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Addendum 9

Chapter 6.8 of the restructured ADR

This text is a consolidated version of Chapter 6.8 following the discussions at the RID/ADR/ADN Joint Meeting held from 13 to 24 March 2000 in Geneva.
The corresponding Chapter 6.8 of RID will be circulated by the Central Office for International Carriage by Rail (OCTI) under the symbol OCTI/RID/GT-III/2000-A/Add.9.

CHAPTER 6.8

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

NOTE: *For portable tanks see Chapter 6.7, for fibre-reinforced plastics tanks see Chapter 6.9, for vacuum operated waste tanks see Chapter 6.10.*

6.8.1 Scope

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

- to fixed tanks (tank-vehicles), to demountable tanks and battery-vehicles (left hand column);
- to tank-containers, tank swap bodies and MEGCs (right hand column).

6.8.1.2 These requirements shall apply to

fixed tanks (tank-vehicles), demountable tanks and battery-vehicles	tank-containers, tank swap bodies and MEGCs

used for the carriage of gaseous, liquid, powdery or granular substances.

6.8.1.3 Section 6.8.2 sets out the requirements applicable to fixed tanks (tank-vehicles), to demountable tanks, tank-containers, tank swap bodies intended for the carriage of substances of all classes and battery-vehicles and MEGCs for gases of Class 2. Sections 6.8.3 to 6.8.5 contain special requirements supplementing or modifying the requirements of section 6.8.2.

6.8.1.4 For provisions concerning use of these tanks see Chapter 4.3.

6.8.2 Requirements applicable to all classes

6.8.2.1 *Construction*

Basic principles

6.8.2.1.1 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 as defined in 6.8.2.1.2 and 6.8.2.1.13;
- prescribed minimum stresses as defined in 6.8.2.1.15.

6.8.2.1.2	The tanks and their fastenings shall be capable of absorbing, under the maximum permissible load, the forces exerted by: - in the direction of travel: twice the total mass; - at right angles to the direction of travel: the total mass; - vertically upwards: the total mass; - vertically downwards: twice the total mass.	Tank-containers and their fastenings shall, under the maximum permissible load be capable of absorbing the forces equal to those exerted by: - in the direction of travel: twice the total mass; - horizontally at right angles to the direction of travel: the total mass; (where the direction of travel is not clearly determined, twice the total mass in each direction); - vertically upwards: the total mass; - vertically downwards: twice the total mass.

6.8.2.1.3 The walls of the shells shall have at least the thickness specified in

6.8.2.1.17 and 6.8.2.1.18 | 6.8.2.1.17 to 6.8.2.1.20.

6.8.2.1.4 Shells shall be designed and constructed in accordance with the requirements of a technical code recognized by the competent authority, in which the material is chosen and the wall thickness determined taking into account maximum and minimum filling and working temperatures, but the following minimum requirements of 6.8.2.1.6 to 6.8.2.1.26 shall be met.

6.8.2.1.5 Tanks intended to contain certain dangerous substances shall be provided with additional protection. This may take the form of additional thickness of the shell (increased calculation pressure) determined in the light of the dangers inherent in the substances concerned or of a protective device (see the special provisions of 6.8.4).

6.8.2.1.6 Welds shall be skilfully made and shall afford the fullest safety. The execution and checking of welds shall comply with the requirements of 6.8.2.1.23.

6.8.2.1.7 Measures shall be taken to protect shells against the risk of deformation as a result of a negative internal pressure.

Materials for shells

6.8.2.1.8 Shells shall be made of suitable metallic materials which, unless other temperature ranges are prescribed in the various classes, shall be resistant to brittle fracture and to stress corrosion cracking between -20 °C and +50 °C.

6.8.2.1.9 The materials of shells or of their protective linings which are in contact with the contents shall not contain substances liable to react dangerously (see "Dangerous reaction" in 1.2.1) with the contents, to form dangerous compounds, or substantially to weaken the material.

If contact between the substance carried and the material used for the construction of the shell entails a progressive decrease in the thickness of the walls, this thickness shall be increased at

manufacture by an appropriate amount. This additional thickness to allow for corrosion shall not be taken into consideration in calculating the thickness of the shell walls.

6.8.2.1.10 For welded shells only materials of faultless weldability whose adequate impact strength at an ambient temperature of -20º C can be guaranteed, particularly in the weld seams and the zones adjacent thereto, shall be used.

If fine-grained steel is used, the guaranteed value of the yield stress Re shall not exceed 460 N/mm^2 and the guaranteed value of the upper limit of tensile strength Rm shall not exceed 725 N/mm^2, in accordance with the specifications of the material.

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

Re = apparent yield stress for steels having a clearly-defined yield point or

guaranteed 0.2% proof stress for steels with no clearly-defined yield point (1% for austenitic steels)

Rm = tensile strength.

The values specified in the inspection certificate for the material shall be taken as a basis in determining this ratio in each case.

6.8.2.1.12 For steel, the elongation at fracture, 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%[1].

Calculation of the wall thickness of the shell

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

In the case of vehicles in which the tank constitutes a stressed self-supporting member, the shell shall be designed to withstand the stresses thus imposed in

[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 l is equal to five times the diameter d (l = 5d); if test-pieces of rectangular section are used, the gauge length shall be calculated by the formula*

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

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

addition to stresses from other sources.	
Under these stresses, the stress at the most severely stressed point of the shell and its fastenings shall not exceed the value σ defined in 6.8.2.1.16.	Under each of these stresses the safety factors to be observed shall be the following: - for metals having a clearly-defined yield point: a safety factor of 1.5 in relation to the apparent yield stress; or - for metals with no clearly-defined yield point: a safety factor of 1.5 in relation to the guaranteed 0.2% proof stress (1% maximum elongation for austenitic steels).

6.8.2.1.14 The calculation pressure is in the second part of the code (see 4.3.1.4) according to column (12) of Table A of Chapter 3.2.

When "G" appears, the following requirements shall apply:

(a) Gravity-discharge shells intended for the carriage of substances having a vapour pressure not exceeding 110 kPa (1.1 bar) (absolute pressure) at 50º 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.

(b) 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 50º C shall be designed for a calculation pressure equal to 1.3 times the filling or discharge pressure.

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

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

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

6.8.2.1.15 At the test pressure, the stress σ at the most severely stressed point of the shell shall not exceed the material-dependent limits prescribed below. Allowance shall be made for any weakening due to the welds.

6.8.2.1.16 For all metals and alloys, the stress σ at the test pressure shall be lower than the smaller of the values given by the following formulae:

$\sigma \leq 0.75$ Re or $\sigma \leq 0.5$ Rm

where

Re = apparent yield stress for steels having a clearly-defined yield point or

guaranteed 0.2% proof stress for steels with no clearly-defined yield point (1% for austenitic steels)

Rm = tensile strength.

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

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

Minimum shell thickness

6.8.2.1.17 The thickness of the shell shall not be less than the greater of the values determined by the following formulae:

$$e = \frac{P_T D}{2} \qquad e = \frac{P_C D}{2s}$$

where:

e = minimum shell thickness in mm

P_T = test pressure in MPa

P_C = calculation pressure in MPa as specified in 6.8.2.1.14

D = internal diameter of shell in mm

σ = permissible stress, as defined in 6.8.2.1.16, in N/mm^2

λ = a coefficient not exceeding or equal to 1, allowing for any weakening due to welds, and linked to the inspection methods defined in 6.8.2.1.23.

The thickness shall in no case be less than that defined in

6.8.2.1.18 to 6.8.2.1.21. | 6.8.2.1.18 to 6.8.2.1.20.

6.8.2.1.18	Shells of circular cross-section[2] not more than 1.80 m in diameter other than those referred to in 6.8.2.1.21, 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 if of another metal.	Shells shall be not less than 5 mm thick if of mild steel[3] (in conformity with the requirements of 6.8.2.1.11 and 6.8.2.1.12) or of equivalent thickness if of another metal. Where the diameter is more than 1.80 m, this thickness shall be increased to 6 mm except in the case of tanks intended for the carriage of powdery or granular substances, if the shell is of mild steel[3] or to an equivalent thickness if of another metal. Whatever the metal used, the thickness of the shell wall shall in no case be less than 3 mm.

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

[3] *For the definitions of "mild steel" and "reference steel" see 1.2.1.*

"Equivalent thickness" means the thickness obtained by the following formula:[4]

$$e_1 = \frac{21.4\, e_0}{\sqrt[3]{Rm_1 A_1}}$$

6.8.2.1.19	Where protection of the tank against damage through lateral impact or overturning is provided according to 6.8.2.1.20, the competent authority may allow the aforesaid minimum thicknesses to be reduced in proportion to the protection provided; however, the said thicknesses shall not be less than 3 mm in the case of mild steel[3], 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[3] and to an equivalent thickness in the case of other metals.	Where protection of the tank against damage is provided according to 6.8.2.1.20, 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,[3] 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,[3] and to an equivalent thickness in the case of other metals.
	Equivalent thickness means the thickness given by the formula in 6.8.2.1.18.	Equivalent thickness means the thickness given by the formula in 6.8.2.1.18.
	Except in cases for which 6.8.2.1.21	

[4] *This formula is derived from the general formula:*

$$e_1 = e_0 \sqrt[3]{\frac{Rm_0 A_0}{Rm_1 A_1}}$$

where

e = *minimum shell thickness for the metal chosen, in mm;*

e_o = *minimum shell thickness for mild steel, in mm, according to 6.8.2.1.18 and 6.8.2.1.19;*

Rm_o = *370 (tensile strength for reference steel, see definition 1.2.1, in N/mm²);*

A_o = *27 (elongation for reference steel, in %);*

Rm_1 = *minimum tensile strength of the metal chosen, in N/mm²; and*

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

provide, the thickness of shells with protection against damage in accordance with 6.8.2.1.20 (a) or (b) shall not be less than the values given in the table below.

	Diameter of shell	≤ 1.80 m	> 1.80 m
Minimum thickness of shells	Stainless austenitic steels	2.5 mm	3 mm
	Other steels	3 mm	4 mm
	Aluminium alloys	4 mm	5 mm
	Pure aluminium of 99.80%	6 mm	8 mm

6.8.2.1.20 For tanks built after 1 January 1990, there is protection against damage as referred to in 6.8.2.1.19 when the following measures or equivalent measures are adopted:

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

The additional protection referred to in 6.8.2.1.19 may consist of:

- overall external structural protection as in "sandwich" construction where the sheathing is secured to the shell; or
- a structure in which the shell is supported by a complete skeleton including longitudinal and transverse structural members, or
- double-wall construction.

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

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

- Distance between two adjacent strengthening elements of not more than 1.75 m.
- Volume contained between two partitions or surge-plates of not more than 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.

Partitions and surge-plates shall conform to the requirements of 6.8.2.1.22.

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

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

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

Where tanks are made with double walls with an intermediate layer of solid materials at least 50 mm thick, the outer wall shall have a thickness of not less than 0.5 mm if it is made of mild steel[3] 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.

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

4. Shells of forms other than in 1, especially box-shaped shells, are provided, all round the mid-point of their vertical height and over at least 30% of their height with a protection designed in such a way as to offer specific resilience at least equal to that of a shell constructed in mild steel[3] 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 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 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 6.8.2.1.18.

This protection is dependent upon the possible stresses exerted on mild steel shells in the event of an accident, where the ends and walls have a thickness of at least 5 mm for a diameter not exceeding 1.80 m or at least 6 mm for a diameter exceeding 1.80 m. If another

metal is used, the equivalent thickness shall be obtained in accordance with the formula in 6.8.2.1.18.

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

6.8.2.1.21 The thickness of shells designed in accordance with 6.8.2.1.14 (a) 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 6.8.3 or 6.8.4, 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 6.8.2.1.18. The thickness of the partitions and surge-plates shall in no case be less than that of the shell.

6.8.2.1.22 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.

Welding and inspection of welds

6.8.2.1.23 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.

The following checks shall be carried out in accordance with the value of the coefficient ë used in determining the thickness of the shell in 6.8.2.1.17:

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

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

ë = 1: all beads shall be 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.

Other construction requirements

6.8.2.1.24 The protective lining shall be so designed that its leakproofness remains intact, whatever the deformation liable to occur in normal conditions of carriage (see 6.8.2.1.2).

6.8.2.1.25 The thermal insulation shall be so designed as not to hinder access to, or the operation of, filling and discharge devices and safety valves.

6.8.2.1.26 If shells intended for the carriage of flammable liquids having a flash-point of not more than 61ºC are fitted with non-metallic protective linings (inner layers), the shells and the protective linings shall be so designed that no danger of ignition from electrostatic charges can occur.

6.8.2.1.27	Shells intended for the carriage of liquids having a flash-point of not more than 61° C or for the carriage of flammable gases, or of UN No.1361 carbon or UN No.1361 carbon black, Packing Group II, shall be linked to the chassis by means of at least one good electrical connection. Any metal contact capable of causing electrochemical corrosion shall be avoided. Shells shall be provided with at least one earth fitting clearly marked with the symbol " ⏚ ", capable of being electrically connected.	All parts of a tank-container intended for the carriage of liquids having a flash-point of not more than 61° C, flammable gases, or UN No.1361 carbon or UN No.1361 carbon black, Packing Group II, shall be capable of being electrically earthed. Any metal contact capable of causing electrochemical corrosion shall be avoided.
6.8.2.1.28	*Protection of fittings mounted on the upper part of the tank* The fittings and accessories mounted on the upper part of the tank shall be protected against damage caused by overturning. This protection may take the form of strengthening rings, protective canopies or transverse or longitudinal members so shaped that effective protection is given.	

6.8.2.2 ***Items of equipment***

6.8.2.2.1 Suitable non-metallic materials may be used to manufacture equipment and accessories.

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 6.8.2.1.1.

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

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

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

6.8.2.2.2 Each bottom-filling or bottom-discharge opening in tanks which are referred to, in column (12) of Table A of Chapter 3.2, with a tank code including the letter "A" in its third part (see 4.3.4.1.1) shall be equipped with at least two mutually independent closures, mounted in series, comprising

- an external stop-valve with piping made of a malleable metal material and
- a closing device at the end of each pipe which may be a screw-threaded plug, a blank flange or an equivalent device.

Each bottom-filling or bottom-discharge opening in tanks which are referred to, in column (12) of Table A of Chapter 3.2, with a tank code including the letter "B" in its third part (see 4.3.4.1.1) shall be equipped with at least three mutually independent closures, mounted in series, comprising

- an internal stop-valve, i.e. a stop-valve mounted inside the shell or in a welded flange or companion flange;
- an external stop-valve or an equivalent device[5]

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

and

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

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

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

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

In order to avoid any loss of contents in the event of damage to the external fittings

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[5] *In the case of tank-containers of less than 1 m^3 capacity, the external stop-valve or other equivalent device may be replaced by a blank flange.*

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

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

All openings of tanks which are referred to in column (12) of Table A of Chapter 3.2, by a tank code including letter "C" or "D" in its third part (see 4.3.3.1.1 and 4.3.4.1.1) shall be situated above the surface level of the liquid. These tanks shall have no pipes or pipe connections below the surface level of the liquid. The cleaning openings (fist-holes) are, however, permitted in the lower part of the shell for tanks referred to by a tank code including letter “C” in its third part. This opening shall be capable of being sealed by a flange so closed as to be leakproof and whose design shall be approved by the competent authority or by a body designated by that authority.

6.8.2.2.3 Unless otherwise prescribed in the provisions of 6.8.4, tanks may have valves to avoid an unacceptable negative internal pressure, without intervening bursting discs.

6.8.2.2.4 The shell or each of its compartments shall be provided with an opening large enough to permit inspection.

6.8.2.2.5 Reserved

6.8.2.2.6 Tanks intended for the carriage of liquids having a vapour pressure of not more than 110 kPa (1.1 bar) (absolute) at 50° C shall have a venting system and a safety device to prevent the contents from spilling out if the shell overturns; otherwise they shall conform to 6.8.2.2.7 or 6.8.2.2.8.

6.8.2.2.7 Tanks intended for the carriage of liquids having a vapour pressure of more than 110 kPa (1.1 bar) but not exceeding 175 kPa (1.75 bar) (absolute) at 50° C shall have a safety valve set at not less than 150 kPa (1.5 bar) (gauge pressure) and which shall be fully open at a pressure not exceeding the test pressure; otherwise they shall conform to 6.8.2.2.8.

6.8.2.2.8 Tanks intended for the carriage of liquids having a vapour pressure of more than 175 kPa (1.75 bar) but not exceeding 300 kPa (3 bar) (absolute) at 50° C shall have a safety valve set at not less than 300 kPa (3 bar) gauge pressure and which shall be fully open at a pressure not exceeding the test pressure; otherwise they shall be hermetically closed[6].

6.8.2.2.9 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 not more than 61° C or for the carriage of flammable gases shall not be made of unprotected corrodible steel.

6.8.2.3 ***Type approval***

[6] *For the definition of “hermetically closed tank” see 1.2.1.*

6.8.2.3.1 The competent authority or a body designated by that authority shall issue in respect of each new type of tank-vehicle, tank-container, battery-vehicle or MEGC a certificate attesting that the prototype, including fastenings, which it has inspected is suitable for the purpose for which it is intended and meets the construction requirements of 6.8.2.1, the equipment requirements of 6.8.2.2 and the special conditions for the classes of substances carried.

The certificate shall show:

- the results of the test;

- an approval number for the prototype;

  The approval number shall consist of the distinguishing sign[7] of the State in whose territory the approval was granted and a registration number.

- the tank code in accordance with 4.3.3.1.1 or 4.3.4.1.1;

- special construction (TC) and equipment (TE) requirements applicable to the prototype;

- the substances and/or group of substances for the carriage of which the tank has been approved. These shall be shown with their chemical name or the corresponding collective entry, together with their classification (Class, Classification code and Packing Group). With the exception of substances of Class 2 and those listed in 4.3.4.1.3, the listing of approved substances may be dispensed with. In such cases, groups of substances permitted on the basis of the tank code shown in the rationalised approach in 4.3.4.1.2 shall be accepted for carriage taking into account any relevant special provision.

The substances referred to in the certificate or the groups of substances approved according to the rationalised approach shall, in general, be compatible with the characteristics of the tank. A reservation shall be included in the certificate if it was not possible to investigate this compatibility exhaustively when the type approval was issued.

6.8.2.3.2 If the tanks, battery-vehicles or MECGs are manufactured in series without modification this approval shall be valid for the tanks, battery-vehicles or MECGs manufactured in series or according to the prototype.

A type approval may however serve for the approval of tanks with limited variations of the design that either reduce the loads and stresses on the tanks (e.g. reduced pressure, reduced mass, reduced volume) or increase the safety of the structure (e.g. increased wall thickness, more baffles, decreased diameter of openings). The limited variations shall be clearly described in the type approval certificate.

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

6.8.2.4 ***Inspections***

6.8.2.4.1 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 examination of the internal and external conditions;
- a hydraulic pressure test[9] at the test pressure indicated on the plate prescribed in 6.8.2.5.1; and
- a check of satisfactory operation of the equipment.

The hydraulic pressure test shall be carried out on the shell as a whole at the test pressure (see Note in 6.8.4 (d)), 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 6.8.2.4.3.

6.8.2.4.2 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[9]. Sheathing for thermal or other insulation shall be removed only to the extent required for reliable appraisal of the characteristics of the shell.

The hydraulic pressure test shall be carried out on the shell as a whole at the test pressure (see Note in 6.8.4 (d)), and separately on each compartment of compartmented shells at a pressure of not less than 1.3 times the maximum working

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[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 6.8.2.1.23 and the tests prescribed in 6.8.5.*

[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.*

pressure.

In the case of tanks intended for the carriage of powdery or granular substances, and with the agreement of the expert approved by the competent authority, the periodic hydraulic pressure tests may be omitted and replaced by leakproofness tests in accordance with 6.8.4.3.

The maximum intervals for inspection shall be six years.	The maximum intervals for inspections shall be five years.

6.8.2.4.3 In addition, a leakproofness test of the shell with its equipment and a check of the satisfactory operation of all the equipment shall be carried out

at least every three years.	at least every two and a half years.

For this purpose the tank shall be subjected to an effective internal pressure equal to the maximum working pressure, but not less than 20 kPa (0.2 bar) (gauge pressure).

For tanks equipped with venting systems and a safety device to prevent the contents spilling out if the tank overturns, the pressure test shall be equal to the static pressure of the filling substance.

The leakproofness test shall be carried out separately on each compartment of compartmented shells.

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

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

6.8.2.5 ***Marking***

6.8.2.5.1 Every tank shall be fitted with a corrosion-resistant metal plate permanently attached to the tank 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] *Add the units of measurement after the numerical values.*

- test pressure (gauge pressure);
- capacity -in the case of multiple-element shells, the capacity of each element;
- design temperature (only if above +50º C or below -20º C);
- date (month and year) of initial test and most recent periodic test in accordance with 6.8.2.4.1 and 6.8.2.4.2;
- stamp of the expert who carried out the tests;
- material of the shell and reference to materials standards, if available and, where appropriate, the protective lining.
- 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 tanks.

6.8.2.5.2	The following particulars shall be inscribed on the tank-vehicle itself or on a plate: - name of owner or operator; - unladen mass; and - maximum permissible mass. These particulars shall not be required in the case of a vehicle carrying demountable tanks.	The following particulars shall be inscribed either on the tank-container itself or on a plate:[10] - names of owner and of operator; - capacity of the shell; - tare; - maximum permissible laden mass; - proper shipping name of substance carried[11]; - tank code according to 4.3.4.1.1.

[11] *A collective description covering a group of substances of a similar nature and equally compatible with the characteristics of the tank may be given instead of the name.*

[6.8.2.6 ***Requirements for tank-vehicles and tank-containers which are designed, constructed and tested according to standards***

The requirements of 6.8.2...deemed to have been complied with if the following relevant standards have been applied: [reserved]**]**

[6.8.2.7 ***Requirements for tank-vehicles and tank-containers which are not designed, constructed and tested according to standards***

Tank-vehicles and tank-containers which are not designed, constructed and tested in accordance with the standards set out in 6.8.2.6 shall be designed, constructed and tested in accordance with the requirements of a technical code recognized by the competent authority. They shall, however, comply with the minimum requirements of 6.8.2.**]**

6.8.3 Special requirements applicable to Class 2

6.8.3.1 ***Construction of shells***

6.8.3.1.1 Shells intended for the carriage of compressed or liquefied gases or gases dissolved under pressure shall be made of steel. In the case of weldless shells, by derogation from 6.8.2.1.12 a minimum elongation at fracture of 14% and also a stress σ 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:

$\sigma \leq 0.75$ Re;

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

$\sigma \leq 0.5$ Rm.

6.8.3.1.2 The requirements of 6.8.5 apply to the materials and construction of welded shells.

6.8.3.1.3 Reserved.

Construction of battery-vehicles and MEGCs

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

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

NOTE 2: *Tanks as elements of battery-vehicles and MEGCs shall be constructed in accordance with 6.8.2.1 and 6.8.3.1.*

NOTE 3: *Demountable tanks[12] are not to be considered elements of battery-vehicles or MEGCs.*

6.8.3.1.5 Elements and their fastenings shall be capable of absorbing under the maximum permissible load the forces defined in 6.8.2.1.2. Under each force the stress at the most severely stressed point of the element and its fastenings shall not exceed the value defined in 6.2.3.1 for cylinders, tubes, pressure drums and bundles of cylinders and for tanks the value of σ defined in 6.8.2.1.16.

6.8.3.2 ***Items of equipment***

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

6.8.3.2.2 Shells intended for the carriage of liquefied gases may be provided with, in addition to the openings prescribed in 6.8.2.2.2 and 6.8.2.2.4, openings for the fitting of gauges, thermometers and with bleed holes, as required for their operation and safety.

6.8.3.2.3 Filling and discharge openings of tanks

| with a capacity greater than $1\ m^3$

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.

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

6.8.3.2.5 Notwithstanding the requirements of 6.8.3.2.3 and 6.8.3.2.4, tanks intended for the carriage of refrigerated liquefied gases may be equipped with external devices in place of internal devices if the external devices afford protection against external damage at least equivalent to that afforded by the wall of the shell.

6.8.3.2.6 If the tanks are equipped with gauges in direct contact with the substance carried, the gauges shall not be made of a transparent material. If there are thermometers, they shall not project directly into the gas or liquid through the shell.

6.8.3.2.7 Filling and discharge openings situated in the upper part of tanks shall be equipped with, in addition to what is prescribed in 6.8.3.2.3, a second, external, closing device. This device shall be capable of being closed by a blank flange or some other equally reliable device.

6.8.3.2.8 Safety valves shall meet the requirements of 6.8.3.2.9 to 6.8.3.2.12 below:

6.8.3.2.9 Tanks intended for the carriage of compressed or liquefied gases or gases dissolved under pressure, may be fitted with not more than two safety valves whose aggregate clear cross-sectional area of passage at the seating or seatings shall be not less than 20 cm^2 per 30 m^3 or part thereof of the shell's capacity. These valves shall be capable of opening automatically under a pressure between 0.9 and 1.0 times

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[12] *For the definition of "demountable tank" see 1.2.1.*

the test pressure of the tank to which they are fitted. They shall be of such a type as to resist dynamic stresses, including liquid surge. The use of dead weight or counter weight valves is prohibited.

6.8.3.2.10 Where tanks are intended for carriage by sea, the requirements of 6.8.3.2.9 shall not prohibit the fitting of safety valves conforming to the IMDG Code.

6.8.3.2.11 Tanks intended for the carriage of refrigerated liquefied gases shall be equipped with two independent safety valves, each so designed as to allow the gases formed by evaporation during normal operation to escape from the tank in such a way that the pressure does not at any time exceed by more than 10% the working pressure indicated on the tank.

One of the two safety valves may be replaced by a bursting disc which shall be such as to burst at the test pressure.

In the event of loss of the vacuum in a double-walled tank, or of destruction of 20% of the insulation of a single-walled tank, the safety valve and the bursting disc shall permit an outflow such that the pressure in the shell cannot exceed the test pressure.

6.8.3.2.12 The safety valves of tanks intended for the carriage of refrigerated liquefied gases shall be capable of opening at the working pressure indicated on the tank. They shall be so designed as to function faultlessly even at their lowest working temperature. The reliability of their operation at that temperature shall be established and checked either by testing each valve or by testing a specimen valve of each design-type.

6.8.3.2.13 The valves of demountable tanks that can be rolled shall be provided with protective caps.

Thermal insulation

6.8.3.2.14 If tanks intended for the carriage of liquefied gases are equipped with thermal insulation, such insulation shall consist of either:

- a sun shield covering not less than the upper third but not more than the upper half of the tank surface and separated from the shell by an air space at least 4 cm across; or

- a complete cladding, of adequate thickness, of insulating materials.

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

6.8.3.2.16 Tanks 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.

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

6.8.3.2.17 By derogation from the requirements of 6.8.2.2.4 shells intended for the carriage of refrigerated liquefied gases need not have an inspection opening.

Items of equipment for battery-vehicles and MEGCs

6.8.3.2.18 The manifold shall be designed for service in a temperature range of -20° C to +50° C.

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

Joints in copper tubing shall be brazed or have an equally strong metal union. The melting point of brazing materials shall be no lower than 525ºC. The joints shall not decrease the strength of tubing as may happen when cutting threads.

6.8.3.2.19 Except for UN No.1001 acetylene, the permissible maximum stress σ of the manifolding arrangement at the test pressure of the receptacles shall not exceed 75% of the guaranteed yield stress of the material.

The necessary wall thickness of the manifolding arrangement for the carriage of UN No.1001 acetylene shall be calculated according to an approved code of practice.

NOTE: *For the yield stress, see 6.8.2.1.11.*

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

6.8.3.2.20 By derogation from the requirements of 6.8.3.2.3, 6.8.3.2.4 and 6.8.3.2.7, for cylinders, tubes, pressure drums and bundles of cylinders (frames) forming a battery-vehicle or MEGC, the required closing devices may be provided for within the manifolding arrangement.

6.8.3.2.21 If one of the elements is equipped with a safety valve and shut-off devices are provided between the elements, every element shall be so equipped.

6.8.3.2.22 The filling and discharge devices may be affixed to a manifold.

6.8.3.2.23 Each element, including each individual cylinder of a bundle, intended for the carriage of toxic gases, shall be capable of being isolated by a shut-off valve.

6.8.3.2.24 If battery-vehicles or MEGCs intended for the carriage of toxic gases are fitted with safety valves, a bursting disc shall be placed before the valve. The arrangement of the bursting disc and safety valve shall be such as to satisfy the competent authority.

6.8.3.2.25 When battery-vehicles or MEGCs are intended for carriage by sea, the requirements of 6.8.3.2.24 shall not prohibit the fitting of safety valves conforming to the IMDG Code.

6.8.3.2.26 Receptacles which are elements of a battery-vehicle or MEGC intended for the carriage of flammable gases shall be combined in groups of not more than 5000 litres which are capable of being isolated by a shut-off valve.

Each element of a battery-vehicle or MEGC intended for the carriage of flammable gases, when consisting of tanks conforming to this Chapter, shall be capable of being isolated by a shut-off valve.

6.8.3.3 ***Type approval***

No special requirements.

6.8.3.4 ***Tests***

6.8.3.4.1 The materials of every welded shell with the exception of cylinders, tubes, pressure drums and cylinders as part of bundles of cylinders which are elements of a battery-vehicle or of a MEGC shall be tested according to the method described in 6.8.5.

6.8.3.4.2 The basic requirements for the test pressure are given in 4.3.3.2.1 to 4.3.3.2.4 and the minimum test pressures are given in the table of gases and gas mixtures in 4.3.3.2.5.

6.8.3.4.3 The first hydraulic pressure test shall be carried out before thermal insulation is placed in position.

6.8.3.4.4 The capacity of each shell intended for the carriage of compressed gases filled by mass, liquefied gases or gases dissolved under pressure shall be determined, under the supervision of an expert approved by the competent authority, by weighing or volumetric measurement of the quantity of water which fills the shell; the measurement of shell capacity shall be accurate to within 1%. Determination by a calculation based on the dimensions of the shell is not permitted. The maximum filling masses allowed in accordance with Packing Instruction P200 or P203 in 4.1.4.1 as well as 4.3.3.2.2 and 4.3.3.2.3 shall be prescribed by an approved expert.

6.8.3.4.5 Checking of the welds shall be carried out in accordance with the ë=1 requirements of 6.8.2.1.23.

6.8.3.4.6 By derogation from the requirements of 6.8.2.4, the periodic tests, including the hydraulic pressure test, shall take place:

a) Every 3 years | Every 2½ years

in the case of tanks intended for the carriage of UN No.1008 boron trifluoride, UN No. 1017 chlorine, UN No. 1048 hydrogen bromide, anhydrous, UN No. 1050 hydrogen chloride, anhydrous, UN No. 1053 hydrogen sulphide, UN No. 1067 dinitrogen tetroxide (nitrogen dioxide), UN No. 1076 phosgene or UN No. 1079 sulphur dioxide;

b) After 6 years | After 8 years

of service and thereafter every 12 years in the case of tanks intended for the carriage of refrigerated liquefied gases:

A leakproofness check shall be performed by an approved expert 6 years after each periodic test.	A leakproofness test may be performed, at the request of the competent authority, between any two successive tests.

6.8.3.4.7 In the case of vacuum-insulated tanks, the hydraulic-pressure test and the check of the internal condition may, with the consent of the approved expert, be replaced by a leakproofness test and measurement of the vacuum.

6.8.3.4.8 If, at the time of periodic inspections, openings have been made in shells intended for the carriage of refrigerated liquefied gases, the method by which they are hermetically closed before the shells are returned to service shall be approved by the approved expert and shall ensure the integrity of the shell.

6.8.3.4.9 Leakproofness tests of tanks intended for the carriage of compressed, liquefied gases or gases dissolved under pressure shall be performed at a pressure of not less than 0.4 MPa (4 bar) and not more than 0.8 MPa (8 bar) (gauge pressure).

Tests for battery-vehicles and MEGCs

6.8.3.4.10 The elements and items of equipment of each battery-vehicle or MEGC shall be inspected and tested either together or separately before being put into service for the first time (initial inspection and test). Thereafter battery-vehicles or MEGCs the elements of which are receptacles shall be inspected at not more than five-year intervals. Battery-vehicles and MEGCs the elements of which are tanks shall be inspected according to 6.8.3.4.6. An exceptional inspection and test shall be performed regardless of the last periodic inspection and test when necessary according to 6.8.3.4.14.

6.8.3.4.11 The initial inspection shall include:

- a check of conformity to the approved prototype;
- a check of the design characteristics;
- an examination of the internal and external conditions;
- a hydraulic pressure test[13] at the test pressure indicated on the plate prescribed in 6.8.3.5.10
- a leakproofness test at the maximum allowable working pressure; and
- a check of satisfactory operation of the equipment.

When the elements and their fittings have been pressure-tested separately, they shall be subjected together after assembly to a leakproofness test.

6.8.3.4.12 Cylinders, tubes and pressure drums and cylinders as part of bundles of cylinders shall be tested according to 6.2.1.4.

The test pressure of the manifold of the battery-vehicle or MEGC shall be the same as that of the elements of the battery-vehicle or MEGC. The pressure test of the manifold may be performed as a hydraulic test or by using another liquid or gas with the agreement of the competent authority or its authorised body. By derogation from this requirement, the test pressure for the manifold of battery-vehicle or MEGC shall not be less than 300 bar for UN No. 1001 acetylene, dissolved.

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[13] *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.*

6.8.3.4.13 The periodic inspection shall include a leakproofness test at the maximum working pressure and an external examination of the structure, the elements and the service equipment without disassembling. The elements and the piping shall be tested at the periodicity defined in packing instruction P200 of 4.1.4.1 and in accordance with the requirements of 6.2.1.5. When the elements and equipment have been pressure-tested separately, they shall be subjected together after assembly to a leakproofness test.

6.8.3.4.14 An exceptional inspection and test is necessary when the battery-vehicle or MEGC shows evidence of damaged or corroded areas, or leakage, or any other conditions, that indicate a deficiency that could affect the integrity of the battery-vehicle or MEGC. The extent of the exceptional inspection and test and, if deemed necessary, the disassembling of elements shall depend on the amount of damage or deterioration of the battery-vehicle or MEGC. It shall include at least the inspection required under 6.8.3.4.15

6.8.3.4.15 The examinations shall ensure that:

(a) the elements are inspected externally for pitting, corrosion, or abrasions, dents, distortions, defects in welds or any other conditions, including leakage, that might render the battery-vehicles or MEGCs unsafe for transport;

(b) the piping, valves, and gaskets are inspected for corroded areas, defects, and other conditions, including leakage, that might render battery-vehicles or MEGCs unsafe for filling, discharge or transport;

(c) missing or loose bolts or nuts on any flanged connection or blank flange are replaced or tightened;

(d) all emergency devices and valves are free from corrosion, distortion and any damage or defect that could prevent their normal operation. Remote closure devices and self-closing stop-valves shall be operated to demonstrate proper operation;

(e) required markings on the battery-vehicles or MEGCs are legible and in accordance with the applicable requirements; and

(f) any framework, supports and arrangements for lifting the battery-vehicles or MEGCs are in satisfactory condition.

6.8.3.4.16 The tests, inspections and checks in accordance with 6.8.3.4.10 to 6.8.3.4.15 shall be carried out by the expert approved by the competent authority. Certificates shall be issued showing the results of these operations.

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

6.8.3.5 ***Marking***

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

6.8.3.5.2 On tanks intended for the carriage of only one substance:

- the proper shipping name of the gas and, in addition for gases classified under an n.o.s. entry, the technical name.[14]

This indication shall be supplemented:

- in the case of tanks intended for the carriage of compressed gases filled by volume (pressure), by an indication of the maximum filling pressure at 15° C permitted for the tank; and

- in the case of tanks intended for the carriage of compressed gases filled by mass, and of liquefied gases, refrigerated liquefied gases or gases dissolved under pressure by an indication of the maximum permissible load mass in kg and of the filling temperature if below -20° C.

6.8.3.5.3 On multipurpose tanks:

- the proper shipping names of the gases and, in addition for gases classified under an n.o.s. entry, the technical name of the gases[14] for whose carriage the tank is approved.

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

6.8.3.5.4 On tanks intended for the carriage of refrigerated liquefied gases:

- the maximum working pressure allowed.

6.8.3.5.5 On tanks equipped with thermal insulation:

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

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[14] *Instead of the proper shipping name of the n.o.s. entry followed by the technical name the use of one of the following names is permitted:*

- *for UN No. 1078 refrigerant gas, n.o.s: mixture F1, mixture F2, mixture F3;*

- *for UN No. 1060 methylacetylene and propadiene mixtures, stabilized: mixture P1, mixture P2;*

- *for UN No. 1965 hydrocarbon gas mixture, liquefied, n.o.s: mixture A, mixture A01, mixture A02, mixture A0, mixture A1, mixture B1, mixture B2, mixture B, mixture C.*

The names customary in the trade and mentioned in 2.2.2.3 Classification code 2F, UN No. 1965 Note 1 may be used only as a complement.

6.8.3.5.6 In addition to the particulars prescribed in 6.8.2.5.2, the following shall be inscribed on

the tank itself or on a plate:	the tank-container itself or on a plate:
(a) - the tank code according to the certificate (see 6.8.2.3.1) with the actual test pressure of the tank	
- the inscription: "minimum filling temperature allowed :…",	
(b) where the tank is intended for the carriage of one substance only:	
- the proper shipping name of the gas and, in addition for gases classified under an n.o.s. entry, the technical name[14];	
	- for compressed gases which are filled by mass, and for liquefied gases, refrigerated liquefied gases or gases dissolved under pressure, the maximum permissible load mass in kg;
(c) where the tank is a multipurpose tank:	
- the proper shipping name of the gas and, for gases classified under an n.o.s. entry, the technical name[14] of all gases to whose carriage the tank is assigned	
	with an indication of the maximum permissible load mass in kg for each of them
(d) where the shell is equipped with thermal insulation:	
- the inscription "thermally insulated" (or "thermally insulated by vacuum"), in an official language of the country of registration and also, if that language is not English, French or German, in English, French or German, unless any agreements concluded between the countries concerned in the transport operation provide otherwise.	

6.8.3.5.7 Reserved.

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

6.8.3.5.9 Reserved.

Marking of battery-vehicles and MEGCs

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

- approval number;
- manufacturer's name or mark;
- manufacturer's serial number;
- year of manufacture;
- test pressure (gauge pressure)[15];
- design temperature[15] (only if above +50° C or below -20° C);
- date (month and year) of initial test and most recent periodic test in accordance with 6.8.3.4.10 to 6.8.3.4.13;
- stamp of the expert who carried out the tests.

6.8.3.5.11

The following particulars shall be inscribed on the battery-vehicle itself or on a plate:	The following particulars shall be inscribed either on the MEGC itself or on a plate:
- names of owner or of operator; - number of elements; - total capacity of the elements[15]; and for battery-vehicles filled by mass: - unladen mass[15]; - maximum permissible mass[15].	- names of owner and of operator; - number of elements; - total capacity of the elements[15]; - maximum permissible laden mass[15]; - proper shipping name of substance carried[16]; and for MEGCs filled by mass: - tare.

6.8.3.5.12 The frame of a battery-vehicle or MEGC shall bear near the filling point a plate specifying:

- the maximum filling pressure[15] at 15° C allowed for elements intended for compressed gases;

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[15] *Add the units of measurements after the numerical values.*

[16] *A collective description covering a group of substances of a similar nature and equally compatible with the characteristics of the tank may be given instead of the name.*

- the proper shipping name of the gas in accordance with Chapter 3.2 and, in addition for gases classified under an n.o.s. entry, the technical name;[17]

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

- the permissible maximum load per element.[15]

6.8.3.5.13 Cylinders, tubes and pressure drums, and cylinders as part of bundles of cylinders, shall be marked according to 6.2.1.7. These receptacles need not be labelled individually with the danger labels as required in Chapter 5.2.

Battery-vehicles and MEGCs shall be marked according to Chapter 5.3 and labelled according to Chapter 5.2.

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

Therequirements of 6.8.3.1.4 to 6.8.3.1.6, 6.8.3.2.18 to 6.8.3.2.26, and 6.8.3.4.10 to 6.8.3.4.16 shall be deemed to have been complied with if the following relevant standards have been applied:

[reserved]

6.8.3.7 ***Requirements for battery-vehicles and MEGCs which are not designed, constructed and tested according to standards***

Battery-vehicles and MEGCs which are not designed, constructed and tested in accordance with the standards set out in 6.8.3.6 shall be designed, constructed and tested in accordance with the requirements of a technical code recognized by the competent authority. They shall, however, comply with the minimum requirements of 6.8.3.

6.8.4 Special provisions

NOTE 1: *For liquids having a flash-point of not more than 61° C and for flammable gases, see also 6.8.2.1.26, 6.8.2.1.27 and 6.8.2.2.9.*

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[17] *Instead of the proper shipping name of the n.o.s. entry followed by the technical name the use of one of the following names is permitted:*

- *for UN No. 1078 refrigerant gas, n.o.s: mixture F1, mixture F2, mixture F3;*
- *for UN No. 1060 methylacetylene and propadiene mixtures, stabilized: mixture P1, mixture P2;*
- *for UN No. 1965 hydrocarbon gas mixture, liquefied, n.o.s: mixture A, mixture A01, mixture A02, mixture A0, mixture A1, mixture B1, mixture B2, mixture B, mixture C.*

The names customary in the trade and mentioned in 2.2.2.3 Classification code 2F, UN No. 1965 Note 1 may be used only as a complement.

NOTE 2: *For requirements for tanks subjected to a pressure test of not less than 1 MPa (10 bar) see 6.8.5.*

When they are shown under an entry in column (13) of Table A of Chapter 3.2, the following special provisions apply:

(a) **Construction (TC)**

TC1 The requirements of 6.8.5 are applicable to the materials and construction of these shells.

TC2 Shells, and their items of equipment, shall be made of aluminium not less than 99.5% pure or of suitable steel not liable to cause hydrogen peroxide to decompose. Where shells are made of aluminium not less than 99.5% pure, the wall thickness need not exceed 15 mm, even where calculation in accordance with 6.8.2.1.17 gives a higher value.

TC3 The shells shall be made of austenitic steel.

TC4 Shells shall be provided with an enamel or equivalent protective lining if the material of the shell is attacked by UN No. 3250 chloroacetic acid.

TC5 Shells shall be provided with a lead lining not less than 5 mm thick or an equivalent lining.

TC6 Where the use of aluminium is necessary for tanks, such tanks shall be made of aluminium not less than 99.5% pure; the wall thickness need not exceed 15 mm even where calculation in accordance with 6.8.2.1.17 gives a higher value.

TC7 The effective minimum thickness of the shell shall not be less than 3 mm.

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

TE1 If tanks, battery-vehicles or MEGCs are fitted with safety valves, a bursting disc shall be placed before the valves. The arrangement of the bursting disc and safety valve shall be such as to satisfy the competent authority. A pressure gauge or another suitable indicator shall be provided in the space between the bursting disc and the safety valve, to enable detection of any rupture, perforation or leakage of the disc which may disrupt the action of the safety valve.

TE2 The bottom discharge system of tanks may consist of an external pipe with a stop-valve, if it is constructed in a metallic material liable to deformation.

TE3 Tanks shall in addition meet the following requirements. The heating device shall not penetrate into, but shall be exterior to 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 tank shall be equipped with a gauging system for verifying the level of the phosphorus and, if water is used as a protective agent, with a fixed gauge mark showing the highest permissible level of the water.

TE4 Shells shall be equipped with thermal insulation made of materials which are not readily flammable.

TE5 If shells are equipped with thermal insulation, such insulation shall be made of materials which are not readily flammable.

TE6 Tanks may be equipped with valves opening automatically inwards or outwards under the effect of a difference of pressure of between 20 kPa and 30 kPa (0.2 bar and 0.3 bar).

TE7 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 an external stop-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 stop-valve. The internal stop-valve shall be such that if the pipe is wrenched off the stop-valve will remain integral with the shell and in the closed position.

TE8 The connections to the external pipe-sockets of tanks shall be made of materials not liable to cause decomposition of hydrogen peroxide.

TE9 Tanks shall be fitted in their upper part with a shut-off device preventing any build-up of excess pressure inside the shell due to the decomposition of the substances carried, any leakage of liquid, and any entry of foreign matter into the shell.

TE10 The shut-off devices of tanks shall be so designed as to preclude obstruction of the devices by solidified ammonium nitrate during carriage. Where tanks are sheathed in thermally-insulating material, the material shall be of an inorganic nature and entirely free from combustible matter.

TE11 Shells and their service equipment shall be so designed as to prevent the entry of foreign matter, leakage of liquid or any building up of dangerous excess pressure inside the shell due to the decomposition of the substances carried.

TE12 Tanks shall be equipped with thermal insulation complying with the requirements of 6.8.3.2.14. If the SADT of the organic peroxide in the tank is 55° C or less, or the tank is constructed of aluminium, the shell shall be completely insulated. The sun shield and any part of the tank not covered by it, or the outer sheathing of a complete lagging, shall be painted white or finished in bright metal. The paint shall be cleaned before each transport journey and renewed in case of yellowing or deterioration. The thermal insulation shall be free from combustible matter. Tanks shall be fitted with temperature sensing devices.

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

Tanks shall be fitted with spring-loaded safety valves to prevent significant pressure build-up within the shell of the decomposition products and vapours released at a temperature of 50° C. The capacity and start-to-discharge pressure of the safety-valve(s) shall be based on the results of the tests specified in special provision TA2. The start-to-discharge pressure shall however in no case be such that liquid could escape from the valve(s) if the tank were overturned.

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:

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

where:

q = heat absorption [W]
A = wetted area [m^2]
F = insulation factor

F = l for non-insulated tanks, or

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

where:

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

The start-to-discharge pressure of the emergency-relief device(s) shall be higher than that above specified and based on the results of the tests referred to in special provision TA2. The emergency-relief devices shall be dimensioned in such a way that the maximum pressure in the tank never exceeds the test pressure of the tank.

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

For tanks equipped with thermal insulation, the capacity and setting of the emergency-relief device(s) shall be determined assuming a loss of insulation from 1% of the surface area.

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

TE13 Tanks shall be thermally insulated and fitted with a heating device on the outside.

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

TE15 Reserved

TE16 Reserved

TE17 Reserved

TE18 Tanks intended for the carriage of substances filled at a temperature higher than 190º 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.

TE19 Fittings and accessories mounted in the upper part of the tank shall be either:

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

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

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

Fittings and accessories mounted on the rear face of the tank shall be protected by the bumper prescribed in 9.7.6. Their height above the ground shall be such that

they are adequately protected by the bumper

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

TA1 Tanks shall not be approved for the carriage of organic substances.

TA2 This substance may be carried in fixed or demountable tanks or tank-containers under the conditions laid down by the competent authority of the country of origin, if, on the basis of the tests mentioned below, the competent authority is satisfied that such a transport operation can be carried out safely. If the country of origin is not party to ADR, these conditions shall be recognized by the competent authority of the first ADR country reached by the consignment.

For the type approval tests shall be undertaken:

- to prove the compatibility of all materials normally in contact with the substance during carriage;
- to provide data to facilitate the design of the emergency pressure-relief devices and safety valves taking into account the design characteristics of the tank; and
- to establish any special requirements necessary for the safe carriage of the substance.

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

(d) **Tests (TP)**

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

Calculation pressure (bar)	Test pressure (bar)
G[18]	G [18]
1.5	1.5
4	4
10	4
15	4

[18] *G = minimum calculation pressure according to the general requirements 6.8.2.1.14 (see - 4.3.4.1).*

21	10 (4[19])

TP1 Tanks of pure aluminium need to be subjected to the initial and periodic hydraulic pressure tests at a pressure of only 250 kPa (2.5 bar) (gauge pressure).

TP2 The condition of the lining of shells shall be inspected every year by an expert approved by the competent authority, who shall inspect the inside of the shell.

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

TP4 Reserved

TP5 The hydraulic pressure tests shall take place at least every

3 years	2½ years,

TP6 The periodic tests shall be carried out at least every 3 years, including the hydraulic pressure test.

(e) **Marking (TM)**

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

TM1 Tanks shall bear in addition to the particulars prescribed in 6.8.2.5.2, the words: "**Do not open during carriage. Liable to spontaneous combustion**" (see also the Note above).

TM2 Tanks shall bear in addition to the particulars prescribed in 6.8.2.5.2, the words: "**Do not open during carriage. Gives off flammable gases on contact with water**" (see also the Note above).

TM3 Tanks shall also bear, on the plate prescribed in 6.8.2.5.1, the proper shipping names of the approved substances and the maximum permissible load of the tank in kg.

TM4 For tanks the following additional particulars shall be marked by stamping or by any other similar method on the plate prescribed in 6.8.2.5.1 or directly on the shell itself, if the walls are so reinforced that the strength of the tank is not impaired: the chemical name with the approved concentration of the substance concerned.

[19] *Minimum test pressure for UN No. 1744 bromine or UN No. 1744 bromine solution.*

TM5 Tanks shall bear, in addition to the particulars referred to in 6.8.2.5.1 the date (month, year) of the most recent inspection of the internal condition of the shell.

TM6 Tanks shall bear on both sides, in addition to the markings stipulated in 6.8.2.5.2, the mark reproduced in Chapter 5.3.

6.8.5 Requirements concerning the materials and construction of fixed welded tanks, demountable welded tanks, and welded shells of tank-containers for which a test pressure of not less than 1 MPa (10 bar) is required, and of fixed welded tanks, demountable welded tanks and welded shells of tank-containers intended for the carriage of refrigerated liquefied gases of Class 2

6.8.5.1 ***Materials and shells***

6.8.5.1.1 (a) Shells intended for the carriage of :

- compressed, liquefied gases or gases dissolved under pressure of Class 2;
- UN Nos. 1366, 1370, 1380, 2003, 2005, 2445, 2845, 2870, 3049, 3050, 3051, 3052, 3053, 3076, 3194 and 3203 of Class 4.2; and
- UN No. 1052 hydrogen fluoride, anhydrous and UN No.1790 hydrofluoric acid with more than 85% hydrogen fluoride of Class 8

shall be made of steel.

(b) Shells constructed of fine-grained steels for the carriage of:

- corrosive gases of Class 2 and UN No. 2073; and
- UN No. 1052 hydrogen fluoride, anhydrous and UN No.1790 hydrofluoric acid with more than 85% hydrogen fluoride of Class 8

shall be heat-treated for thermal stress relief.

(c) Shells intended for the carriage of refrigerated liquefied gases of Class 2, shall be made of steel, aluminium, aluminium alloy, copper or copper alloy (e.g. brass). However, shells made of copper or copper alloy shall be allowed only for gases containing no acetylene; ethylene, however, may contain not more than 0.005% acetylene.

(d) Only materials appropriate to the lowest and highest working temperatures of the shells and of their fittings and accessories may be used.

6.8.5.1.2 The following materials shall be allowed for the manufacture of shells:

(a) steels not subject to brittle fracture at the lowest working temperature (see 6.8.5.2.1):

- mild steels (except for refrigerated liquefied gases of Class 2);
- fine-grained steels, down to a temperature of -60º C;

- nickel steels (with a nickel content of 0.5 to 9%), down to a temperature of -196º C, depending on the nickel content;

- austenitic chrome-nickel steels, down to a temperature of -270º C;

(b) aluminium not less than 99.5% pure or aluminium alloys (see 6.8.5.2.2);

(c) deoxidized copper not less than 99.9% pure, or copper alloys having a copper content of over 56% (see 6.8.5.2.3).

6.8.5.1.3 (a) Shells made of steel, aluminium or aluminium alloys shall be either seamless or welded.

(b) Shells made of austenitic steel, copper or copper alloy may be hard-soldered.

6.8.5.1.4 The fittings and accessories may either be screwed to the shells or be secured thereto as follows:

(a) shells made of steel, aluminium or aluminium alloy: by welding;

(b) shells made of austenitic steel, of copper or of copper alloy: by welding or hard-soldering.

6.8.5.1.5 The construction of shells and their attachment to the vehicle, to the underframe or in the container frame shall be such as to preclude with certainty any such reduction in the temperature of the load-bearing components as would be likely to render them brittle. The means of attachment of shells shall themselves be so designed that even when the shell is at its lowest working temperature they still possess the necessary mechanical properties.

6.8.5.2 ***Test requirements***

6.8.5.2.1 *Steel shells*

The materials used for the manufacture of shells and the weld beads shall, at their lowest working temperature, but at least at -20º C, meet at least the following requirements as to impact strength:

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

- The minimum impact strength (see 6.8.5.3.1 to 6.8.5.3.3) for test-pieces with the longitudinal axis at right angles to the direction of rolling and a V-shaped notch (conforming to ISO R 148) perpendicular to the plate surface, shall be 34 J/cm2 for mild steel (which, because of existing ISO standards, may be tested with test-pieces having the longitudinal axis in the direction of rolling); fine-grained steel; ferritic alloy steel Ni < 5%, ferritic alloy steel 5% # Ni # 9%; or austenitic Cr - Ni steel;

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

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

6.8.5.2.2 *Shells made of aluminium or aluminium alloy*

The seams of shells shall meet the requirements laid down by the competent authority.

6.8.5.2.3 *Shells made of copper or copper alloy*

It is not necessary to carry out tests to determine whether the impact strength is adequate.

6.8.5.3 ***Impact-strength tests***

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

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

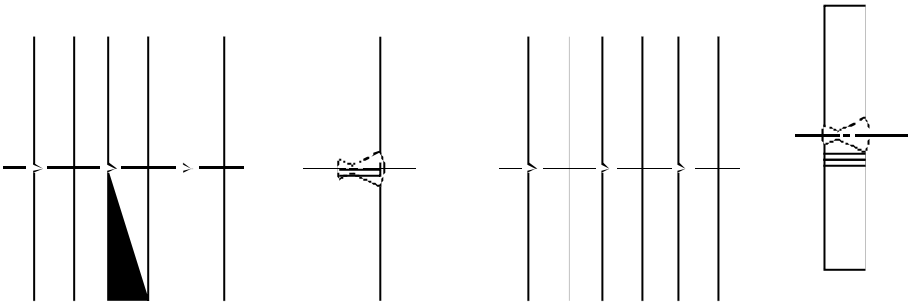
6.8.5.3.2 (a) For the purpose of testing sheets, the impact strength shall be determined on three test-pieces. Test-pieces shall be taken at right angles to the direction of rolling; however, for mild steel they may be taken in the direction of rolling.

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

when e # 10 mm:

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

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



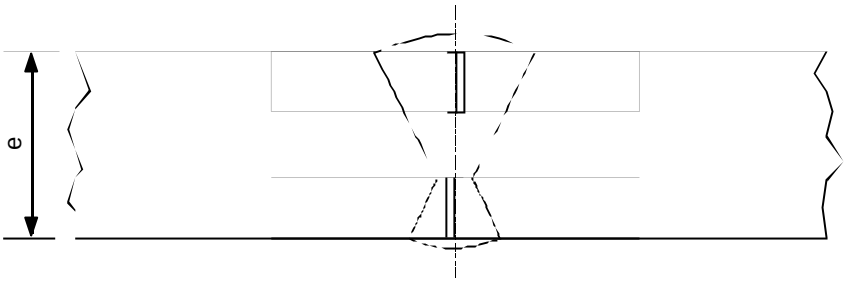
Center of the weld Heat affected zone

when 10 mm < e # 20 mm:

three test-pieces from the centre of the weld;

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

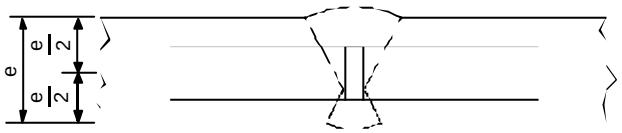
Center of weld



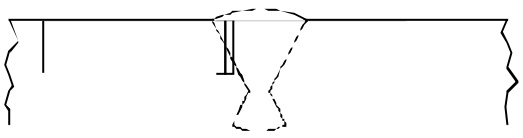
Heat affected zone

when e > 20 mm

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



Center of weld

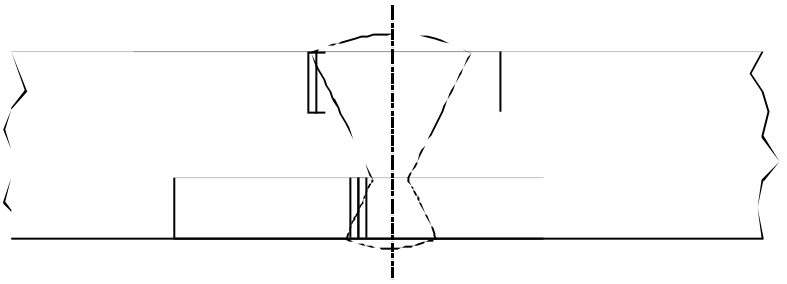


Heat affected zone

6.8.5.3.3 (a) For sheets, the average of the three tests shall meet the minimum value of 34 J/cm^2 indicated in 6.8.5.2.1; not more than one of the individual values may be below the minimum value and then not below 24 J/cm^2.

(b) For welds, the average value obtained from the three test-pieces taken at the centre of the weld shall not be below the minimum value of 34 J/cm^2; not more than one of the individual values may be below the minimum value and then not below 24 J/cm^2.

(c) For the heat affected zone (the V-notch to cross the fusion boundary at the centre of the specimen) the value obtained from not more than one of the three test-pieces may be below the minimum value of 34 J/cm^2, though not below 24 J/cm^2.



6.8.5.3.4 If the requirements prescribed in 6.8.5.3.3 are not met, one retest only may be done if:

(a) the average value of the first three tests is below the minimum value of 34 J/cm^2, or

(b) more than one of the individual values is less than the minimum value of 34 J/cm^2 but not below 24 J/cm^2.

6.8.5.3.5 In a repeated impact test on sheets or welds, none of the individual values may be below 34 J/cm2. The average value of all the results of the original test and of the retest should be equal to or more than the minimum of 34 J/cm2.

On a repeated impact strength test on the heat-affected zone, none of the individual values may be below 34 J/cm2.

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