a)		(b)	(c)	(d)	(e)	(f)	(g)
2 F	1965	Hydrocarbon gas mixture, liquefied, n.o.s.					
		Mixture A	1	10	1	10	0.50
		Mixture A01	1.2	12	1.4	14	0.49
		Mixture A02	1.2	12	1.4	14	0.48
		Mixture A0	1.2	12	1.4	14	0.47
		Mixture A1	1.6	16	1.8	18	0.46
		Mixture B1	2	20	2.3	23	0.45
		Mixture B2	2	20	2.3	23	0.44
		Mixture B	2	20	2.3	23	0.43
		Mixture C	2.5	25	2.7	27	0.42
		Other mixtures	See marginal 2.5.2.2 or 2.5.2.3				
3 F	1966	Hydrogen, refrigerated liquid	See marginal 2.5.2.4				
2 T	1967	Insecticide gas, toxic, n.o.s.	See marginal 2.5.2.2 or 2.5.2.3				
2 A	1968	Insecticide gas, n.o.s.	See marginal 2.5.2.2. or 2.5.2.3				
2 F	1969	Isobutane	1	10	1	10	0.49
3 A	1970	Krypton, refrigerated liquid	See marginal 2.5.2.4				
1 F	1971	Methane, compressed or natural gas, compressed, with high methane content	See marginal 2.5.2.1				
3 F	1972	Methane, refrigerated liquid or natural gas, refrigerated liquid, with high methane content	See marginal 2.5.2.4				
2 A	1973	Chlorodifluoromethane and chloropentafluoroethene mixture with fixed boiling point, with approximately 49% chlorodifluoro methane (R502)	2.5	25	2.8	28	1.05
2 A	1974	Chlorodifluorobromomethane (R12B1)	1	10	1	10	1.61
2 A	1976	Octafluorocyclobutane (RC318)	1	10	1	10	1.34
3 A	1977	Nitrogen, refrigerated liquid	See marginal 2.5.2.4				
2 F	1978	Propane	2.1	21	2.3	23	0.42
1 A	1979	Rare gases mixture, compressed	See marginal 2.5.2.1				
1 A	1980	Rare gases and oxygen mixture, compressed	See marginal 2.5.2.1				

			Mpa	bar	Mpa	bar	kg
(a)		(b)	(c)	(d)	(e)	(f)	(g)
1 A	1981	Rare gases and nitrogen mixture, compressed	See marginal 2.5.2.1				
1 A	1982	Tetrafluoromethane, compressed (R14)	20 30	200 300	20 30	200 300	0.62 0.94
2 A	1983	1-chloro-2,2,2-trifluoroethane (R133a)	1	10	1	10	1.18
2 A	1984	Trifluoromethane (R23)	19 25	190 250	 19 25	 190 250	0.92 0.99 0.87 0.95
1 F	2034	Hydrogen and methane mixture, compressed	See marginal 2.5.2.1				
2 F	2035	1,1,1-trifluoroethane (R143a)	2.8	28	3.2	32	0.79
1 A	2036	Xenon, compressed	12	120	 13	 130	1.30 1.24
2 F	2044	2,2-dimethyl propane	1	10	1	10	0.53
4 A	2073	Ammonia solutions, relative density less than 0.880 at 15E C in water With more than 35% and not more than 40% ammonia With more than 40% and not more than 50% ammonia	 1 1.2	 10 12	 1 1.2	 10 12	 0.80 0.77
3 A	2187	Carbon dioxide, refrigerated liquid	See marginal 2.5.2.4				
2 TFC	2189	Dichlorosilane	1	10	1	10	0.90
2 T	2191	Sulphuryl fluoride	5	50	5	50	1.1
1 A	2193	Hexafluoroethane, compressed (R116)	16 20	160 200	 20	 200	1.28 1.34 1.10
2 TC	2197	Hydrogen iodide, anhydrous	1.9	19	2.1	21	2.25
2 F	2200	Propadiene, inhibited	1.8	18	2.0	20	0.50
3 O	2201	Nitrous oxide, refrigerated liquid	See marginal 2.5.2.4				
1 F	2203	Silane, compressed	22.5 25	225 250	22.5 25	225 250	0.32 0.41
2 TF	2204	Carbonyl sulphide	2.7	27	3.0	30	0.84
1 TC	2417	Carbonyl fluoride, compressed	20 30	200 300	20 30	200 300	0.47 0.70
2 F	2419	Bromotrifluoroethylene	1	10	1	10	1.19

			Mpa	bar	Mpa	bar	kg
(a)		(b)	(c)	(d)	(e)	(f)	(g)
2 TC	2420	Hexafluoroacetone	1.6	16	1.8	18	1.08
2 A	2422	Octafluorobut-2-ene (R1318)	1	10	1	10	1.34
2 A	2424	Octafluoropropane (R218)	2.1	21	2.3	23	1.07
1 O	2451	Nitrogen trifluoride, compressed	20 30	200 300	20 30	200 300	0.50 0.75
2 F	2452	Ethylacetylene, inhibited	1	10	1	10	0.57
2 F	2453	Ethyl fluoride (R161)	2.1	21	2.5	25	0.57
2 F	2454	Methyl fluoride (R41)	30	300	30	300	0.36
2 F	2517	1-chloro-1,1-difluoroethane (R142b)	1	10	1	10	0.99
3 A	2591	Xenon, refrigerated liquid	See marginal 2.5.2.4				
2 A	2599	Chlorotrifluoromethane and trifluoromethane, azeotropic mixture with approximately 60% chlorotrifluoromethane (R503)	3.1 4.2 10	31 42 100	3.1 4.2 10	31 42 100	0.11 0.21 0.76 0.20 0.66
1 TF	2600	Carbon monoxide and hydrogen mixture, compressed	See marginal 2.5.2.1				
2 F	2601	Cyclobutane	1	10	1	10	0.63
2 A	2602	Dichlorodifluoromethane and 1,1-difluoroethane, azeotropic mixture with approximately 74% dichlorodifluoromethane (R500)	1.8	18	2	20	1.01
2 TOC	2901	Bromine chloride	1	10	1	10	1.50
2 TC	3057	Trifluoroacetyl chloride	1.3	13	1.5	15	1.17
2 A	3070	Ethylene oxide and dichlorodifluoromethane mixture with not more than 12.5% ethylene oxide	1.5	15	1.6	16	1.09
2 TO	3083	Perchloryl fluoride	2.7	27	3.0	30	1.21
3 A	3136	Trifluoromethane, refrigerated liquid	See marginal 2.5.2.4				
3 F	3138	Ethylene, acetylene and propylene in mixture, refrigerated liquid, containing at least 71.5% ethylene with not more than 22.5% acetylene and not more than 6% propylene	See marginal 2.5.2.4				
2 F	3153	Perfluoro(methyl vinyl ether)	1.4	14	1.5	15	1.14

			Mpa	bar	Mpa	bar	kg
(a)		(b)	(c)	(d)	(e)	(f)	(g)
2 F	3154	Perfluoro(ethyl vinyl ether)	1	10	1	10	0.98
1 O	3156	Compressed gas, oxidizing, n.o.s.	See marginal 2.5.2.1 or 2.5.2.2				
2 O	3157	Liquefied gas, oxidizing, n.o.s.	See marginal 2.5.2.2. or 2.5.2.3				
3 A	3158	Gas, refrigerated liquid, n.o.s.	See marginal 2.5.2.4				
2 A	3159	1,1,1,2-tetrafluoroethane (R134a)	1.6	16	1.8	18	1.04
2 TF	3160	Liquefied gas, toxic, flammable, n.o.s.	See marginal 2.5.2.2 or 2.5.2.3				
2 F	3161	Liquefied gas, flammable, n.o.s.	See marginal 2.5.2.2 or 2.5.2.3				
2 T	3162	Liquefied gas, toxic, n.o.s.	See marginal 2.5.2.2 or 2.5.2.3				
2 A	3163	Liquefied gas, n.o.s.	See marginal 2.5.2.2 or 2.5.2.3				
2 A	3220	Pentafluoroethane (R125)	4.1	41	4.9	49	0.95
2 F	3252	Difluoromethane (R32)	3.9	39	4.3	43	0.78
2 A	3296	Heptafluoropropane (R227)	1.4	14	1.6	16	1.20
2 A	3297	Ethylene oxide and chlorotetrafluoroethane mixture, with not more than 8.8% ethylene oxide	1	10	1	10	1.16
2 A	3298	Ethylene oxide and pentafluoroethane mixture, with not more than 7.9% ethylene oxide	2.4	24	2.6	26	1.02
2 A	3299	Ethylene oxide and tetrafluoroethane mixture, with not more than 5.6% ethylene oxide	1.5	15	1.7	17	1.03
2 TF	3300	Ethylene oxide and carbon dioxide mixture, with more than 87% ethylene oxide	2.8	28	2.8	28	0.73
1 TO	3303	Compressed gas, toxic, oxidizing, n.o.s.	See marginal 2.5.2.1 or 2.5.2.2				
1 TC	3304	Compressed gas, toxic, corrosive, n.o.s.	See marginal 2.5.2.1 or 2.5.2.2				
1 TFC	3305	Compressed gas, toxic, flammable, corrosive, n.o.s.	See marginal 2.5.2.1 or 2.5.2.2				
1 TOC	3306	Compressed gas, toxic, oxidizing, corrosive, n.o.s.	See marginal 2.5.2.1 or 2.5.2.2				

			Mpa	bar	Mpa	bar	kg
(a)		(b)	(c)	(d)	(e)	(f)	(g)
2 TO	3307	Liquefied gas, toxic, oxidizing, n.o.s.	See marginal 2.5.2.2 or 2.5.2.3				
2 TC	3308	Liquefied gas, toxic, corrosive, n.o.s.	See marginal 2.5.2.2 or 2.5.2.3				
2 TFC	3309	Liquefied gas, toxic, flammable, corrosive, n.o.s.	See marginal 2.5.2.2 or 2.5.2.3				
2 TOC	3310	Liquefied gas, toxic, oxidizing, corrosive, n.o.s.	See marginal 2.5.2.2 or 2.5.2.3				
3 O	3311	Gas, refrigerated, liquefied, oxidizing, n.o.s.	See marginal 2.5.2.4				
3 F	3312	Gas, refrigerated, liquefied, flammable, n.o.s.	See marginal 2.5.2.4				
4 TC	3318	Ammonia solutions, relative density less than 0.880 at 15E C in water, with more than 50% ammonia	See marginal 2.5.2.2.				
2 A	3337	Refrigerant gas R404A	2.9	29	3.2	32	0.82
2 A	3338	Refrigerant gas R407A	2.9	29	3.3	33	0.94
2 A	3339	Refrigerant gas R407B	2.9	29	3.3	33	0.94
2 A	3340	Refrigerant gas R407C	2.7	27	3.1	31	0.95
2 F	3354	Insecticide gas, flammable, n.o.s	See marginal 2.5.2.2 or 2.5.2.3				
2 TF	3355	Insecticide gas, toxic, flammable, n.o.s.	See marginal 2.5.2.2 or 2.5.2.3				

6.7.2.3.8 **[2.5.3 21x252]** The first hydraulic pressure test shall be carried out before the thermal insulation is placed in position.

6.7.2.3.9 **[2.5.4 21x253]** The capacity of each shell intended for the carriage of gases of 1° filled by mass, or gases of 2° or 4° shall be determined, under the supervision of an expert approved by the competent authority, by weighing or volumetric measurement of the quantity of water which fills the shell; any error in the measurement of shell capacity shall be of 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.

6.7.2.3.10 **[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].

6.7.2.3.11 **[2.5.6 21x255]** By derogation from the requirements of 1.5, the periodic tests shall take place:

6.7.2.3.12 **[2.5.6.1 212 255 (1)]** Every four years [ADR three years] in the case of shells

[2.5.6.1 212 255 (1)] Every two and half years in the case of shells

intended for the carriage of 1008 boron trifluoride, 1053 hydrogen sulphide, 1048 hydrogen bromide, anhydrous, 1050 hydrogen chloride, anhydrous, 1017 chlorine, 1076 phosgene or 1079 sulphur dioxide, or 1067 dinitrogen tetroxide (nitrogen dioxide);

6.7.2.3.13 **[2.5.6.2 21x255 (2)]** After 8 years' service and thereafter every 12 years in the case of shells intended for the carriage of gases of 3°.

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

A leakproofness test may be performed, at the request of the competent authority, between any two successive tests.

6.7.2.3.14 **[2.5.7 21x256]** In the case of vacuum-insulated shells, 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.

6.7.2.3.15 **[2.5.8 21x257]** If apertures have been made, on the occasion of periodic inspections, in shells intended for the carriage of gases of 3°, 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.

6.7.2.3.16 **[2.5.9 21x258]** Leakproofness test of shells intended for the carriage of gases of 1°, 2° or 4° shall be performed at a pressure of not less than 400 kPa (4 bar) and not more than 800 kPa (8 bar) (gauge pressure).

6.7.2.4 **Marking**

6.7.2.4.1 **[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, or directly on the walls of the shell itself if the walls are so reinforced that the strength of the shell is not impaired:

6.7.2.4.2 **[2.6.1.1 21x260 (1)]** On shells intended for the carriage of only one substance:

- the name of the gas in letters in accordance with marginal 201 and, in addition for gases classified under an n.o.s. entry, the technical name. 14/

14/ 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 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 A0, mixture A1, mixture B, mixture C.

The names customary in the trade and mentioned in Note 1 under the entry 1965 of 2° F of marginal 201 may be used only as a complement.

This indication shall be supplemented in the case of shells intended for the carriage of compressed gases of 1° filled by volume (pressure), by an indication of the maximum filling pressure at 15° C permitted for the shell, and in the case of shells intended for the carriage of gases of 1° filled by mass, and of gases of 2°, 3° and 4° by the maximum permissible load mass in kg and of the filling temperature if below -20° C.

6.7.2.4.3 **[2.6.1.2 21x260 (2)]** On multipurpose shells:

- the name of the gas in letters in accordance with marginal 201 and, in addition for gases classified under an n.o.s. entry, the technical name of the gases for whose carriage the shell is approved.

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

6.7.2.4.4 **[2.6.1.3 21x260 (3)]** On shells intended for the carriage of gases of 3°:

- the maximum working pressure allowed.

6.7.2.4.5 **[2.6.1.4 21x260 (4)]** On shells equipped with thermal insulation:

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

6.7.2.4.6

[XI 2.6.3] In addition to the inscriptions prescribed in 1.6.2, the following shall be inscribed on each side of the tank-wagon or on panels:	**[X 2.6.3]** In addition to the particulars prescribed in 1.6.2, the following shall be inscribed either on the shell itself or on a plate:
[211 262] In addition to the particulars prescribed in marginal 211 161, the following shall be inscribed either on the shell itself or on a plate:	**[212 262]** In addition to the particulars prescribed in marginal 212 161, the following shall be inscribed either on the tank-container itself or on a plate:

(a) - the inscription: “minimum filling temperature allowed: ...”;

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

- the name of the gas in letters in accordance with marginal 201 and, in addition for gases classified under an n.o.s. entry, the technical name;

(c) where the shell is a multipurpose shell:

- the name in letters of all gases to whose carriage the shell is assigned, with an indication of the maximum permissible load mass in kg for each of them;

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

- the inscription “thermally insulated” or “thermally insulated by vacuum”, in an official language of the country of registration and also 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.]

6.7.2.4.7 **[RID/ADR 2.6.3.1]** For compressed gases of 1° filled by mass, for liquefied gases of 2° and 3° and gases dissolved under pressure of 4° the load limits in accordance with 1.6.2 shall be determined in the light of the maximum permissible load mass of the shell, depending on the substance carried; in the case of multipurpose shells, the name in full of the particular gas being carried shall be stated together with the load limit on the same folding panel.

6.7.2.4.8 **[RID/ADR 2.6.4]** The panels on wagons carrying demountable receptacles as referred to in 2.3.5.5 need not bear the particulars prescribed in 1.6.2 and 2.6.3.

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

6.7.2.4.9 **[RID/ADR 2.6.5]** Shells intended for the carriage of liquefied gases of 2° and 3° shall be marked with an unbroken orange 15/ band, about 30 cm wide, encircling the shell at mid-height.

6.7.2.5 **Multiple-element battery-wagons/battery-vehicles**

6.7.2.5.1 **[2.2.1.2 21x220 (2)]** Receptacles as defined in marginals 211 (1), (2) and (3) and cylinders as part of bundles of cylinders as defined in marginal 211 (5) which are elements of a battery-vehicle, shall be constructed according to marginal 212.

6.7.2.5.2 **[2.3.2.7 21x232 (7)]** By derogation from the provisions of 2.3.2.1, 2.3.2.2 and 2.3.2.6, for receptacles as defined in marginals 211 (1), (2), (3) and (5) which form a multiple-element battery-vehicle, the required closing devices may be provided for within the manifolding arrangement.

6.7.2.5.3 **[2.3.5 21x235 (2)]** The following conditions shall be complied with for multiple-element shells:

6.7.2.5.4 **[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.

6.7.2.5.5 **[2.3.5.2 21x235 (2) (b)]** The filling and discharge devices may be affixed to a manifold.

6.7.2.5.6 **[2.3.5.3 21x235 (2) (c)]** Each element of a multiple-element shell, including each individual cylinder of a bundle, as defined in marginal 211 (5), intended for the carriage of gases designated by capital letter T in marginal 201, shall be capable of being isolated by a shut-off valve.

6.7.2.5.7 **[2.3.5.4 21x235 (2) (d)]** The elements of a multiple-element shell intended for the carriage of gases designated by capital letter F in marginal 201, when consisting of receptacles as defined in marginals 211 (1), (2), (3) and (5), shall be combined to groups of not more than 5,000 litres which are capable of being isolated by a shut-off valve.

15/ See Appendix VIII, marginal 1800 (1), Note.

Each element of a multiple-element shell intended for the carriage of gases designated by capital letter F in marginal 201 when consisting of shells as defined in Appendix XI/X shall be capable of being isolated by a shut-off valve.

6.7.2.5.8 **[2.3.5.5]** If the elements are demountable, 16/ the following requirements apply:

(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 the elements can be rolled, the valves shall be provided with protective caps.

[ADR 211 235 (3)] The following requirements apply to demountable tanks:

(a) They shall not be interconnected by a manifold; and

(b) If the demountable tanks can be rolled, the valves shall be provided with protective caps.

6.7.2.5.9 **[2.5.1.1 21x250 (1)]** Receptacles as defined in marginal 211 (1), (2) and (3) and cylinders as part of bundles of cylinders as defined in marginal 211 (5), which are elements of a multiple-element shell, shall be tested according to marginal 219.

6.7.2.5.10 **[2.5.6.3 21x255 (3)]** Receptacles as defined in marginals 211 (1), (2) and (3) and cylinders as part of bundles of cylinders as defined in marginal 211 (5), which are elements of a multiple-element shell, shall have periodic inspections according to Class 2, marginal 217.

6.7.2.5.11 **[2.6.2.1 21x261 (1)]** The frame of a multiple-element shell, excluding movable tanks, shall bear near the filling point a plate specifying: 17/

- the test pressure of the elements;
- the maximum filling pressure at 15° C allowed for elements intended for compressed gases;
- the number of elements;
- the total capacity of the elements;

16/ See 1.2.1.

17/ The units of measurement should be indicated after numerical valves.

- the name of the gas in letters 18/ in accordance with marginal 201 and, in addition for gases classified under an n.o.s. entry, the technical name;

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

- the permissible maximum load per element.

6.7.2.5.12 **[2.6.2.2 21x261 (2)]** Receptacles as defined in marginal 211 (1), (2), (3) and (5), which are elements of a multiple-element shell, shall be marked according to marginal 223. These receptacles need not be labelled individually with the danger labels as required in marginal 224.

Multiple-element shells shall be marked according to Appendix VIII and labelled according to marginal 224.

6.7.2.6 **Special provisions applicable to Class 2**

[2.2.3 21x222] Shells [intended for the carriage of 1017 chlorine or 1076 phosgene of 2° TC] shall be designed for a calculation pressure of at least 2.2 MPa (22 bar) (gauge pressure).

[2.2.3.1 21x332 gases of 1E to 4E, designated by T] If shells 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.

6.7.3 **Requirements applicable to Classes 3 to 9 [7?]**

Note: 1. For requirements concerning the use of tanks, see Part 4.

2. For requirements for receptacles subjected to a test pressure of not less than 1 MPa (10 bar), see Chapter 6.5.

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

6.7.3.1 **Construction**

[4.2.1 21x420 8.2.1 21x820 6E] The requirements of [Appendix II.C] are applicable to the materials and construction of these shells.

18/ 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 under the entry 1965 of 2° F of marginal 201 may be used only as a complement.

[4.2.5 21x424] All parts of the tank-container shall be connected to the underframe of the vehicle by equipotential connections and shall be capable of being electrically earthed.

[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 be greater than 15 mm, even where calculation in accordance with 1.2.8.2 gives a higher value.

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

[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 24E (b)].

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

[8.2.2 21x821 nitric acid of 2E (a)] Where the use of aluminium is necessary for shells, such shells shall be made of aluminium not less than 99.5% pure; even where the calculation pressure according to 1.2.8.2 gives a higher value, the wall thickness need not exceed 15 mm.

[ADR 21x920] The effective minimum thickness of the walls of shells intended for the carriage of substances of 20E (c) shall not be less than 3 mm.

6.7.3.2 Items of equipment

[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** 1E and 2E**]** If shells 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.

[3.3.4 21x333] If the shells are fitted with non-metallic protective linings (inner layers), these shall be so designed that no danger of ignition from electrostatic charges can occur.

[3.3.4 21x334 61E (c) **9.3.4 21x933** 20E] The bottom discharge system of shells may consist of an external pipe with a stop-valve, if it is constructed in a metallic material liable to deformation.

[4.3.3 21x432] Shells intended for the carriage of the substances referred to in 4.1.2 shall in addition meet the following requirements: 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. The shell 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.

[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.

[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.

[4.3.7 21x436 4.1.6] Shells 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).

[5.3.1 21x530 1E (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.

[5.3.2 21x530] UN10 TP6 501 1E The connections to the external pipe-sockets of shells shall be made of materials not liable to cause decomposition of hydrogen peroxide.

[5.3.3 21x532 501 1E (a) 20E**] UN10 TP6 TP16** Shells 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.

[5.3.3 5.3.4 21x532 21x533 501 20E] UN10 TP17 The shut-off devices of shells intended for the ammonium nitrate liquid of marginal 2501, 20E, shall be so designed as to preclude obstruction of the devices by solidified ammonium nitrate during carriage. Where shells are sheathed in thermally-insulating material, the material shall be of an inorganic nature and entirely free from combustible matter.

[5.3.3 21x532 8.3.5 21x834 501 1E (b) and (c) - 801 1791 hypochlorite of 61E**] UN10 TP24 also for 1908 chlorite solution** Shells and their service equipment intended for carriage of hypochlorite solutions of 61E 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.

[5.3.5 5.3.6.1 to 6 21x534 21x535 5.1.2] Shells shall be equipped with thermal insulation complying with the requirements of 2.3.4.1. The sun shield and any part of the shell 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. Shells intended for the carriage of substances referred to in marginal 212 511 shall be fitted with temperature sensing devices.

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

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

[21x536 (2)] Shells 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 50E 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 shell were overturned.

[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:

$$q = 70961\ F\ A^{0.82}$$

where:

q	=	heat absorption (W)	
A	=	wetted area [m^2]	
F	=	insulation factor [-]	
F	=	l for non-insulated vessels, or	
F	=	$\frac{U\ (923\ -\ T_{PO})}{47032}$ *for insulated vessels*	

where:

K	=	heat conductivity of insulation layer	[W0m^{-1}0K^{-1}]
L	=	thickness of insulation layer	[m]
U	=	K/L = heat transfer coefficient of the insulation	[W0m^{-2}0K^{-1}]
T_{PO}	=	temperature of peroxide at relieving conditions	[K]

***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.*

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.

[21x536 (4)] For shells with an insulation consisting of a complete cladding, the capacity and setting of the pressure-relief device(s) shall be determined assuming a loss of insulation from 1% of the surface area.

[21x536 (5)] Vacuum-relief devices and spring-loaded safety valves of shells 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.

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

[9.3.3 21x932 20E**]** Shells 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 50E C higher than the maximum temperature for which the shell was designed.

[RID XI 3.3.2 3.1.3 **XI 6.3.2** 6.1.4**]** Shells are also considered to be hermetically closed when they are fitted with pressure-activated venting devices which open when pressure loss is 0.4 bar.

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

[RID XI 8.3.1] The following requirements are applicable to movable tanks intended for the carriage of substances of 6E:

(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 the receptacles can be rolled, the valves shall be provided with protective caps.

[ADR 21x934] Shells intended for the carriage of substances filled at a temperature higher than 190E 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.

[ADR 211 633] Protection of equipment

Fittings and accessories mounted in the upper part of the shell

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 shell

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 shell or be protected by a rail having a coefficient of inertia of not less than 20 cm^3 transversally to the direction of travel; their ground clearance shall be not less than 300 mm with the shell full.

Fittings and accessories mounted on the rear face of the shell

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.

6.7.3.3 Type approval

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

[5.4.2 21x541 5.1.1] For the type approval of shells 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 pressure-relief devices and safety valves taking into account the design characteristics of tha tank-wagon; 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.

6.7.3.4 Tests

6.7.3.4.1 Shells 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 19/
1.5	1.5
4	4
10	4
14	4
21	10 20/ (4 21/)

(reserved)

(reserved)

(reserved)

[5.5.1 21x550 501 1° **8.5.2 21x851** 801 nitric acid of 2° (a)**]** Shells of pure aluminium need be subjected to the initial and periodic hydraulic pressure tests at a pressure of only 250 kPa (2.5 bar) (gauge pressure).

[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.

[X 4.5.2 21x451 4.1.4] By derogation from the requirements of 1.5.2 shells shall undergo periodic inspections at least every eight years which shall include a thickness check using suitable instruments. For such shells, the leakproofness test and check, for which provision is made in marginal 1.5.3, shall be carried out at least every four years.

19/ G = minimum calculation according to the general requirements [of marginal 1.2.4] (see subsection 4.3.3.1).

20/ The materials of each of these shells shall be tested according to the method described [in Appendix II C].

21/ Minimum test pressure for 1744 bromine or 1744 bromine solution.

TP7	**[XI 8.5.1** 801 6° and 7°**]** Shells intended for the carriage of these substances shall be inspected every four years for resistance to corrosion, by means of suitable instruments (e.g. by ultrasound).	**[X 8.5.1** 801 6° and 7°**]** Shells intended for the carriage of these substances shall be inspected every two and a half years for resistance to corrosion, by means of suitable instruments (e.g. by ultrasound)
TP8	**[**RID **XI 6.5.1 31° (a) XI 8.5.2]** The periodic tests shall be carried out at intervals of not more than four years, and shall include the hydraulic pressure test. **[**ADR **211 650 31° (a) 211 851 1829]** The periodic tests shall be carried out at intervals of not more than three years and shall include the hydraulic pressure test.	**[X 8.5.2 212 851** 1829**]** The periodic tests shall be carried out at intervals of not more than two and a half years and shall include the hydraulic pressure test.

6.7.3.5 Marking

[RID] These particulars shall be in an official language of the country of approval, and also in French, German, Italian or English unless the international tariffs or agreements concluded between the railway administrations provide otherwise.

[ADR] 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.

[4.6.1 21x460] Shells 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”.

[4.6.1 21x460] Shells 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”.

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

[5.6.2 21x560 5.1.2**]** For shells 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 shell is not impaired: the chemical name with the approved concentration of the substance concerned.

[8.6.1 21x860 6° and 14°**]** Shells 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.

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

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