

- 6.7.5.2.8** MEGCs and their fastenings shall, under the maximum permissible load, be capable of withstanding the following separately applied static forces:
- (a) in the direction of travel: twice the MPGM multiplied by the acceleration due to gravity (g)¹³;
 - (b) horizontally at right angles to the direction of travel: the MPGM (when the direction of travel is not clearly determined, the forces shall be equal to twice the MPGM) multiplied by the acceleration due to gravity (g)¹³;
 - (c) vertically upwards: the MPGM multiplied by the acceleration due to gravity (g)¹³; and
 - (d) vertically downwards: twice the MPGM (total loading including the effect of gravity) multiplied by the acceleration due to gravity (g)¹³.
- 6.7.5.2.9** Under the forces defined in 6.7.5.2.8, the stress at the most severely stressed point of the elements shall not exceed the values given in either the relevant standards of 6.2.2.1 or, if the elements are not designed, constructed and tested according to those standards, in the technical code or standard recognised or approved by the competent authority of the country of use (see 6.2.5).
- 6.7.5.2.10** Under each of the forces in 6.7.5.2.8, the safety factor for the framework and fastenings to be observed shall be as follows:
- (a) for steels having a clearly defined yield point, a safety factor of 1.5 in relation to the guaranteed yield strength; or
 - (b) for steels with no clearly defined yield point, a safety factor of 1.5 in relation to the guaranteed 0.2% proof strength and, for austenitic steels, the 1% proof strength.
- 6.7.5.2.11** MEGCs intended for the carriage of flammable gases shall be capable of being electrically earthed.
- 6.7.5.2.12** The elements shall be secured in a manner that prevents undesired movement in relation to the structure and the concentration of harmful localized stresses.
- 6.7.5.3 Service equipment**
- 6.7.5.3.1** Service equipment shall be configured or designed to prevent damage that could result in the release of the pressure receptacle contents during normal conditions of handling and carriage. When the connection between the frame and the elements allows relative movement between the sub-assemblies, the equipment shall be so fastened as to permit such movement without damage to working parts. The manifolds, the discharge fittings (pipe sockets, shut-off devices), and the stop-valves shall be protected from being wrenched off by external forces. Manifold piping leading to shut-off valves shall be sufficiently flexible to protect the valves and the piping from shearing, or releasing the pressure receptacle contents. The filling and discharge devices (including flanges or threaded plugs) and any protective caps shall be capable of being secured against unintended opening.
- 6.7.5.3.2** Each element intended for the carriage of toxic gases (gases of groups T, TF, TC, TO, TFC and TOC) shall be fitted with a valve. The manifold for liquefied toxic gases (gases of classification codes 2T, 2TF, 2TC, 2TO, 2TFC and 2TOC) shall be so designed that the elements can be filled separately and be kept isolated by a valve capable of being sealed. For the carriage of flammable gases (gases of group F), the elements shall be divided into groups of not more than 3 000 litres each isolated by a valve.
- 6.7.5.3.3** For filling and discharge openings of the MEGC, two valves in series shall be placed in an accessible position on each discharge and filling pipe. One of the valves may be a non-return valve. The filling and discharge devices may be fitted to a manifold. For sections of piping which can be closed at both ends and where a liquid product can be trapped, a pressure-relief valve shall be provided to prevent excessive pressure build-up. The main isolation valves on an MEGC shall be clearly marked to indicate their directions of closure. Each stop-valve or other means of closure shall be designed and constructed to withstand a pressure equal to or greater than 1.5 times the test pressure of the MEGC. All stop-valves with screwed spindles shall close by a clockwise motion of the handwheel. For other stop-valves, the position (open and closed) and direction of closure shall be clearly indicated. All stop-valves shall be designed and positioned to prevent unintentional opening. Ductile metals shall be used in the construction of valves or accessories.
- 6.7.5.3.4** Piping shall be designed, constructed and installed so as to avoid damage due to expansion and contraction, mechanical shock and vibration. Joints in tubing shall be brazed or have an equally strong metal union. The melting point of brazing materials shall be no lower than 525 °C. The rated pressure of the service equipment and of the manifold shall be not less than two thirds of the test pressure of the elements.

¹³ For calculation purposes $g = 9.81 \text{ m/s}^2$.

6.7.5.4 Pressure-relief devices

6.7.5.4.1 The elements of MEGCs used for the carriage of UN 1013 carbon dioxide and UN 1070 nitrous oxide shall be divided into groups of not more than 3 000 litres each isolated by a valve. Each group shall be fitted with one or more pressure relief devices. If so required by the competent authority of the country of use, MEGCs for other gases shall be fitted with pressure relief devices as specified by that competent authority.

6.7.5.4.2 When pressure relief devices are fitted, every element or group of elements of an MEGC that can be isolated shall then be fitted with one or more pressure relief devices. Pressure relief devices shall be of a type that will resist dynamic forces including liquid surge and shall be designed to prevent the entry of foreign matter, the leakage of gas and the development of any dangerous excess pressure.

6.7.5.4.3 MEGCs used for the carriage of certain non-refrigerated gases identified in portable tank instruction T 50 in 4.2.5.2.6 may have a pressure-relief device as required by the competent authority of the country of use. Unless an MEGC in dedicated service is fitted with an approved pressure relief device constructed of materials compatible with the gas carried, such a device shall comprise a frangible disc preceding a spring-loaded device. The space between the frangible disc and the spring-loaded device may be equipped with a pressure gauge or a suitable telltale indicator. This arrangement permits the detection of disc rupture, pinholing or leakage which could cause a malfunction of the pressure relief device. The frangible disc shall rupture at a nominal pressure 10% above the start-to-discharge pressure of the spring-loaded device.

6.7.5.4.4 In the case of multi-purpose MEGCs used for the carriage of low-pressure liquefied gases, the pressure-relief devices shall open at a pressure as specified in 6.7.3.7.1 for the gas having the highest maximum allowable working pressure of the gases allowed to be carried in the MEGC.

6.7.5.5 Capacity of pressure relief devices

6.7.5.5.1 The combined delivery capacity of the pressure relief devices when fitted shall be sufficient that, in the event of total fire engulfment of the MEGC, the pressure (including accumulation) inside the elements does not exceed 120% of the set pressure of the pressure relief device. The formula provided in CGA S-1.2-2003 "Pressure Relief Device Standards – Part 2 – Cargo and Portable Tanks for Compressed Gases" shall be used to determine the minimum total flow capacity for the system of pressure relief devices. CGA S-1.1-2003 "Pressure Relief Device Standards – Part 1 – Cylinders for Compressed Gases" may be used to determine the relief capacity of individual elements. Spring-loaded pressure relief devices may be used to achieve the full relief capacity prescribed in the case of low pressure liquefied gases. In the case of multi-purpose MEGCs, the combined delivery capacity of the pressure-relief devices shall be taken for the gas which requires the highest delivery capacity of the gases allowed to be carried in the MEGC.

6.7.5.5.2 To determine the total required capacity of the pressure relief devices installed on the elements for the carriage of liquefied gases, the thermodynamic properties of the gas shall be considered (see, for example, CGA S-1.2-2003 "Pressure Relief Device Standards – Part 2 – Cargo and Portable Tanks for Compressed Gases" for low pressure liquefied gases and CGA S-1.1-2003 "Pressure Relief Device Standards – Part 1 – Cylinders for Compressed Gases" for high pressure liquefied gases).

6.7.5.6 Marking of pressure-relief devices

6.7.5.6.1 Pressure relief devices shall be clearly and permanently marked with the following:

- (a) The manufacturer's name and relevant catalogue number;
- (b) The set pressure and/or the set temperature;
- (c) The date of the last test;
- (d) The cross sectional flow areas of the spring loaded pressure-relief devices and frangible discs in mm².

6.7.5.6.2 The rated flow capacity marked on spring loaded pressure relief devices for low pressure liquefied gases shall be determined according to ISO 4126-1:2004 and ISO 4126-7:2004.

6.7.5.7 Connections to pressure-relief devices

6.7.5.7.1 Connections to pressure-relief devices shall be of sufficient size to enable the required discharge to pass unrestricted to the pressure relief device. No stop-valve shall be installed between the element and the pressure-relief devices, except when duplicate devices are provided for maintenance or other reasons, and the stop-valves serving the devices actually in use are locked open, or the stop-valves are interlocked so that at least one of the duplicate devices is always operable and capable of meeting the requirements of 6.7.5.5. There shall be no obstruction in an opening leading to or leaving from a vent or pressure-relief device which might restrict or cut-off the flow from the element to that device. The opening through all piping and fittings shall have at least the same flow area as the inlet of the pressure relief device to which it is connected. The nominal size of the discharge piping shall be at least as large as that of the pressure relief device outlet. Vents from the pressure-relief devices, when used, shall deliver the relieved vapour or liquid to the atmosphere in conditions of minimum back-pressure on the relieving device.

6.7.5.8 Siting of pressure-relief devices

6.7.5.8.1 Each pressure relief device shall, under maximum filling conditions, be in communication with the vapour space of the elements for the carriage of liquefied gases. The devices, when fitted, shall be so arranged as to ensure that the escaping vapour is discharged upwards and unrestrictedly as to prevent any impingement of escaping gas or liquid upon the MEGC, its elements or personnel. For flammable, pyrophoric and oxidizing gases, the escaping gas shall be directed away from the element in such a manner that it cannot impinge upon the other elements. Heat resistant protective devices which deflect the flow of gas are permissible provided the required pressure relief device capacity is not reduced.

6.7.5.8.2 Arrangements shall be made to prevent access to the pressure-relief devices by unauthorized persons and to protect the devices from damage caused by the MEGC overturning.

6.7.5.9 Gauging devices

6.7.5.9.1 When an MEGC is intended to be filled by mass, it shall be equipped with one or more gauging devices. Level-gauges made of glass or other fragile material shall not be used.

6.7.5.10 MEGC supports, frameworks, lifting and tie-down attachments

6.7.5.10.1 MEGCs shall be designed and constructed with a support structure to provide a secure base during carriage. The forces specified in 6.7.5.2.8 and the safety factor specified in 6.7.5.2.10 shall be considered in this aspect of the design. Skids, frameworks, cradles or other similar structures are acceptable.

6.7.5.10.2 The combined stresses caused by element mountings (e.g. cradles, frameworks, etc.) and MEGC lifting and tie-down attachments shall not cause excessive stress in any element. Permanent lifting and tie-down attachments shall be fitted to all MEGCs. In no case shall mountings or attachments be welded onto the elements.

6.7.5.10.3 In the design of supports and frameworks, the effects of environmental corrosion shall be taken into account.

6.7.5.10.4 When MEGCs are not protected during carriage, according to 4.2.4.3, the elements and service equipment shall be protected against damage resulting from lateral or longitudinal impact or overturning. External fittings shall be protected so as to preclude the release of the elements' contents upon impact or overturning of the MEGC on its fittings. Particular attention shall be paid to the protection of the manifold. Examples of protection include:

- (a) protection against lateral impact which may consist of longitudinal bars;
- (b) protection against overturning which may consist of reinforcement rings or bars fixed across the frame;
- (c) protection against rear impact which may consist of a bumper or frame;
- (d) protection of the elements and service equipment against damage from impact or overturning by use of an ISO frame in accordance with the relevant provisions of ISO 1496-3:1995.

6.7.5.11 Design approval

6.7.5.11.1 The competent authority or its authorized body shall issue a design approval certificate for any new design of an MEGC. This certificate shall attest that the MEGC has been surveyed by that authority, is suitable for its intended purpose and meets the requirements of this Chapter, the applicable provisions for gases of Chapter 4.1 and of packing instruction P 200. When a series of MEGCs are manufactured without change in the design, the certificate shall be valid for the entire series. The certificate shall refer to the prototype test report, the materials of construction of the manifold, the standards to which the elements are made and an approval number. The approval number shall consist of the distinguishing sign or mark of the country granting the approval, indicated by the distinguishing sign used on vehicles in international road traffic¹⁴, and a registration number. Any alternative arrangements according to 6.7.1.2 shall be indicated on the certificate. A design approval may serve for the approval of smaller MEGCs made of materials of the same type and thickness, by the same fabrication techniques and with identical supports, equivalent closures and other appurtenances.

6.7.5.11.2 The prototype test report for the design approval shall include at least the following:

- (a) the results of the applicable framework test specified in ISO 1496-3:1995;
- (b) the results of the initial inspection and test specified in 6.7.5.12.3;
- (c) the results of the impact test specified in 6.7.5.12.1; and
- (d) certification documents verifying that the cylinders and tubes comply with the applicable standards.

¹⁴ Distinguishing sign of the State of registration used on motor vehicles and trailers in international road traffic, e.g. in accordance with the Geneva Convention on Road Traffic of 1949 or the Vienna Convention on Road Traffic of 1968.

6.7.5.12 Inspection and testing

6.7.5.12.1 MEGCs meeting the definition of container in the International Convention for Safe Containers (CSC), 1972, as amended, shall not be used unless they are successfully qualified by subjecting a representative prototype of each design to the Dynamic, Longitudinal Impact Test prescribed in the Manual of Tests and Criteria, Part IV, Section 41.

6.7.5.12.2 The elements and items of equipment of each MEGC shall be inspected and tested before being put into service for the first time (initial inspection and test). Thereafter, MEGCs shall be inspected at no more than five-year intervals (5 year periodic inspection). An exceptional inspection and test shall be performed, regardless of the last periodic inspection and test, when necessary according to 6.7.5.12.5.

6.7.5.12.3 The initial inspection and test of an MEGC shall include a check of the design characteristics, an external examination of the MEGC and its fittings with due regard to the gases to be carried, and a pressure test performed at the test pressures according to packing instruction P 200 of 4.1.4.1. 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 authorized body. Before the MEGC is placed into service, a leakproofness test and a test of the satisfactory operation of all service equipment shall also be performed. When the elements and their fittings have been pressure-tested separately, they shall be subjected together after assembly to a leakproofness test.

6.7.5.12.4 The 5-year periodic inspection and test shall include an external examination of the structure, the elements and the service equipment in accordance with 6.7.5.12.6. The elements and the piping shall be tested at the periodicity specified in packing instruction P 200 and in accordance with the provisions described in 6.2.1.6. When the elements and equipment have been pressure-tested separately, they shall be subjected together after assembly to a leakproofness test.

6.7.5.12.5 An exceptional inspection and test is necessary when the MEGC shows evidence of damaged or corroded areas, leakage, or other conditions that indicate a deficiency that could affect the integrity of the MEGC. The extent of the exceptional inspection and test shall depend on the amount of damage or deterioration of the MEGC. It shall include at least the examinations required under 6.7.5.12.6.

6.7.5.12.6 The examinations shall ensure that:

- (a) the elements are inspected externally for pitting, corrosion, abrasions, dents, distortions, defects in welds or any other conditions, including leakage, that might render the MEGC unsafe for carriage;
- (b) the piping, valves, and gaskets are inspected for corroded areas, defects, and other conditions, including leakage, that might render the MEGC unsafe for filling, discharge or carriage;
- (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 marks on the MEGC are legible and in accordance with the applicable requirements; and
- (f) the framework, the supports and the arrangements for lifting the MEGC are in satisfactory condition.

6.7.5.12.7 The inspections and tests in 6.7.5.12.1, 6.7.5.12.3, 6.7.5.12.4 and 6.7.5.12.5 shall be performed or witnessed by a body authorized by the competent authority. When the pressure test is a part of the inspection and test, the test pressure shall be the one indicated on the data plate of the MEGC. While under pressure, the MEGC shall be inspected for any leaks in the elements, piping or equipment.

6.7.5.12.8 When evidence of any unsafe condition is discovered, the MEGC shall not be returned to service until it has been corrected and the applicable tests and verifications are passed.

6.7.5.13 Marking

6.7.5.13.1 Every MEGC shall be fitted with a corrosion resistant metal plate permanently attached to the MEGC in a conspicuous place readily accessible for inspection. The metal plate shall not be affixed to the elements. The elements shall be marked in accordance with Chapter 6.2. As a minimum, at least the following information shall be marked on the plate by stamping or by any other similar method:

- (a) Owner information
 - (i) Owner's registration number;
- (b) Manufacturing information
 - (i) Country of manufacture;
 - (ii) Year of manufacture;
 - (iii) Manufacturer's name or mark;
 - (iv) Manufacturer's serial number;

(c) Approval information

- (i) The United Nations packaging symbol
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- ;

This symbol shall not be used for any purpose other than certifying that a packaging, a flexible bulk container, a portable tank or an MEGC complies with the relevant requirements in Chapter 6.1, 6.2, 6.3, 6.5, 6.6, 6.7 or 6.11;

- (ii) Approval country;
 (iii) Authorized body for the design approval;
 (iv) Design approval number;
 (v) Letters "AA", if the design was approved under alternative arrangements (see 6.7.1.2);

(d) Pressures

- (i) Test pressure (in bar gauge)¹⁵;
 (ii) Initial pressure test date (month and year);
 (iii) Identification mark of the initial pressure test witness;

(e) Temperatures

- (i) Design temperature range (in °C)¹⁵;

(f) Elements / Capacity

- (i) Number of elements;
 (ii) Total water capacity (in litres)¹⁵;

(g) Periodic inspections and tests

- (i) Type of the most recent periodic test (5-year or exceptional);
 (ii) Date of the most recent periodic test (month and year);
 (iii) Identification mark of the authorized body who performed or witnessed the most recent test.

Figure 6.7.5.13.1: Example of a plate for marking

Owner's registration number					
MANUFACTURING INFORMATION					
Country of manufacture					
Year of manufacture					
Manufacturer					
Manufacturer's serial number					
APPROVAL INFORMATION					
	Approval country				
	Authorized body for design approval				
	Design approval number				"AA" (if applicable)
PRESSURES					
Test pressure					bar
Initial pressure test date:		(mm/yyyy)	Witness stamp:		
TEMPERATURES					
Design temperature range					°C to °C
ELEMENTS / CAPACITY					
Number of elements					
Total water capacity					litres
PERIODIC INSPECTIONS / TESTS					
Test type	Test date	Witness stamp	Test type	Test date	Witness stamp
	(mm/yyyy)			(mm/yyyy)	

¹⁵ The unit used shall be indicated.

6.7.5.13.2 The following information shall be durably marked on a metal plate firmly secured to the MEGC:

Name of the operator

Maximum permissible load mass _____ kg

Working pressure at 15 °C: _____ bar gauge

Maximum permissible gross mass (MPGM) _____ kg

Unladen (tare) mass _____ kg

Chapter 6.8 Requirements for the construction, equipment, type approval, inspections and tests, and marking of tank-wagons, demountable tanks and tank-containers and tank swap bodies, with shells made of metallic materials, and battery-wagons and multiple element gas containers (MEGCs)

NOTE 1: For portable tanks and UN multiple-element gas containers (MEGCs) see Chapter 6.7, for portable tanks with shells made of fibre-reinforced plastics (FRP) materials, see Chapter 6.9, for vacuum-operated waste tanks see Chapter 6.10.

2: In this chapter, "inspection body" means a body conforming to 1.8.6.

6.8.1 Scope and general provisions

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

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

6.8.1.2 These requirements shall apply to tank-wagons, demountable tanks and battery-wagons | 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 tank-wagons, to demountable tanks, tank-containers, tank swap bodies intended for the carriage of substances of all classes and battery-wagons 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.

6.8.1.5 Conformity assessment, type approval and inspections procedures

The following provisions describe how to apply the procedures in 1.8.7.

Note: These provisions apply, subject to the compliance of the inspection bodies with the provisions of 1.8.6, and without prejudice to rights and obligations, in particular notification and recognition, fixed for them by agreements or legal acts (e.g. Directive 2010/35/EU) otherwise binding on RID Contracting States.

For the purpose of this sub-section the term "country of registration" means:

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| the RID Contracting State of registration of the wagon on which the tank is mounted. | <ul style="list-style-type: none"> – the RID Contracting State where the owner's or operator's company is registered; – if the owner's or operator's company is not known, the RID Contracting State of the competent authority that approved the inspection body which performed the initial inspection. Notwithstanding 1.6.4.57 these inspection bodies shall be accredited according to EN ISO/IEC 17020: 2012 (except clause 8.1.3) Type A. |
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The conformity assessment of the tank shall verify that all its components conform to the requirements of RID, irrespective of where they have been manufactured.

6.8.1.5.1 Type examination according to 1.8.7.2.1

- (a) The manufacturer of the tank shall engage a single inspection body approved or recognized by the competent authority of either the country of manufacture or the first country of registration of the first tank manufactured according to that type to take responsibility for the type examination. If the country of manufacture is not an RID Contracting State, the manufacturer shall engage a single inspection body approved or recognized by the competent authority of the country of registration of the first tank manufactured according to that type to take responsibility for the type examination.
- (b) If the type examination of the service equipment is performed separately from the tank according to 6.8.2.3.1, the manufacturer of the service equipment shall engage single inspection body approved or recognized by an RID Contracting State to take responsibility for the type examination.

6.8.1.5.2 *Type approval certificate issue according to 1.8.7.2.2*

Only the competent authority that approved or recognized the inspection body that performed the type examination shall issue the type approval certificate.

However, when an inspection body is designated by the competent authority to issue the type approval certificate the type examination shall be performed by that inspection body.

6.8.1.5.3 *Supervision of manufacture according to 1.8.7.3*

(a) For the supervision of manufacture, the manufacturer of the tank shall engage a single inspection body approved or recognized either by the competent authority of the country of registration or the country of manufacture. If the country of manufacture is not an RID Contracting State, a manufacturer shall engage a single inspection body approved or recognized by the competent authority of the country of registration.

(b) If the type examination of the service equipment is performed separately from the tank, the manufacturer of the service equipment shall engage a single inspection body approved or recognized by the competent authority of an RID Contracting State. The manufacturer may use an in-house inspection service according to 1.8.7.7 to perform the procedures of 1.8.7.3.

6.8.1.5.4 *Initial inspection and tests according to 1.8.7.4*

(a) The manufacturer of the tank shall engage a single inspection body approved or recognized by the competent authority of the country of registration or the country of manufacture to take responsibility for the initial inspection and tests. If the country of manufacture is not an RID Contracting State, a manufacturer shall engage a single inspection body approved or recognized by the competent authority of the country of registration to take responsibility for the initial inspection and tests.

(b) If the service equipment is type approved separately from the tank, the manufacturer of the service equipment shall engage the same single inspection body engaged for the purposes of 6.8.1.5.3 (b) to take responsibility for the initial inspection and tests. The manufacturer may use an in-house inspection service according to 1.8.7.7 to perform the procedures of 1.8.7.4.

6.8.1.5.5 *Entry into service verification according to 1.8.7.5*

The competent authority of the country of first registration may require, on an occasional basis, an entry into service verification of the tank to verify conformity with the applicable requirements.¹

When the country of registration of a tank-wagon is changed, the competent authority of the RID Contracting State to which the tank-wagon is transferred may require, on an occasional basis, an entry into service verification of the tank.

The competent authority of the country of first registration may require, on an occasional basis, an entry into service verification of the tank to verify conformity with the applicable requirements.

When the country of registration of a tank-container is changed, the competent authority of the RID Contracting State to which the tank-container is transferred may require, on an occasional basis an entry into service verification.

To perform the entry into service verification, the owner or operator of the tank shall engage a single inspection body different to the inspection bodies engaged for the type examination, supervision of manufacture or initial inspection. The inspection body engaged for the entry into service verification shall be approved by the competent authority of the country of registration or, if no such inspection body exists, the inspection body shall be recognized by the competent authority of the country of registration. The entry into service verification shall consider the condition of the tank and shall ensure that the requirements of RID are fulfilled.

6.8.1.5.6 *Intermediate, periodic or exceptional inspection according to 1.8.7.6*

The intermediate or periodic or exceptional inspection shall be performed

by an inspection body approved or recognized by the competent authority of the country where the inspection takes place or by an inspection body approved or recognized by the competent authority of the country of registration.

by an inspection body approved or recognized by the competent authority of the RID Contracting State where the inspection takes place or by an inspection body approved or recognized by the competent authority of the country of registration.

The owner or operator of the tank, or its authorized representative, shall engage a single inspection body for each intermediate, periodic or exceptional inspection.

¹ For those tank-wagons that have received a vehicle authorization from the European Union Agency for Railways (ERA) in accordance with Article 21 of Directive (EU) 2016/797 and Commission Implementing Regulation (EU) 2018/545, this authorization shall be sufficient and no entry into service verification shall be required to confirm the conformity of the tank for the purpose of registering the tank-wagon in the National Vehicle Register (NVR).

6.8.2 Requirements applicable to all classes**6.8.2.1 Construction*****Basic principles***

- 6.8.2.1.1** Shells, 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** Tank-wagons shall be constructed as to be capable of withstanding, under the maximum permissible load, the stresses which occur during carriage by rail.² As regards these stresses, reference should be made to the tests prescribed by the competent authority.
- Tank-containers³ 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 standards listed in 6.8.2.6 or of a technical code recognized by the competent authority, in accordance with 6.8.2.7, in which the material is chosen and the shell 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.
- Shells, other than shells according to 6.8.2.2.6, designed to be equipped with vacuum valves shall be able to withstand, without permanent deformation, an external pressure of not less than 21 kPa (0.21 bar) above the internal pressure. Shells used for the carriage of solid substances (powdery or granular) of packing groups II or III only, which do not liquefy during carriage, may be designed for a lower external pressure but not less than 5 kPa (0.05 bar). The vacuum valves shall be set to relieve at a vacuum setting not greater than the tank's design vacuum pressure. Shells, which are not designed to be equipped with a vacuum valve shall be able to withstand, without permanent deformation an external pressure of not less than 40 kPa (0.4 bar) above the internal pressure.

² This requirement is deemed to be met if

- the notified body in charge of verifying compliance with the technical specification for interoperability (TSI) relating to the subsystem "rolling stock – freight wagons" of the rail system in the European Union (Commission Regulation (EU) No 321/2013 of 13 March 2013) or
- the assessing entity in charge of verifying compliance with the uniform technical prescriptions (UTP) applicable to the Rolling Stock subsystem: FREIGHT WAGONS – (Ref. A 94-02/2.2012 of 1 January 2014)

has successfully evaluated compliance with the provisions of RID, in addition to the requirements of the TSI or UTP mentioned above, and has confirmed this compliance by a relevant certificate.

³ See also 7.1.3.

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 appreciably 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 shell thickness, 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 shell thickness.

6.8.2.1.10 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.

If fine-grained steel is used, the guaranteed value of the yield strength R_e shall not exceed 460 N/mm² and the guaranteed value of the upper limit of tensile strength R_m shall not exceed 725 N/mm², in accordance with the specifications of the material.

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

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

R_m = 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%⁴.

Calculation of the shell thickness

6.8.2.1.13 The pressure on which the shell thickness 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 wagons in which the tank constitutes a stressed self-supporting member, the shell shall be designed to withstand the stresses thus imposed in addition to stresses from other sources.

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

⁴ 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

$$l = 5.65 \sqrt{F_0}$$

where F_0 indicates the initial cross-section area of the test-piece.

- 6.8.2.1.14** The calculation pressure is in the second part of the code (see 4.3.4.1) 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 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.
- (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 50 °C shall be designed for a calculation pressure equal to 1.3 times the filling or discharge pressure.

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

- (c) Shells intended for the carriage of substances having a vapour pressure of more than 110 kPa (1.1 bar) at 50 °C and a boiling point of more than 35 °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 boiling point of not more than 35 °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:

$$\sigma \leq 0.75 R_e \text{ or } \sigma \leq 0.5 R_m$$

where

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

R_m = tensile strength.

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

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 minimum values shall, however, not be exceeded when the formula given in 6.8.2.1.18 is applied.

Minimum shell thickness

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

$$e = \frac{P_T D}{2 \sigma \lambda}$$

$$e = \frac{P_C D}{2 \sigma}$$

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 or in the table of 4.3.3.1.1

D = internal diameter of shell in mm

σ = permissible stress, as defined in 6.8.2.1.16, in N/mm²

λ = a coefficient not exceeding 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. | 6.8.2.1.18 to 6.8.2.1.20.

6.8.2.1.18 Shells shall be not less than 6 mm thick if of mild steel⁵, or of equivalent thickness if of another metal. For powdery or granular substances, this thickness may be reduced to 5 mm for mild steel or to an equivalent thickness for other metals.

Whichever metal is used, the minimum wall thickness of the shell shall in no case be less than 4.5 mm.

Shells shall be not less than 5 mm thick if of mild steel⁵ (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 steel⁵ or to an equivalent thickness if of another metal.

Whatever the metal used, the shell thickness shall in no case be less than 3 mm, or 4.5 mm if the tank is an extra-large tank-container.

"Equivalent thickness" means the thickness obtained by the following formula⁶:

$$e_1 = \frac{464 e_0}{\sqrt[3]{(Rm_1 A_1)^2}}$$

6.8.2.1.19 (Reserved)

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 steel⁵, 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 steel⁵, 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.

The thickness of shells with protection against damage in accordance with 6.8.2.1.20 shall not be less than the values given in the table below:

⁵ For the definitions of "mild steel" and "reference steel" see 1.2.1. "Mild steel" in this case also covers a steel referred to in EN material standards as "mild steel", with a minimum tensile strength between 360 N/mm² and 490 N/mm² and a minimum elongation at fracture conforming to 6.8.2.1.12.

⁶ This formula is derived from the general formula:

$$e_1 = e_0 \sqrt[3]{\left(\frac{Rm_0 A_0}{Rm_1 A_1}\right)^2}$$

where

e_1 = minimum shell thickness for the metal chosen, in mm;

e_0 = minimum shell thickness for mild steel, in mm, according to 6.8.2.1.18 and 6.8.2.1.19;

Rm_0 = 370 (tensile strength for reference steel, see definition 1.2.1, in N/mm²);

A_0 = 27 (elongation at fracture for reference steel, in %);

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

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

		Diameter of shell	
		≤ 1.80 m	> 1.80 m
Minimum thickness of shells	Austenitic stainless steels	2.5 mm	3 mm
	Austenitic-ferritic stainless steels	3 mm	3.5 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 (Reserved)

The 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.

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 steel⁵ 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.

6.8.2.1.21 (Reserved)

6.8.2.1.22 (Reserved)

Welding and inspection of welds

6.8.2.1.23 The inspection body performing inspections in accordance with 6.8.2.4.1 or 6.8.2.4.4 shall verify and confirm the ability of the manufacturer or the maintenance or repair shop to perform welding operations and the operation of a weld quality assurance system. Welding shall be performed by qualified welders using a qualified welding process whose effectiveness (including any heat treatments required) has been demonstrated by tests.

NOTE: When 6.8.5 is applicable, the impact-strength tests carried out for the qualifications of the welding processes shall comply with the requirements of 6.8.5.3.

The following checks shall be carried out for welds made by each welding process used by the manufacturer in accordance with the value of the coefficient λ used in determining the thickness of the shell in 6.8.2.1.17:

$\lambda = 0.8$: All weld beads shall so far as possible be inspected visually on both faces and shall be subjected to non-destructive checks. The non-destructive checks shall include all weld "Tee" junctions, all inserts used to avoid welds crossing and all welds in the knuckle area of the tank ends. The total length of welds to be examined shall not be less than:

- 10% of the length of all the longitudinal welds,
- 10% of the length of all the circumferential welds,
- 10% of the length of all the circumferential welds in the tank ends, and
- 10% of the length of all the radial welds in the tank ends.

$\lambda = 0.9$: All weld beads shall so far as possible be inspected visually on both faces and shall be subjected to non-destructive checks. The non-destructive checks shall include all connections, all inserts used to avoid welds crossing, all welds in the knuckle area of the tank ends and all welds for the assembly of large-diameter items of equipment. The total length of welds to be examined shall not be less than:

- 100% of the length of all the longitudinal welds,
- 25% of the length of all the circumferential welds,
- 25% of the length of all the circumferential welds in the tank ends, and
- 25% of the length of all the radial welds in the tank ends.

$\lambda = 1$: All weld beads throughout their length shall be subjected to non-destructive checks and shall so far as possible be inspected visually on both faces. A weld test-piece shall be taken.

The non-destructive checks of the circumferential, longitudinal and radial welds shall be carried out by radiography or by ultrasound. Other welds allowed in the appropriate design and construction standard shall be tested using alternative methods in accordance with the relevant standard(s) referenced in 6.8.2.6.2. The checks shall confirm that the quality of the welding is appropriate to the stresses.

In the cases of either $\lambda = 0.8$ or $\lambda = 0.9$, when the presence of an unacceptable defect is detected in a portion of a weld, the non-destructive checks shall be extended to a portion of equal length on both sides of the portion that contains the defect. If the non-destructive checks detect an additional defect that is unacceptable, non-destructive checks shall be extended to all remaining welds of the same type of welding process.

Welds made during repairs or alterations shall be assessed as above and in accordance with the non-destructive tests specified in the relevant standard(s) referenced in 6.8.2.6.2.

Where there are doubts regarding the quality of welds, including the welds made to repair any defects revealed by the non-destructive checks, additional checks of the welds may be required.

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 60 °C are fitted with non-metallic protective linings (inner layers), the shells and the protective linings shall be so designed that no danger of ignition from electrostatic charges can occur. | |
| 6.8.2.1.27 | All parts of tank-wagons intended for the carriage of liquids having a flash-point of not more than 60 °C and for the carriage of flammable gases, or of UN 1361 carbon or UN 1361 carbon black, packing group II, shall be linked to the chassis by means of electrical connection and shall be capable of being electrically earthed. Any metal contact capable of causing electrochemical corrosion shall be avoided. | All parts of a tank-container intended for the carriage of liquids having a flash-point of not more than 60 °C, flammable gases, or UN 1361 carbon or UN 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 | (Reserved) | |
| 6.8.2.1.29 | The minimum distance between the headstock plane and the most protruding point at the shell extremity on tank-wagons shall be 300 mm.

Alternatively for tank-wagons for substances other than those for which the requirements of special provision TE 25 of 6.8.4 (b) apply, buffer override protection of a design approved by the competent authority shall be provided. This alternative is only applicable to tank-wagons used solely on railway infrastructure requiring a freight vehicle gauge smaller than G1 ⁷ . | (Reserved) |

⁷ The G1 gauge is referenced in Annex A to standard EN 15273-2:2013 Railway applications – Gauges – Part 2: Rolling stock gauge.

6.8.2.2 Items of equipment**6.8.2.2.1** Suitable non-metallic materials may be used to manufacture service and structural equipment.

Welded elements shall be attached to the shell in such a way that tearing of the shell is prevented. This can be achieved, for example, through the following measures:

- Underframe connection: securing by means of a pad ensuring distribution of dynamic loads;
- Supports for upper gangway, access ladder, drainage pipes, valve control mechanisms and other load transmission brackets: securing by means of weld-on reinforcement plate;
- Appropriate dimensioning or other protective measures (e.g. designated breaking point).

Welded elements shall be attached to the shell in such a way that tearing of the shell is prevented.

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.

Piping shall be designed, constructed and installed so as to avoid the risk of damage due to thermal expansion and contraction, mechanical shock and vibration.

The leakproofness of the service equipment shall be ensured even in the event of the overturning of the tank-wagon or 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. This closing device shall be sufficiently tight so that the substance is contained without loss. Measures shall be taken to enable the safe release of pressure in the discharge pipe before the closing device is completely removed.

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 4.3.3.1.1 or 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 device⁸, one at the end of each pipe and | 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. This closing device shall be sufficiently tight so that the substance is contained without loss. Measures shall be taken to enable the safe release of pressure in the discharge pipe before the closing device is completely removed.

However, in the case of tanks intended for the carriage of certain crystallizable or highly viscous substances and shells fitted with a protective lining, 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

⁸ In the case of tank-containers of less than 1 m³ capacity, the external stop-valve or other equivalent device may be replaced by a blank flange.

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 (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.⁹

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.

6.8.2.2.3

Tanks that are not hermetically closed may be fitted with vacuum valves or with self-operating ventilation valves

to avoid an unacceptable negative internal pressure; these valves shall be set to relieve at a vacuum setting not greater than the vacuum pressure for which the tank has been designed (see 6.8.2.1.7). Hermetically closed tanks shall not be fitted with vacuum valves or with self-operating ventilation valves.

However, tanks of the tank code SGAH, S4AH or L4BH, fitted with these valves which open at a negative pressure of not less than 21 kPa (0.21 bar) shall be considered as being hermetically closed. For tanks intended for the carriage of solid substances (powdery or granular) of packing group II or III only, which do not liquefy during transport, the negative pressure may be reduced to not less than 5 kPa (0.05 bar).

Vacuum valves

and self-operating ventilation valves

and breather devices (see 6.8.2.2.6) used on tanks intended for the carriage of substances meeting the flash-point criteria of Class 3, shall prevent the immediate passage of flame into the shell by means of a suitable protective device, or the shell of the tank shall be explosion pressure shock resistant, which means being capable of withstanding without leakage, but allowing deformation, an explosion resulting from the passage of the flame.

If the protective device consists of a suitable flame trap or flame arrester, it shall be positioned as close as possible to the shell or the shell compartment. For multi-compartment tanks, each compartment shall be protected separately.

Flame arresters for breather devices shall be suitable for the vapour emitted by the substances carried (maximum experimental safety gap – MESG), temperature range and application. They shall meet the requirements and tests of EN ISO 16852:2016 (Flame arresters – Performance requirements, test methods and limits for use) for the situations given in the Table below:

Application/Installation	Testing requirements
Direct communication with atmosphere	EN ISO 16852:2016, 7.3.2.1
Communication to pipe work system	EN ISO 16852:2016, 7.3.3.2 (applies to valve/flame arrester combinations when tested together)
	EN ISO 16852:2016, 7.3.3.3 (applies to flame arresters tested independently of the valves)

For tanks with self-operating ventilation valves, the connection between the self-operating ventilation valve and the bottom valve shall be so arranged that the valves do not open in the event of deformation of the tank or the contents cannot escape in the event of their opening.

⁹ The mode of operation of dry break couplings is self-closing. Consequently, an open/closed indicator is not necessary. This type of closure shall only be used as a second or third closure.

- 6.8.2.2.4** The shell or each of its compartments shall be provided with an opening large enough to permit inspection. These openings shall be provided with closures designed for a test pressure of at least 0.4 MPa (4 bar). Hinged dome covers for tanks with a test pressure of more than 0.6 MPa (6 bar) shall not be permitted.
- These openings for extra-large tank-containers intended for the carriage of substances in the liquid state which are not divided by partitions or surge plates into sections of not more than 7 500 litres capacity shall be provided with closures designed for a test pressure of at least 0.4 MPa (4 bar).
- Hinged dome covers shall not be permitted for extra-large tank-containers with a test pressure of more than 0.6 MPa (6 bar).
- 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 breather device and a safety device to prevent the contents from spilling out if the tank 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) at 50 °C and a boiling point of more than 35 °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 boiling point of not more than 35 °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 closed¹⁰.
- 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 60 °C or for the carriage of flammable gases shall not be made of unprotected corrodible steel.
- 6.8.2.2.10** If tanks required to be hermetically closed are equipped with safety valves, these shall be preceded by a bursting disc, and the following conditions shall be observed:
- Except for tanks intended for the carriage of compressed, liquefied or dissolved gases where the arrangement of the bursting disc and safety valve satisfy the requirements of 6.8.3.2.9, burst pressures of the bursting disc shall satisfy the following requirements:
- the minimum burst pressure at 20 °C, tolerances included, shall be greater than or equal to 0.8 times the test pressure,
 - the maximum burst pressure at 20 °C, tolerances included, shall be less than or equal to 1.1 times the test pressure, and
 - the burst pressure at the maximum service temperature shall be greater than the maximum working pressure.
- 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.
- 6.8.2.2.11** Level-gauges shall neither be part of, nor fitted to shells, if they incorporate transparent material which can, at any time, come into direct contact with the substance carried in the shell.
- 6.8.2.3** **Type examination and type approval**
- 6.8.2.3.1** *Type examination*
- The provisions in 1.8.7.2.1 shall be applied.
- A manufacturer of service equipment for which a standard is listed in the table in 6.8.2.6.1 or 6.8.3.6 may request a separate type examination. This separate type examination shall be taken into account during the type examination of the tank.

¹⁰ For the definition of "hermetically closed tank" see 1.2.1.

6.8.2.3.2 *Type approval*

The competent authority shall issue in respect of each new type of tank-wagon, tank-container, tank swap body, battery-wagon or MEGC a certificate attesting that the type, including fastenings, which has been examined, 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 in addition to the items listed in 1.8.7.2.2.1:

- an approval number for the type which shall consist of the distinguishing sign used on vehicles in international road traffic¹¹ 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;
- the alphanumeric codes of special provisions of construction (TC), equipment (TE) and type approval (TA) of 6.8.4 which are shown in column (13) of Table A of Chapter 3.2 for those substances for the carriage of which the tank has been approved;
- if required, 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 (see 2.1.1.2), 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.

NOTE: Annex B of EN 12972:2018 + A1:2024 describing the type as well as the list of authorized service equipment for the tank type, or equivalent documents shall be attached to or included in the certificate.

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.

A copy of the certificate shall be attached to the tank record of each tank, battery-wagon or MEGC constructed (see 4.3.2.1.7).

When the manufacturer of service equipment had a separate type examination carried out and when the manufacturer requests it, the competent authority shall issue a certificate attesting that the type which has been examined meets the standard listed in the table in 6.8.2.6.1 or 6.8.3.6.

6.8.2.3.3 If the tanks, battery-wagons or MEGCs are manufactured in series without modification this approval shall be valid for the tanks, battery-wagons or MEGCs 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 shell thickness, more surge-plates, decreased diameter of openings). The limited variations shall be clearly described in the type approval certificate.

6.8.2.3.4 In accordance with 1.8.7.2.2.3, the competent authority shall issue a supplementary approval certificate for the modification in the case of a modification of a tank, battery-wagon or MEGC with a valid, expired or withdrawn type approval.

6.8.2.4 **Inspections and tests**

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 type;
- a check of the design characteristics¹²;
- an examination of the internal and external conditions;

¹¹ Distinguishing sign of the State of registration used on motor vehicles and trailers in international road traffic, e.g. in accordance with the Geneva Convention on Road Traffic of 1949 or the Vienna Convention on Road Traffic of 1968.

¹² 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.

- a hydraulic pressure test¹³ at the test pressure indicated on the plate prescribed in 6.8.2.5.1; and
- a leakproofness test and a check of satisfactory operation of the equipment.

Except in the case of Class 2, the test pressure for the hydraulic pressure test depends on the calculation pressure and shall be at least equal to the pressure indicated below:

Calculation pressure (bar)	Test pressure (bar)
G ¹⁴	G ¹⁴
1.5	1.5
2.65	2.65
4	4
10	4
15	4
21	10 (4 ¹⁵)

The minimum test pressures for Class 2 are given in the table of gases and gas mixtures in 4.3.3.2.5.

The hydraulic pressure test shall be carried out on the shell as a whole and separately on each compartment of compartmented shells.

The hydraulic pressure test shall be carried out before the installation of a thermal insulation 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.

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

6.8.2.4.2 Shells and their equipment shall undergo periodic inspections no later than every
eight years. | five years.

These periodic inspections shall include:

- An external and internal examination;
- A leakproofness test in accordance with 6.8.2.4.3 of the shell with its equipment and check of the satisfactory operation of all the equipment;
- As a general rule, a hydraulic pressure test¹³ (for the test pressure for the shells and compartments if applicable, see 6.8.2.4.1).

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 tanks intended for the carriage of powdery or granular substances, and with the agreement of the inspection body, the periodic hydraulic pressure tests may be omitted and replaced by leakproofness tests in accordance with 6.8.2.4.3, at an effective internal pressure at least equal to the maximum working pressure.

Protective linings shall be visually examined for defects. In case defects appear the condition of the lining shall be evaluated by appropriate test(s).

6.8.2.4.3 Shells and their equipment shall undergo intermediate inspections no later than
four years | two and a half years
after the initial inspection and each periodic inspection.

However, the intermediate inspection may be performed at any time before the specified date.

If an intermediate inspection is performed more than three months before the specified date, another intermediate inspection shall be performed no later than
four years | two and a half years
after this earlier date or alternatively a periodic inspection may be performed in accordance with 6.8.2.4.2.

¹³ In special cases, if agreed by the competent authority, the hydraulic pressure test may be replaced by a pressure test using gas, or if agreed by the inspection body, by using another liquid, where such an operation does not present any danger.

¹⁴ G = minimum calculation pressure according to the general requirements of 6.8.2.1.14 (see 4.3.4.1).

¹⁵ Minimum test pressure for UN 1744 bromine or UN 1744 bromine solution.

These intermediate inspections shall include a leakproofness test of the shell with its equipment and check of the satisfactory operation of all the equipment. For this purpose the tank shall be subjected to an effective internal pressure at least equal to the maximum working pressure. For tanks intended for the carriage of liquids or solids in the granular or powdery state, when a gas is used for the leakproofness test it shall be carried out at a pressure at least equal to 25% of the maximum working pressure. In all cases, it shall not be less than 20 kPa (0.2 bar) (gauge pressure).

For tanks equipped with breather devices and a safety device to prevent the contents spilling out if the tank overturns, the leakproofness test shall be carried out at a pressure at least equal to the static pressure of the densest substance to be carried, the static pressure of water or 20 kPa (0.2 bar), whichever is the highest.

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

Protective linings shall be visually examined for defects. In case defects appear the condition of the lining shall be evaluated by appropriate test(s).

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 inspection shall be carried out. If an exceptional inspection fulfilling the requirements of 6.8.2.4.2 has been performed, then the exceptional inspection may be considered to be a periodic inspection. If an exceptional inspection fulfilling the requirements of 6.8.2.4.3 has been performed then the exceptional inspection may be considered to be an intermediate inspection.

6.8.2.4.5 Certificates shall be issued by the inspection body referred to in 6.8.1.5.4 or 6.8.1.5.6 and shall show the results of the inspections in accordance with 6.8.2.4.1 to 6.8.2.4.4, even in the case of negative results. These certificates shall refer to the list of the substances permitted for carriage in this tank or to the tank code and the alphanumeric codes of special provisions in accordance with 6.8.2.3.2.

A copy of these certificates shall be attached to the tank record of each tank, battery-wagon or MEGC tested (see 4.3.2.1.7).

6.8.2.4.6 (Deleted)

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:

- approval number;
- manufacturer's name or mark;
- manufacturer's serial number;
- year of manufacture;
- test pressure (gauge pressure)¹⁶;
- external design pressure (see 6.8.2.1.7)¹⁶;
- capacity of the shell¹⁶ – in the case of multiple-compartment shells, the capacity of each compartment¹⁶

followed by the symbol "S" when the shells or the compartments of more than 7 500 litres are divided by surge plates into sections of not more than 7 500 litres capacity;

- design temperature (only if above +50 °C or below -20 °C)¹⁶;
- date and type of the most recent inspection: "month, year" followed by a "P" when the inspection is the initial inspection or a periodic inspection in accordance with 6.8.2.4.1 and 6.8.2.4.2, or "month, year" followed by an "L" when the inspection is an intermediate inspection in accordance with 6.8.2.4.3;
- stamp of the inspection body that carried out the inspection;
- material of the shell and reference to materials standards, if available and, where appropriate, the protective lining.

In addition, the maximum working pressure¹⁶ shall be inscribed on pressure-filled or pressure-discharge tanks (for Class 2, see 6.8.3.5).

¹⁶ Add the units of measurement after the numerical values.

6.8.2.5.2

The following particulars shall be inscribed on both sides of the tank-wagon (on the tank itself or on panels):

- vehicle keeper mark or name of operator¹⁷;
- capacity¹⁶;
- unladen mass of tank-wagon¹⁶;
- load limits according to the characteristics of the wagon and the nature of the lines used;
- for the substances according to 4.3.4.1.3, the proper shipping name of the substance(s) accepted for carriage;
- tank code according to 4.3.4.1.1;
- for substances other than those according to 4.3.4.1.3, the alphanumeric codes of all special provisions TC and TE which are shown in column (13) of Table A of Chapter 3.2 for the substances to be carried in the tank; and
- date (month, year) of the next inspection in accordance with 6.8.2.4.2 and 6.8.2.4.3 or with the TT special provisions of 6.8.4 for the substance(s) accepted for carriage. If the next inspection is an inspection in accordance with 6.8.2.4.3, the date shall be followed by the letter "L".

The following particulars shall be inscribed on the tank-container (on the tank itself or on panels):

- names of owner and of operator;
- capacity of the shell¹⁶;
- tare¹⁶;
- maximum permissible gross mass¹⁶;
- for the substances according to 4.3.4.1.3, the proper shipping name of the substance(s) accepted for carriage;
- tank code according to 4.3.4.1.1; and
- for substances other than those according to 4.3.4.1.3, the alphanumeric codes of all special provisions TC and TE which are shown in column (13) of Table A of Chapter 3.2 for the substances to be carried in the tank.

6.8.2.6

Requirements for tanks which are designed, constructed, inspected and tested according to referenced standards

NOTE: Persons or bodies identified in standards as having responsibilities in accordance with RID shall meet the requirements of RID.

6.8.2.6.1

Design and construction

Since 1 January 2009 the use of the referenced standards has been mandatory. Exceptions are dealt with in 6.8.2.7 and 6.8.3.7.

Type approval certificates shall be issued in accordance with 1.8.7 and 6.8.2.3. For the issuance of a type approval certificate, one standard applicable according to the indication in column (4) shall be chosen from the table below. If more than one standard may be applied, only one of them shall be chosen.

Column (3) shows the paragraphs of Chapter 6.8 to which the standard conforms.

Column (5) gives the latest date when existing type approvals shall be withdrawn according to 1.8.7.2.2.2; if no date is shown the type approval remains valid until it expires.

Standards shall be applied in accordance with 1.1.5. They shall be applied in full, unless otherwise specified in the table below.

The scope of application of each standard is defined in the scope clause of the standard unless otherwise specified in the table below.

Reference	Title of document	Requirements the standard complies with	Applicable to new type approvals or to renewals	Latest date for withdrawal of existing type approvals
(1)	(2)	(3)	(4)	(5)
For design and construction of tanks				
EN 14025:2003 + AC:2005	Tanks for the transport of dangerous goods – Metallic pressure tanks – Design and construction	6.8.2.1	Between 1 January 2005 and 30 June 2009	

¹⁷ Vehicle keeper marking in accordance with the Uniform Technical Prescription applicable to Vehicle Numbers and linked alphabetical marking on the bodywork (UTP Marking) and in accordance with the corresponding European Union legislation.

Reference	Title of document	Requirements the standard complies with	Applicable to new type approvals or to renewals	Latest date for withdrawal of existing type approvals
(1)	(2)	(3)	(4)	(5)
EN 14025:2008	Tanks for the transport of dangerous goods – Metallic pressure tanks – Design and construction	6.8.2.1 and 6.8.3.1	Between 1 July 2009 and 31 December 2016	
EN 14025:2013	Tanks for the transport of dangerous goods – Metallic pressure tanks – Design and construction	6.8.2.1 and 6.8.3.1	Between 1 January 2015 and 31 December 2018	
EN 14025:2013+ A1:2016 (except Annex B)	Tanks for the transport of dangerous goods – Metallic pressure tanks – Design and construction	6.8.2.1 and 6.8.3.1	Between 1 January 2017 and 31 December 2021	
EN 14025:2018 + AC:2020	Tanks for the transport of dangerous goods – Metallic pressure tanks – Design and construction NOTE: Materials of shells shall at least be attested by a type 3.1 certificate issued in accordance with standard EN 10204.	6.8.2.1 and 6.8.3.1	Between 1 January 2021 and 31 December 2026	
EN 14025:2023	Tanks for the transport of dangerous goods – Metallic pressure tanks – Design and construction NOTE: Materials of shells shall at least be attested by a type 3.1 certificate issued in accordance with standard EN 10204.	6.8.2.1 and 6.8.3.1	Until further notice	
EN 13094:2004	Tanks for the transport of dangerous goods – Metallic tanks with a working pressure not exceeding 0.5 bar – Design and construction	6.8.2.1	Between 1 January 2005 and 31 December 2009	
EN 13094:2008 + AC:2008	Tanks for the transport of dangerous goods – Metallic tanks with a working pressure not exceeding 0.5 bar – Design and construction	6.8.2.1	Between 1 January 2010 and 31 December 2018	
EN 13094:2015	Tanks for the transport of dangerous goods – Metallic tanks with a working pressure not exceeding 0.5 bar – Design and construction NOTE: The guideline on the OTIF website (https://otif.org/en/?page_id=1105) also applies.	6.8.2.1	Between 1 January 2017 and 31 December 2024	
EN 13094:2020 + A1:2022	Tanks for the transport of dangerous goods – Metallic gravity-discharge – Design and construction	6.8.2.1	Until further notice	
For equipment				
EN 14432:2006	Tanks for the transport of dangerous goods – Tank equipment for the transport of liquid chemicals – Product discharge and air inlet valves	6.8.2.2.1	Between 1 January 2009 and 31 December 2018	

Reference	Title of document	Requirements the standard complies with	Applicable to new type approvals or to renewals	Latest date for withdrawal of existing type approvals
(1)	(2)	(3)	(4)	(5)
EN 14432:2014	Tanks for the transport of dangerous goods – Tank equipment for the transport of liquid chemicals and liquefied gases – Product discharge and air inlet valves NOTE: This standard may also be used for gravity-discharge tanks.	6.8.2.2.1, 6.8.2.2.2 and 6.8.2.3.1	Between 1 January 2019 and 31 December 2026	
EN 14432:2023	Tanks for the transport of dangerous goods – Tank equipment for the transport of liquid chemicals and liquefied gases – Product discharge and air inlet valves NOTE: This standard may also be used for gravity discharge tanks.	6.8.2.2.1, 6.8.2.2.2 and 6.8.2.3.1	Until further notice	
EN 14433:2006	Tanks for the transport of dangerous goods – Tank equipment for the transport of liquid chemicals – Foot valves	6.8.2.2.1	Between 1 January 2009 and 31 December 2018	
EN 14433:2014	Tanks for the transport of dangerous goods – Tank equipment for the transport of liquid chemicals and liquefied gases – Foot valves NOTE: This standard may also be used for gravity-discharge tanks.	6.8.2.2.1, 6.8.2.2.2 and 6.8.2.3.1	Between 1 January 2019 and 31 December 2026	
EN 14433:2023	Tanks for the transport of dangerous goods – Tank equipment for the transport of liquid chemicals and liquefied gases – Foot valves NOTE: This standard may also be used for gravity discharge tanks.	6.8.2.2.1, 6.8.2.2.2 and 6.8.2.3.1	Until further notice	
EN ISO 23826:2021	Gas cylinders – Ball valves – Specification and testing	6.8.2.1.1 and 6.8.2.2.1	Mandatorily from 1 January 2025	
EN 13799:2022	LPG equipment and accessories – Contents gauges for Liquefied Petroleum Gas (LPG) pressure vessels	6.8.2.2.1 and 6.8.2.2.11	Until further notice	

6.8.2.6.2 Type examination, inspection and test

The use of a referenced standard is mandatory.

One standard applicable according to the indication in column (4) shall be chosen from the table below for the type examination and the inspection and test of tanks.

Column (3) shows the paragraphs of Chapter 6.8 to which the standard conforms.

The standards shall be applied in accordance with 1.1.5.

The scope of application of each standard is defined in the scope clause of the standard unless otherwise indicated in the table below.

Reference	Title of document	Requirements the standard complies with	Applicable
(1)	(2)	(3)	(4)
EN 12972:2018	Tanks for transport of dangerous goods – Testing, inspection and marking of metallic tanks	6.8.2.1.23, 6.8.2.3, 6.8.2.4, 6.8.3.4	Until 31 December 2026
EN 12972:2018 + A1:2024	Tanks for transport of dangerous goods – Testing, inspection and marking of metallic tanks	6.8.2.1.23, 6.8.2.3, 6.8.2.4 and 6.8.3.4	Until further notice

6.8.2.7 Requirements for tanks which are not designed, constructed, inspected and tested according to referenced standards

To reflect scientific and technical progress or where no standard is referenced in 6.8.2.6 or to deal with specific aspects not addressed in a standard referenced in 6.8.2.6, the competent authority may recognize the use of a technical code providing the same level of safety. Tanks shall, however, comply with the minimum requirements of 6.8.2.

As soon as a standard newly referenced in 6.8.2.6 can be applied, the competent authority shall withdraw its recognition of the relevant technical code. A transitional period ending no later than the date of entry into force of the next edition of RID may be applied.

The competent authority shall transmit to the secretariat of OTIF a list of the technical codes that it recognises and shall update the list if it changes. The list should include the following details: name and date of the code, purpose of the code and details of where it may be obtained. The secretariat shall make this information publicly available on its website.

A standard which has been adopted for reference in a future edition of the RID may be approved by the competent authority for use without notifying the OTIF secretariat.

For testing, inspection and marking, the applicable standard as referenced in 6.8.2.6 may also be used.

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 dissolved gases 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:

- When the ratio R_e/R_m (of the minimum guaranteed characteristics after heat treatment) is higher than 0.66 without exceeding 0.85: $\sigma \leq 0.75 R_e$.
- When the ratio R_e/R_m (of the minimum guaranteed characteristics after heat treatment) is higher than 0.85: $\sigma \leq 0.5 R_m$.

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

If other metals are used, an equivalent minimum wall thickness shall be maintained; this thickness is to be calculated according to the formula in footnote 6 to 6.8.2.1.18, where $R_{m0} = 490 \text{ N/mm}^2$ and $A_0 = 30\%$.

The outer shell shall 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

(Reserved)

shall be calculated according to the formula given in
6.8.2.1.18.

Construction of battery-wagons and MEGCs

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

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

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

3: Demountable tanks¹⁸ are not to be considered elements of battery-wagons or MEGCs.

6.8.3.1.5 Elements and their fastenings of battery wagons and the frame of MEGCs 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 6.2.5.3 for cylinders, tubes, pressure drums and bundles of cylinders and for tanks the value of σ defined in 6.8.2.1.16.

Other provisions for the construction of tank-wagons and battery-wagons

6.8.3.1.6 Tank-wagons and battery-wagons shall be fitted with buffers with a minimum energy absorption capacity of 70 kJ. This provision does not apply to tank-wagons and battery-wagons fitted with energy absorption elements in accordance with the definition in 6.8.4, special provision TE 22. (Reserved)

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, manometers and with bleed holes, as required for their operation and safety.

6.8.3.2.3 The internal stop-valve of all filling and all discharge openings of tanks intended for the carriage of liquefied flammable or toxic gases shall be instant-closing and shall close automatically in the event of an unintended movement of the tank or in the event of fire. It shall also be possible to operate the internal stop-valve by remote control.

The device which keeps the internal closure open, e.g. a rail hook, is not a component of the wagon.

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, shall be equipped with an internal shut-off device.

6.8.3.2.5 Notwithstanding the requirements of 6.8.2.2.2, 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 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.

¹⁸ For the definition of "demountable tank" see 1.2.1.

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 or dissolved gases may be fitted with safety valves.	Tanks intended for the carriage of flammable liquefied gases shall be fitted with safety valves. Tanks intended for the carriage of compressed gases, non-flammable liquefied gases or dissolved gases may be fitted with safety valves.
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Safety valves, where fitted, shall meet the requirements of 6.8.3.2.9.1 to 6.8.3.2.9.5.

6.8.3.2.9.1 Safety valves shall be capable of opening automatically under a pressure between 0.9 and 1.0 times the test pressure of the tank to which they are fitted. They shall be of such a type as to resist dynamic stresses, including liquid surge. The use of dead weight or counterweight valves is prohibited. The required capacity of the safety valves shall be calculated in accordance with the formula contained in 6.7.3.8.1.1 and the safety valve shall conform at least to the requirements of 6.7.3.9.

Safety valves shall be designed to prevent or be protected from the entry of water or other foreign matter which may impair their correct functioning. Any protection shall not impair their performance.

6.8.3.2.9.2 If tanks required to be hermetically closed are equipped with safety valves, these shall be preceded by a bursting disc and the following conditions shall be met:

- (a) The minimum burst pressure at 20 °C, tolerances included, shall be greater than or equal to 1.0 times the test pressure;
- (b) The maximum burst pressure at 20 °C, tolerances included, shall be equal to 1.1 times the test pressure; and
- (c) The bursting disc shall not reduce the required discharge capacity or correct operation of the safety valve.

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.

6.8.3.2.9.3 Safety valves shall be directly connected to the shell or directly connected to the outlet of the bursting disc.

6.8.3.2.9.4 Each safety valve inlet shall be situated on top of the shell as close as practicable to the top generating line. All safety valve inlets shall, under maximum filling conditions, be situated in the vapour space of the shell and the devices shall be so arranged as to ensure that the escaping vapour is discharged unrestrictedly. For flammable liquefied gases, the escaping vapour shall be directed away from the shell in such a manner that it cannot impinge upon the shell. Protective devices which deflect the flow of vapour are permissible provided the required safety valve capacity is not reduced.

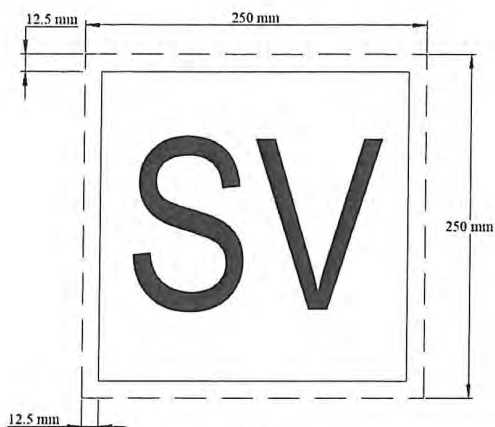
6.8.3.2.9.5 Arrangements shall be made to protect the safety valves from damage caused by the tank overturning or striking overhead obstacles. Where possible, safety valves shall not project outside of the profile of the shell.

6.8.3.2.9.6 Safety valve mark

6.8.3.2.9.6.1 Tanks fitted with safety valves in accordance with 6.8.3.2.9.1 to 6.8.3.2.9.5 shall display the mark as set out in 6.8.3.2.9.6.3 to 6.8.3.2.9.6.6.

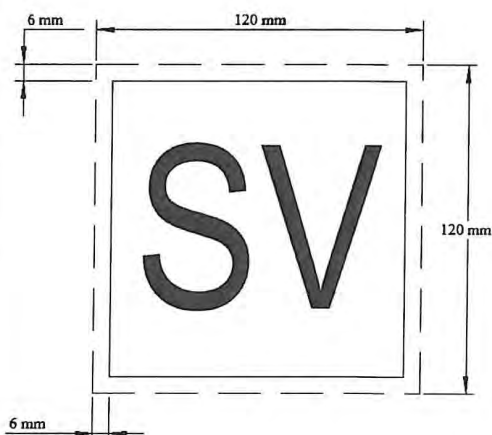
6.8.3.2.9.6.2 Tanks not fitted with safety valves in accordance with 6.8.3.2.9.1 to 6.8.3.2.9.5 shall not display the mark as set out in 6.8.3.2.9.6.3 to 6.8.3.2.9.6.6.

6.8.3.2.9.6.3 The mark shall consist of a white square with minimum dimensions of 250 mm × 250 mm. The line inside the edge shall be black, parallel and approximately 12.5 mm from the outside of that line to the outside edge of the mark. The letters "SV" shall be black, a minimum of 120 mm high and have a minimum stroke thickness of 12 mm.



6.8.3.2.9.6.4 (Reserved)

For tank-containers with a capacity of not more than 3 000 litres the mark may be reduced in size to not less than 120 mm × 120 mm. The line inside the edge shall be black, parallel and approximately 6 mm from the outside of that line to the outside edge of the mark. The letters "SV" shall be black, a minimum of 60 mm high and have a minimum stroke thickness of 6 mm.



- 6.8.3.2.9.6.5** The material used shall be weather-resistant and it shall be ensured that the mark is durable. The mark shall not become detached from its mount in the event of 15 minutes' engulfment in fire. It shall remain affixed irrespective of the orientation of the tank.
- 6.8.3.2.9.6.6** The letters "SV" shall be indelible and shall remain legible after 15 minutes' engulfment in fire.
- 6.8.3.2.9.6.7** The marks shall be displayed on both sides of tank-wagons.
- The marks shall be displayed on both sides and both ends of tank-containers. For tank-containers with a capacity of not more than 3 000 litres the marks may be displayed either on both sides or on both ends.
- 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 or more independent safety valves capable of opening at the maximum working pressure indicated on the tank. Two of these safety valves shall be individually sized 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 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 combination of the pressure relief devices shall permit an outflow such that the pressure in the shell cannot exceed the test pressure. The provisions of 6.8.2.1.7 shall not apply to vacuum-insulated tanks.

- 6.8.3.2.12** These pressure relief devices of tanks intended for the carriage of refrigerated liquefied gases 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 device or by testing a specimen device of each design-type.

- | | | |
|-------------------|--|------------|
| 6.8.3.2.13 | For demountable tanks ¹⁸ the following requirements shall apply: | (Reserved) |
| | (a) if they can be rolled, the valves shall be provided with protective caps; | |
| | (b) they shall be so fixed on the underframe of the wagon that they cannot move. | |

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. For type testing of the effectiveness of the insulation system, see 6.8.3.4.11.

- 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-wagons and MEGCs

- 6.8.3.2.18** Service and structural equipment shall be configured or designed to prevent damage that could result in the release of the pressure receptacle contents during normal conditions of handling and carriage. When the connection between the frame of the battery-wagon or MEGC and the elements allows relative movement between the sub-assemblies, the equipment shall be so fastened as to permit such movement without damage to working parts. Manifold piping leading to shut-off valves shall be sufficiently flexible to protect the valves and the piping from shearing, or releasing the pressure receptacle contents. The filling and discharge devices (including flanges or threaded plugs) and any protective caps shall be capable of being secured against unintended opening.

- 6.8.3.2.19** In order to avoid any loss of content in the event of damage, the manifolds, the discharge fittings (pipe sockets, shut-off devices), and the stop-valves shall be protected or arranged from being wrenched off by external forces or designed to withstand them.

- 6.8.3.2.20** 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 525 °C. The joints shall not decrease the strength of tubing as may happen when cutting threads.

- 6.8.3.2.21** Except for UN 1001 acetylene, dissolved, the permissible maximum stress σ of the manifolding arrangement at the test pressure of the receptacles shall not exceed 75% of the guaranteed yield strength of the material.
- The necessary wall thickness of the manifolding arrangement for the carriage of UN 1001 acetylene, dissolved shall be calculated according to an approved code of practice.
- NOTE:** For the yield strength, see 6.8.2.1.11.
- 6.8.3.2.22** 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-wagon or MEGC, the required closing devices may be provided for within the manifolding arrangement.
- 6.8.3.2.23** 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.
- 6.8.3.2.24** The filling and discharge devices may be affixed to a manifold.
- 6.8.3.2.25** 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.
- 6.8.3.2.26** Battery-wagons or MEGCs intended for the carriage of toxic gases shall not have safety valves, unless the safety valves are preceded by a bursting disc. In the latter case, the arrangement of the bursting disc and safety valve shall be satisfactory to the competent authority.
- 6.8.3.2.27** When battery-wagons or MEGCs are intended for carriage by sea, the requirements of 6.8.3.2.26 shall not prohibit the fitting of safety valves conforming to the IMDG Code.
- 6.8.3.2.28** Receptacles which are elements of a battery-wagon or MEGC intended for the carriage of flammable gases shall be combined in groups of not more than 5 000 litres which are capable of being isolated by a shut-off valve.
- Each element of a battery-wagon 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 examination and type approval**
- No special requirements.
- 6.8.3.4 Inspections and 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-wagon 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. When the shell, its fittings, piping and items of equipment have been tested separately, the tank shall be subjected to a leakproofness test after assembly.
- 6.8.3.4.4** The capacity of each shell intended for the carriage of compressed gases filled by mass, liquefied gases or dissolved gases shall be determined, under the supervision of an inspection body, 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 P 200 or P 203 in 4.1.4.1 as well as 4.3.3.2.2 and 4.3.3.2.3 shall be prescribed by an inspection body.
- 6.8.3.4.5** Checking of the welds shall be carried out in accordance with the $\lambda=1$ requirements of 6.8.2.1.23.
- 6.8.3.4.6** For tanks intended for the carriage of refrigerated liquefied gases:
- (a) By derogation from the requirements of 6.8.2.4.2, the periodic inspections shall be performed no later than eight years after the initial inspection and thereafter no later than every 12 years;
 - (b) By derogation from the requirements of 6.8.2.4.3, the intermediate inspections shall be performed no later than six years after each periodic inspection.
- 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 inspection body, 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 inspection body and shall ensure the integrity of the shell.

6.8.3.4.9 Leakproofness tests of tanks intended for the carriage of gases shall be performed at a pressure of not less than:

- For compressed gases, liquefied gases and dissolved gases: 20% of the test pressure;
- For refrigerated liquefied gases: 90% of the maximum working pressure.

Holding times for tanks carrying refrigerated liquefied gases

6.8.3.4.10 The reference holding time for tanks carrying refrigerated liquefied gases shall be determined on the basis of the following:

- (a) The effectiveness of the insulation system, determined in accordance with 6.8.3.4.11;
- (b) The lowest set pressure of the pressure limiting device(s);
- (c) The initial filling conditions;
- (d) An assumed ambient temperature of 30 °C;
- (e) The physical properties of the individual refrigerated liquefied gas intended to be carried.

6.8.3.4.11 The effectiveness of the insulation system (heat influx in Watts) shall be determined by type testing the tanks. This test shall consist of either:

- (a) A constant pressure test (for example at atmospheric pressure) during which the loss of refrigerated liquefied gas is measured over a period of time; or
- (b) A closed system test during which the rise in pressure in the shell is measured over a period of time.

When performing the constant pressure test, variations in atmospheric pressure shall be taken into account. When performing either test corrections shall be made for any variation of the ambient temperature from the assumed ambient temperature reference value of 30 °C.

NOTE: ISO 21014:2006 "Cryogenic vessels – Cryogenic insulation performance" details methods of determining the insulation performance of cryogenic vessels and provides a method of calculating the holding time.

Inspections and tests for battery-wagons and MEGCs

6.8.3.4.12 The elements and items of equipment of each battery-wagon 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-wagons or MEGCs the elements of which are receptacles shall be inspected at not more than five-year intervals. Battery-wagons and MEGCs the elements of which are tanks shall be inspected according to 6.8.2.4.2 and 6.8.2.4.3. An exceptional inspection and test shall be performed regardless of the last periodic inspection and test when necessary according to 6.8.3.4.16.

6.8.3.4.13 The initial inspection shall include:

- a check of conformity to the approved type;
- a check of the design characteristics;
- an examination of the internal and external conditions;
- a hydraulic pressure test¹⁹ at the test pressure indicated on the plate prescribed in 6.8.3.5.10;
- a leakproofness test at the maximum 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.

6.8.3.4.14 Cylinders, tubes and pressure drums and cylinders as part of bundles of cylinders shall be tested according to packing instruction P 200 or P 203 in 4.1.4.1.

The test pressure of the manifold of the battery-wagon or MEGC shall be the same as that of the elements of the battery-wagon 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. By derogation from this

¹⁹ In special cases, if agreed by the competent authority, the hydraulic pressure test may be replaced by a pressure test using gas, or if agreed by the inspection body, by using another liquid, where such an operation does not present any danger.

requirement, the test pressure for the manifold of battery-wagon or MEGC shall not be less than 300 bar for UN 1001 acetylene, dissolved.

6.8.3.4.15 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 P 200 of 4.1.4.1 and in accordance with the requirements of 6.2.1.6 and 6.2.3.5 respectively. When the elements and equipment have been pressure-tested separately, they shall be subjected together after assembly to a leakproofness test.

6.8.3.4.16 An exceptional inspection and test is necessary when the battery-wagon 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-wagon 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-wagon or MEGC. It shall include at least the examinations required under 6.8.3.4.17.

6.8.3.4.17 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-wagons 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-wagons 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 marks on the battery-wagons or MEGCs are legible and in accordance with the applicable requirements; and
- (f) Any framework, supports and arrangements for lifting the battery-wagons or MEGCs are in satisfactory condition.

6.8.3.4.18 The tests, inspections and checks in accordance with 6.8.3.4.12 to 6.8.3.4.17 shall be carried out by the inspection body. Certificates shall be issued showing the results of these operations, even in the case of negative results. These certificates shall refer to the list of the substances permitted for carriage in this battery-wagon or MEGC in accordance with 6.8.2.3.2.

A copy of these certificates shall be attached to the tank record of each tank, battery-wagon or MEGC tested (see 4.3.2.1.7).

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 name²⁰.

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

²⁰ Instead of the proper shipping name or, if applicable, of the proper shipping name of the n.o.s. entry followed by the technical name, the use of the following names is permitted:

- for UN 1078 refrigerant gas, n.o.s: mixture F1, mixture F2, mixture F3;
- for UN 1060 methylacetylene and propadiene mixtures, stabilized: mixture P1, mixture P2;
- for UN 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;
- for UN 1010 Butadienes, stabilized: 1,2-Butadiene, stabilized, 1,3-Butadiene, stabilized;
- for UN 1012 Butylene: 1-butylene, cis-2-butylene, trans-2-butylene, butylenes mixture.

- in the case of tanks intended for the carriage of compressed gases filled by mass, and of liquefied gases, refrigerated liquefied gases or dissolved gases 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 gases²⁰ 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 pressure²¹;
- reference holding time (in days or hours) for each gas²¹;
- the associated initial pressures (in bar gauge or kPa gauge)²¹.

6.8.3.5.5 On tanks equipped with thermal insulation:

- the inscription "thermally insulated" or "thermally insulated by vacuum".

6.8.3.5.6 In addition to the particulars prescribed in 6.8.2.5.2, the following shall be inscribed on both sides of the tank-wagon (on the tank itself or on the tank-container (on the tank itself or on panels):

- the tank code according to the certificate (see 6.8.2.3.2) with the actual test pressure of the tank;
- the inscription: "minimum filling temperature allowed: ...";
- 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 name²⁰;
 - for compressed gases which are filled by mass, and for liquefied gases, refrigerated liquefied gases or dissolved gases, the maximum permissible load mass in kg;
- 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 name²⁰ 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;
- 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, German or Italian, in English, French, German or Italian, unless any agreements concluded between the countries concerned in the transport operation provide otherwise.

6.8.3.5.7 The load limits in accordance with 6.8.2.5.2 (Reserved)

- for compressed gases filled by mass,
- for liquefied or refrigerated, liquefied gases and
- for dissolved gases,

shall be determined in the light of the maximum permissible load mass of the shell, depending on the substance carried; in the case of multi-purpose tanks and if folding panels are used, the name in full of the particular gas being carried shall be stated together with the load limit on the same folding panel. If such panels are used they shall be designed and be capable of being secured so that they cannot unfold or become loose from the frame during carriage (especially as a result of impacts or unintentional actions).

6.8.3.5.8 The panels on wagons carrying demountable tanks as referred to in 6.8.3.2.13 need not bear the particulars prescribed in 6.8.2.5.2 and 6.8.3.5.6. (Reserved)

²¹ Add the units of measurements after the numerical values.

6.8.3.5.9 (Reserved)

Marking of battery-wagons and MEGCs

6.8.3.5.10 Every battery-wagon 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)²¹;
- design temperature (only if above +50 °C or below -20 °C)²¹;
- date (month and year) of initial inspection and most recent periodic inspection in accordance with 6.8.3.4.12 to 6.8.3.4.15;
- stamp of the inspection body that carried out the inspection.

6.8.3.5.11 The following particulars shall be inscribed on both sides of the battery-wagon on a plate:

- vehicle keeper mark or name of operator²²;
- number of elements;
- total capacity of the elements²¹;
- load limits according to the characteristics of the wagon and the nature of the lines used;
- tank code according to the certificate (see 6.8.2.3.2) with the relevant test pressure for the battery-wagon;
- proper shipping name and, in addition, for gases covered by an n.o.s. entry, the technical name²⁰ of the gas the transport of which the battery-wagon is used;
- the date (month, year) of the next inspection in accordance with 6.8.2.4.3 and 6.8.3.4.15.

The following particulars shall be inscribed either on the MEGC itself or on a plate:

- names of owner and of operator;
- number of elements;
- total capacity of the elements²¹;
- maximum permissible laden mass²¹;
- tank code according to the certificate (see 6.8.2.3.2) with the relevant test pressure for the MEGC;
- proper shipping name and, in addition, for gases covered by an n.o.s. entry, the technical name²⁰ of the gas the transport of which the MEGC is used;

and for MEGCs filled by mass:

- tare²¹.

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

- the maximum filling pressure²¹ at 15 °C allowed for elements intended for compressed gases;
- 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 name²⁰;

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

- the permissible maximum load per element²¹.

6.8.3.5.13 Cylinders, tubes and pressure drums, and cylinders as part of bundles of cylinders, shall be marked according to 6.2.2.7. These receptacles need not be labelled individually with the danger labels as required in Chapter 5.2.

Battery-wagons and MEGCs shall be placarded and marked according to Chapter 5.3.

²² Vehicle keeper marking in accordance with the Uniform Technical Prescription applicable to Vehicle Numbers and linked alphabetical marking on the bodywork (UTP Marking) and in accordance with the corresponding European Union legislation.

6.8.3.6 Requirements for battery-wagons and MEGCs which are designed, constructed, inspected and tested according to referenced standards

NOTE: Persons or bodies identified in standards as having responsibilities in accordance with RID shall meet the requirements of RID.

Since 1 January 2009 the use of the referenced standards has been mandatory. Exceptions are dealt with in 6.8.3.7.

Type approval certificates shall be issued in accordance with 1.8.7 and 6.8.2.3. For the issuance of a type approval certificate, one standard applicable according to the indication in column (4) shall be chosen from the table below. If more than one standard may be applied, only one of them shall be chosen.

Column (3) shows the paragraphs of Chapter 6.8 to which the standard conforms.

Column (5) gives the latest date when existing type approvals shall be withdrawn according to 1.8.7.2.2.2; if no date is shown the type approval remains valid until it expires.

Standards shall be applied in accordance with 1.1.5. They shall be applied in full unless otherwise specified in the table below.

The scope of application of each standard is defined in the scope clause of the standard unless otherwise specified in the table below.

Reference	Title of document	Requirements the standard complies with	Applicable for new type approvals or for renewals	Latest date for withdrawal of existing type approvals
(1)	(2)	(3)	(4)	(5)
EN 13807:2003	Transportable gas cylinders – Battery vehicles – Design, manufacture, identification and testing NOTE: Where appropriate this standard may be applied to MEGCs which consist of pressure receptacles.	6.8.3.1.4, 6.8.3.1.5, 6.8.3.2.18 to 6.8.3.2.26, 6.8.3.4.12 to 6.8.3.4.14 and 6.8.3.5.10 to 6.8.3.5.13	Between 1 January 2005 and 31 December 2020	
EN 13807:2017	Transportable gas cylinders – Battery vehicles and multiple-element gas containers (MEGCs) – Design, manufacture, identification and testing	6.8.3.1.4, 6.8.3.1.5, 6.8.3.2.18 to 6.8.3.2.28, 6.8.3.4.12 to 6.8.3.4.14 and 6.8.3.5.10 to 6.8.3.5.13	Until further notice	
EN ISO 23826:2021	Gas cylinders – Ball valves – Specification and testing	6.8.2.1.1 and 6.8.2.2.1	Mandatorily from 1 January 2025	

6.8.3.7 Requirements for battery-wagons and MEGCs which are not designed, constructed, inspected and tested according to referenced standards

To reflect scientific and technical progress or where no standard is referenced in 6.8.3.6 or to deal with specific aspects not addressed in a standard referenced in 6.8.3.6, the competent authority may recognize the use of a technical code providing the same level of safety. Battery-wagons and MEGCs shall, however, comply with the minimum requirements of 6.8.3.

As soon as a standard newly referenced in 6.8.3.6 can be applied, the competent authority shall withdraw its recognition of the relevant technical code. A transitional period ending no later than the date of entry into force of the next edition of RID may be applied.

The procedure for periodic inspections shall be specified in the type approval if the standards referenced in 6.2.2, 6.2.4 or 6.8.2.6 are not applicable or shall not be applied.

The competent authority shall transmit to the secretariat of OTIF a list of the technical codes that it recognises and shall update the list if it changes. The list should include the following details: name and date of the code, purpose of the code and details of where it may be obtained. The secretariat shall make this information publicly available on its website.

A standard which has been adopted for reference in a future edition of the RID may be approved by the competent authority for use without notifying the OTIF secretariat.

6.8.4 Special provisions

NOTE 1: For liquids having a flash-point of not more than 60 °C and for flammable gases, see also 6.8.2.1.26, 6.8.2.1.27 and 6.8.2.2.9.

2: For requirements for tanks subjected to a pressure test of not less than 1 MPa (10 bar) or for tanks intended for the carriage of refrigerated liquefied gases, 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)

- TC 1** The requirements of 6.8.5 are applicable to the materials and construction of these shells.
- TC 2** 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.
- TC 3** The shells shall be made of austenitic steel.
- TC 4** Shells shall be provided with an enamel or equivalent protective lining if the material of the shell is attacked by UN 3250 chloroacetic acid.
- TC 5** Shells shall be provided with a lead lining not less than 5 mm thick or an equivalent lining.
- TC 6** The wall thickness of tanks made of aluminium not less than 99% pure or aluminium alloy need not exceed 15 mm even where calculation in accordance with 6.8.2.1.17 gives a higher value.
- TC 7** (Reserved)

(b) Items of equipment (TE)

- TE 1** (Deleted)
- TE 2** (Deleted)
- TE 3** 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.
- TE 4** Shells shall be equipped with thermal insulation made of materials which are not readily flammable.
- TE 5** If shells are equipped with thermal insulation, such insulation shall be made of materials which are not readily flammable.
- TE 6** Tanks may be equipped with a device of a design which precludes its obstruction by the substance carried and which prevents leakage and the build-up of excess overpressure or underpressure inside the shell.
- TE 7** 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.

TE 8 The connections to the external pipe-sockets of tanks shall be made of materials not liable to cause decomposition of hydrogen peroxide.

TE 9 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.

TE 10 The shut-off devices of tanks shall be so designed as to preclude obstruction of the devices by solidified substance during carriage.

Where tanks are sheathed in thermally-insulating material, the material shall be of an inorganic nature and entirely free from combustible matter.

TE 11 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. A safety valve preventing the entry of foreign matter also fulfils this provision.

TE 12 Tanks shall be equipped with thermal insulation complying with the requirements of 6.8.3.2.14. 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 TA 2. The start-to-discharge pressure shall however in no case be such that liquid could escape from the valve(s) if the tank were overturned.

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:

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

where:

q = heat absorption [W]

A = wetted area [m²]

F = insulation factor [-]

$F = 1$ for non-insulated tanks, or

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

where:

K = heat conductivity of insulation layer [W·m⁻¹·K⁻¹]

L = thickness of insulation layer [m]

$U = K/L$ = heat transfer coefficient of the insulation [W·m⁻²·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 TA 2. The emergency-relief devices shall be dimensioned in such a way that the maximum pressure in the tank never exceeds the test pressure of the tank.

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

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

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.

TE 13	Tanks shall be thermally insulated and fitted with a heating device on the outside.	
TE 14	Tanks shall be equipped with thermal insulation. The thermal insulation directly in contact with the shell and/or components of the heating system shall have an ignition temperature at least 50 °C higher than the maximum temperature for which the tank was designed.	
TE 15	(Deleted)	
TE 16	(Deleted)	
TE 17	For demountable tanks ²³ , 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 they can be rolled, the valves shall be provided with protective caps.	(Reserved)
TE 18	(Reserved)	
TE 19	(Reserved)	
TE 20	Notwithstanding the other tank-codes which are permitted in the hierarchy of tanks of the rationalized approach in 4.3.4.1.2, tanks shall be equipped with a safety valve.	
TE 21	The closures shall be protected with lockable caps.	
TE 22	In order to reduce the extent of damage in the event of a collision shock or accident, each end of tank-wagons for substances carried in the liquid state and gases or battery-wagons shall be capable of absorbing at least 800 kJ of energy by means of elastic or plastic deformation of defined components of the subframe or by means of a similar procedure (e.g. crash elements). The energy absorption shall be determined in relation to a collision on a straight track. Energy absorption by means of plastic deformation shall only occur in conditions other than those encountered during normal conditions of rail transport (impact speed higher than 12 km/h or individual buffer force greater than 1500 kN). Energy absorption of not more than 800 kJ at each end of the wagon shall not lead to transfer of energy to the shell which could cause visible, permanent deformation of the shell. The requirements of this special provision are deemed to be met if crashworthy buffers (energy absorption elements) that conform to clause 7 of standard EN 15551:2009 + A1:2010 (Railway applications – Railway rolling stock – Buffers) are used and if the resistance of the wagon body satisfies clause 6.3 and sub clause 8.2.5.3 of standard EN 12663-2:2010 (Railway applications – Structural requirements of railway vehicle bodies – Part 2: Freight wagons). The requirements of this special provision are deemed to be met by tank-wagons with an automatic	(Reserved)

²³ For the definition of "demountable tank", see 1.2.1.

coupling device equipped with energy absorption elements capable of absorbing at least 130 kJ at each end of the wagon.

TE 23 Tanks shall be equipped with a device of a design which precludes its obstruction by the substance carried and which prevents leakage and the build-up of excess overpressure or underpressure inside the shell.

TE 24 (Deleted)

TE 25 Shells of tank-wagons shall also be protected against the overriding of buffers and derailment or, failing that, to limit damage when buffers override by at least one of the following measures. (Reserved)

Measures to avoid overriding

(a) Device to protect against the overriding of buffers

The device to protect against the overriding of buffers shall ensure that the sub-frames of the wagons remain on the same horizontal level. The following requirements shall be fulfilled:

- The device to protect against the overriding of buffers shall not interfere with the normal operation of the wagons (for example negotiating curves, Berne rectangle, shunter's handle). The device to protect against the overriding of buffers shall permit the free taking of curves by another wagon fitted with a device to protect against the overriding of buffers in a curve of 75 m radius).
- The device to protect against the overriding of buffers shall not interfere with the normal functioning of the buffers (elastic or plastic deformation) (see also special provision TE 22 in 6.8.4 (b)).
- The device to protect against the overriding of buffers shall function independently of the condition of the load and the wear and tear of the wagons concerned.
- The device to protect against the overriding of buffers shall withstand a vertical force (upwards or downwards) of 150 kN.
- The device to protect against the overriding of buffers shall be effective irrespective of whether the other wagon concerned is fitted with a device to protect against the overriding of buffers. It shall not be possible for devices to protect against the overriding of buffers to obstruct each other.
- The increase in the overhang for fixing the device to protect against the overriding of buffers shall be less than 20 mm.
- The width of the device to protect against the overriding of buffers shall be at least as big as the width of the buffer head (with the exception of the device to protect against the overriding of buffers located above the left-hand footboard, which shall be tangent to the free space for the shunter, although the maximum width of the buffer must be covered).
- A device to protect against the overriding of buffers shall be located above every buffer.
- The device to protect against the overriding of buffers shall permit the attachment of buffers prescribed in standards EN 12663-2:2010 (Railway applications – Structural requirements of railway vehicle bodies – Part 2:

Freight wagons) and EN 15551:2009 + A1:2010 (Railway applications – Railway rolling stock – Buffers) and shall not present an obstacle to maintenance work.

- The device to protect against the overriding of buffers shall be built in such a way that the risk of penetration of the tank end is not increased in the event of a shock.

Measures to limit damage when buffers override

- (b) Increasing the wall thickness of the tank ends or using other materials with a greater energy absorption capacity

In this case, the wall thickness of the tank ends shall be at least 12 mm.

However, the wall thickness of the ends of tanks for the carriage of gases UN 1017 chlorine, UN 1749 chlorine trifluoride, UN 2189 dichlorosilane, UN 2901 bromine chloride and UN 3057 trifluoroacetyl chloride shall in this case be at least 18 mm.

- (c) Sandwich cover for tank ends

If protection is provided by a sandwich cover, it shall cover the entire area of the tank ends and shall have a specific energy absorption capacity of at least 22 kJ (corresponding to a wall thickness of 6 mm), which shall be measured in accordance with the method described in Annex B to standard EN 13094 "Tanks for the transport of dangerous goods – Metallic tanks with a working pressure not exceeding 0.5 bar – Design and construction". If the risk of corrosion cannot be eliminated by structural measures, it shall be made possible to undertake an inspection of the external wall of the tank end, e.g. by providing a removable cover.

- (d) Protective shield at each end of the wagon

If a protective shield is used at each end of the wagon, the following requirements shall apply:

- the protective shield shall cover the width of the tank in each case, up to the respective height. In addition, the width of the protective shield shall, over the entire height of the shield, be at least as wide as the distance defined by the outside edge of the buffer heads;
- the height of the protective shield, measured from the top edge of the headstock, shall cover
 - either two thirds of the tank diameter
 - or at least 900 mm and shall in addition be equipped at the top edge with an arresting device for climbing buffers;
- the protective shield shall have a minimum wall thickness of 6 mm;
- the protective shield and its attachment points shall be such that the possibility of the tank ends being penetrated by the protective shield itself is minimized.

- (e) Protective shield at each end of wagons fitted with automatic couplers

If a protective shield is used at each end of the wagon, the following requirements shall apply:

- the protective shield shall cover the tank end to a height of at least 1100 mm, measured

from the top edge of the headstock, the couplers shall be fitted with anticreep devices to prevent unintentional uncoupling and the protective shield shall, over the entire height of the shield, be at least 1200 mm wide;

- the protective shield shall have a minimum wall thickness of 12 mm;
- the protective shield and its attachment points shall be such that the possibility of the tank ends being penetrated by the protective shield itself is minimized.

The wall thicknesses specified in (b), (c) and (d) above relate to reference steel. If other materials are used, except if mild steel is used, the equivalent thickness shall be calculated in accordance with the formula in 6.8.2.1.18. The values of R_m and A to be used shall be specified minimum values according to material standards.

- TE 26** All filling and discharge connections, including those in the vapour phase, of tanks intended for the carriage of flammable refrigerated liquefied gases shall be equipped with an instant closing automatic stop-valve (see 6.8.3.2.3) as close as possible to the tank.

(c) Type approval (TA)

- TA 1** Tanks shall not be approved for the carriage of organic substances.

- TA 2** This substance may be carried in tank-wagons 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 an RID Contracting State, these conditions shall be recognized by the competent authority of the first RID Contracting State 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.

- TA 3** This substance may be carried only in tanks with the tank code LGAV or SGAV; the hierarchy in 4.3.4.1.2 is not applicable.

- TA 4** The conformity assessment procedures of section 1.8.7 shall be applied by the competent authority or the inspection body conforming to 1.8.6.3 and accredited according to EN ISO/IEC 17020:2012 (except clause 8.1.3) type A.

- TA 5** This substance may only be carried in tanks with tank code S2.65AN(+); the hierarchy in 4.3.4.1.2 is not applicable.

(d) Tests (TT)

- TT 1** 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).

- TT 2** The condition of the lining of shells shall be inspected every year by an inspection body, which shall inspect the inside of the shell (see special provision TU 43 in 4.3.5).

- TT 3** (Reserved)

By derogation from the requirements of 6.8.2.4.2, periodic inspections shall be performed no later than 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 performed no later than every four years.

- TT 4** (deleted)

- TT 5** The hydraulic pressure tests shall be performed no later than 4 years | 2½ years.
- TT 6** The periodic inspection shall be performed no later than every 4 years. | (Reserved)
- TT 7** Notwithstanding the requirements of 6.8.2.4.2, the periodic internal inspection may be replaced by a programme approved by the competent authority.
- TT 8** Tanks on which the proper shipping name required for the entry UN 1005 AMMONIA, ANHYDROUS is marked in accordance with 6.8.3.5.1 to 6.8.3.5.3 and constructed of fine-grained steel with a yield strength of more than 400 N/mm² in accordance with the material standard, shall be subjected at each periodic inspection according to 6.8.2.4.2, to magnetic particle inspections to detect surface cracking.
- For the lower part of each shell at least 20% of the length of each circumferential and longitudinal weld shall, together with all nozzle welds and any repair or ground areas, be inspected.
- If the mark of the substance on the tank or tank plate is removed, a magnetic particle inspection shall be carried out and these actions recorded in the inspection certificate attached to the tank record.
- Such magnetic particle inspections shall be performed in accordance with EN 12972:2018 + A1:2024.
- TT 9** For inspections and tests (including supervision of the manufacture) the procedures of section 1.8.7 shall be applied by the competent authority or the inspection body conforming to 1.8.6.3 and accredited according to EN ISO/IEC 17020:2012 (except clause 8.1.3) type A.
- TT 10** The periodic inspections according to 6.8.2.4.2 shall be performed no later than every four years. | two and a half years.

(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, German or Italian, in English, French, German or Italian, unless any agreements concluded between the countries concerned in the transport operation provide otherwise.

- TM 1** 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).
- TM 2** 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).
- TM 3** Tanks shall also bear, on the plate prescribed in 6.8.2.5.1, the proper shipping name and the maximum permissible load mass in kg for this substance.
- The load limits in accordance with 6.8.2.5.2 shall be determined in the light of the maximum permissible load mass of the shell, depending on the substance carried.
- TM 4** For tanks the following additional particulars shall be marked by stamping or by any other similar method on the plate prescribed in 6.8.2.5.2 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.
- TM 5** 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.
- TM 6** Tank-wagons shall bear an orange band in accordance with 5.3.5. | (Reserved)
- TM 7** The trefoil symbol, as described in 5.2.1.7.6, shall be marked by stamping or any other equivalent method on the plate described in 6.8.2.5.1. This trefoil 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.

6.8.5 Requirements concerning the materials and construction of shells of tank-wagons and tank-containers for which a test pressure of not less than 1 MPa (10 bar) is required, and of shells of tank-wagons and 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 dissolved gases of Class 2;
 - UN Nos. 1380, 2845, 2870, 3194 and 3391 to 3394 of Class 4.2; and
 - UN 1052 hydrogen fluoride, anhydrous and UN 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 2073 ammonia solution; and
 - UN 1052 hydrogen fluoride, anhydrous and UN 1790 hydrofluoric acid with more than 85% hydrogen fluoride of Class 8
- shall be heat-treated for thermal stress relief.
- Thermal stress relief shall not be required if:
1. there is no risk of corrosion due to stress cracking; and
 2. the mean notch bar impact value in the welding metal, the transition area and the base material, determined in each case by means of three samples, is an average of 45 J. ISO-V shall be used as a sample. For the base material, the sample shall be tested "crosswise". For the welding material and the transition area, notch position S in the middle of the welding metal or the middle of the transitional area shall be selected. Testing shall be carried out at the lowest operating temperature.
- (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 -60 °C;
 - nickel steels (with a nickel content of 0.5 to 9%), down to a temperature of -196 °C, depending on the nickel content;
 - austenitic chrome-nickel steels, down to a temperature of -270 °C;
 - austenitic-ferritic stainless steels, down to a temperature of -60 °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 underframe of the wagon 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 -20 °C, meet at least the following requirements as to impact strength:

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

- The minimum impact strength (see 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%; austenitic Cr-Ni steel; or austenitic-ferritic stainless steel;
- In the case of austenitic steels, only the weld bead need be subjected to an impact-strength test;
- For working temperatures below -196 °C the impact-strength test is not performed at the lowest working temperature, but at -196 °C.

6.8.5.2.2 Shells made of aluminium or aluminium alloy

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/cm² shall be required in every case.

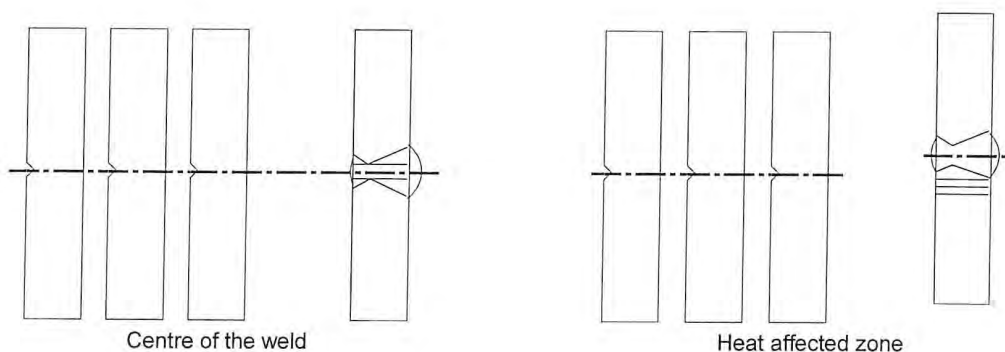
NOTE: No impact-strength test shall be carried out on sheets less than 5 mm thick, or on their weld seams.

- 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 $e \leq 10$ mm:

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

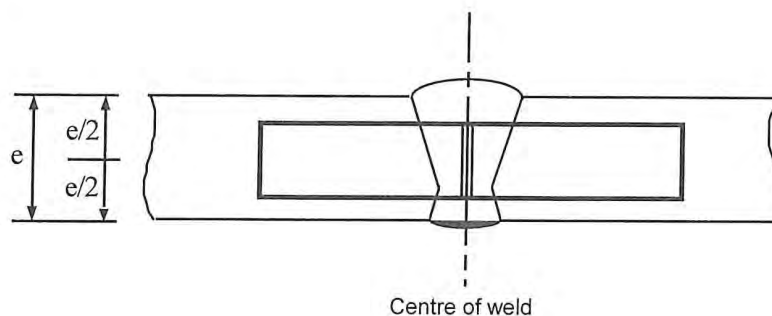
three test-pieces with the notch in the centre of the heat affected zone (the V-notch to cross the fusion boundary at the centre of the specimen);

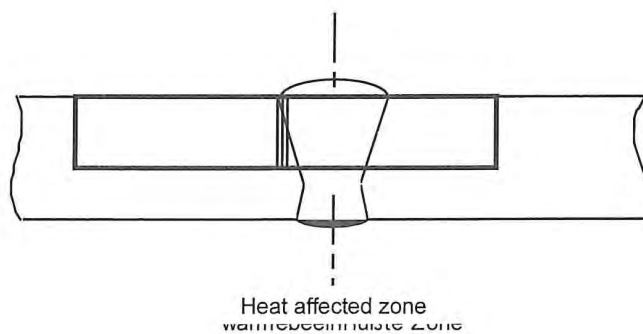


when $10 \text{ mm} < e \leq 20 \text{ mm}$:

three test-pieces from the centre of the weld;

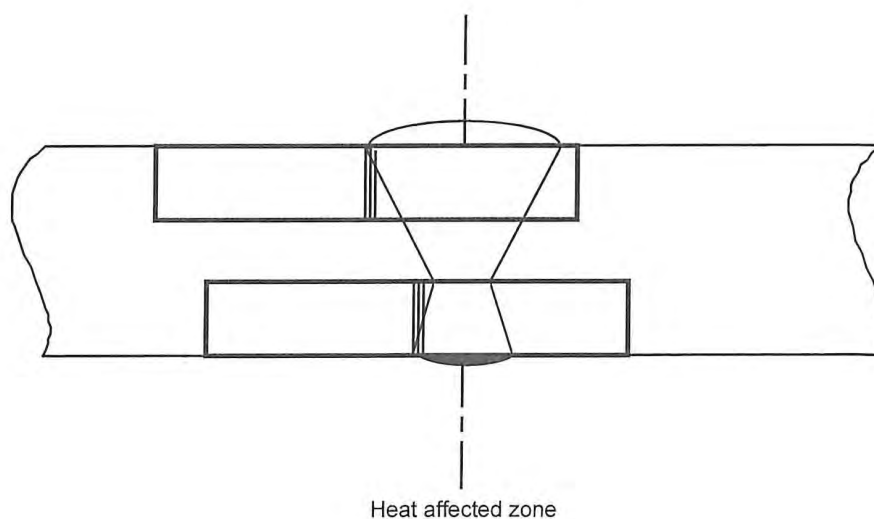
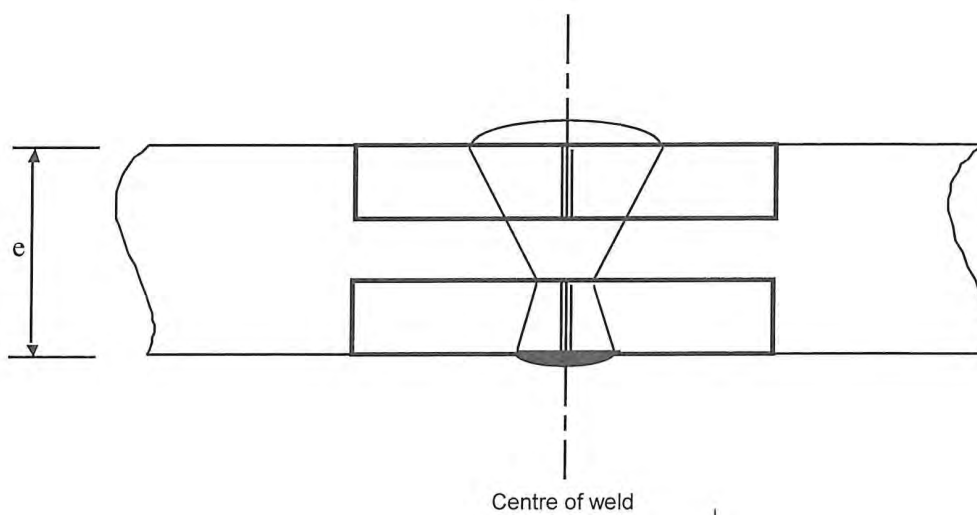
three test-pieces from the heat affected zone (the V-notch to cross the fusion boundary at the centre of the specimen);





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)



- 6.8.5.3.3** (a) For sheets, the average of the three tests shall meet the minimum value of 34 J/cm² 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/cm².
(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/cm²; not more than one of the individual values may be below the minimum value and then not below 24 J/cm².
(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/cm², though not below 24 J/cm².

- 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/cm², or
(b) more than one of the individual values is less than the minimum value of 34 J/cm² but not below 24 J/cm².

- 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.

6.8.5.4 Reference to standards

The requirements of 6.8.5.2 and 6.8.5.3 shall be deemed to have been complied with if the following relevant standards have been applied:

EN ISO 21028-1:2016 Cryogenic vessels – Toughness requirements for materials at cryogenic temperature
– Part 1: Temperatures below -80 °C

EN ISO 21028-2:2018 Cryogenic vessels – Toughness requirements for materials at cryogenic temperature
– Part 2: Temperatures between -80 °C and -20 °C.

Chapter 6.9 Requirements for the design, construction, inspection and testing of portable tanks with shells made of fibre-reinforced plastics (FRP) materials

6.9.1 Application and general requirements

6.9.1.1 The requirements of section 6.9.2 apply to portable tanks with an FRP shell intended for the carriage of dangerous goods of Classes 1, 3, 5.1, 6.1, 6.2, 8 and 9 by all modes of transport. In addition to the requirements of this Chapter, unless otherwise specified, the applicable requirements of the International Convention for Safe Containers (CSC) 1972, as amended, shall be fulfilled by any multimodal portable tank with FRP shell which meets the definition of a "container" within the terms of that Convention.

6.9.1.2 The requirements of this Chapter do not apply to offshore portable tanks.

6.9.1.3 The requirements of Chapter 4.2 and section 6.7.2 apply to FRP portable tank shells except for those concerning the use of metal materials for the construction of a portable tank shell and additional requirements stated in this Chapter.

6.9.1.4 In recognition of scientific and technological advances, the technical requirements of this Chapter may be varied by alternative arrangements. These alternative arrangements shall offer a level of safety not less than that given by the requirements of this Chapter with respect to compatibility with substances carried and the ability of the FRP portable tank to withstand impact, loading and fire conditions. For international carriage, alternative arrangement FRP portable tanks shall be approved by the applicable competent authorities.

6.9.2 Requirements for the design, construction, inspection and testing of FRP portable tanks

6.9.2.1 Definitions

For the purposes of this section, the definitions of 6.7.2.1 apply except for definitions related to metal materials ("Fine grain steel", "Mild steel" and "Reference steel") for the construction of the shell of a portable tank.

Additionally, the following definitions apply to portable tanks with an FRP shell:

External layer means the part of the shell which is directly exposed to the atmosphere;

Fibre-reinforced plastics (FRP), see 1.2.1;

Filament winding means a process for constructing FRP structures in which continuous reinforcements (filament, tape, or other), either previously impregnated with a matrix material or impregnated during winding, are placed over a rotating mandrel. Generally, the shape is a surface of revolution and may include ends (heads);

FRP shell means a closed part of cylindrical shape with an interior volume intended for carriage of chemical substances;

FRP tank means a portable tank constructed with an FRP shell and ends (heads), service equipment, safety relief devices and other installed equipment;

Glass transition temperature (T_g) means a characteristic value of the temperature range over which the glass transition takes place;

Hand layup means a process for moulding reinforced plastics in which reinforcement and resin are placed on a mould;

Liner means a layer on the inner surface of an FRP shell preventing contact with the dangerous goods being carried;

Mat means a fibre reinforcement made of random, chopped or twisted fibres bonded together as sheets of various length and thickness;

Parallel shell-sample means an FRP specimen, which must be representative of the shell, constructed in parallel to the shell construction if it is not possible to use cut-outs from the shell itself. The parallel shell-sample may be flat or curved;

Representative sample means a sample cut out from the shell;

Resin infusion means an FRP construction method by which dry reinforcement is placed into a matched mould, single sided mould with vacuum bag, or otherwise, and liquid resin is supplied to the part through the use of external applied pressure at the inlet and/or application of full or partial vacuum pressure at the vent;

Structural layer means FRP layers of a shell required to sustain the design loads;

Veil means a thin mat with high absorbency used in FRP product plies where polymeric matrix surplus fraction content is required (surface evenness, chemical resistance, leakage-proof, etc.).

6.9.2.2 General design and construction requirements

6.9.2.2.1 The requirements of 6.7.1 and 6.7.2.2 apply to FRP portable tanks. For areas of the shell that are made from FRP, the following requirements of Chapter 6.7 are exempt: 6.7.2.2.1, 6.7.2.2.9.1, 6.7.2.2.13 and 6.7.2.2.14. Shells shall be designed and constructed in accordance with the requirements of a pressure vessel code, applicable to FRP materials, recognized by the competent authority.

In addition, the following requirements apply.

6.9.2.2.2 *Manufacturer's quality system*

6.9.2.2.2.1 The quality system shall contain all the elements, requirements, and provisions adopted by the manufacturer. It shall be documented in a systematic and orderly manner in the form of written policies, procedures, and instructions.

6.9.2.2.2.2 The contents shall in particular include adequate descriptions of:

- (a) The organizational structure and responsibilities of personnel with regard to design and product quality;
- (b) The design control and design verification techniques, processes, and procedures that will be used when designing the portable tanks;
- (c) The relevant manufacturing, quality control, quality assurance and process operation instructions that will be used;
- (d) Quality records, such as inspection reports, test data and calibration data;
- (e) Management reviews to ensure the effective operation of the quality system arising from the audits in accordance with 6.9.2.2.2.4;
- (f) The process describing how customer requirements are met;
- (g) The process for control of documents and their revision;
- (h) The means for control of non-conforming portable tanks, purchased components, in-process and final materials; and
- (i) Training programmes and qualification procedures for relevant personnel.

6.9.2.2.2.3 Under the quality system, the following minimum requirements shall be met for each FRP portable tank manufactured:

- (a) Use of an inspection and test plan (ITP);
- (b) Visual inspections;
- (c) Verification of fibre orientation and mass fraction by means of documented control process;
- (d) Verification of fibre and resin quality and characteristics by means of certificates or other documentation;
- (e) Verification of liner quality and characteristics by means of certificates or other documentation;
- (f) Verification of whichever is applicable of formed thermoplastic resin characteristic or degree of cure of thermoset resin, by direct or indirect means (e.g. Barcol test or differential scanning calorimetry) to be determined in accordance with 6.9.2.7.1.2 (h), or by creep testing of a representative sample or parallel shell-sample in accordance with 6.9.2.7.1.2 (e) for a period of 100 hours;
- (g) Documentation of whichever is applicable of thermoplastic resin forming processes or thermoset resin cure and post-cure processes; and
- (h) Retention and archiving of shell samples for future inspection and shell verification (e.g. from manhole cut out) for a period of 5 years.

6.9.2.2.2.4 Audit of the quality system

The quality system shall be initially assessed to determine whether it meets the requirements in 6.9.2.2.2.1 to 6.9.2.2.2.3 to the satisfaction of the competent authority.

The manufacturer shall be notified of the results of the audit. The notification shall contain the conclusions of the audit and any corrective actions required.

Periodic audits shall be carried out, to the satisfaction of the competent authority, to ensure that the manufacturer maintains and applies the quality system. Reports of the periodic audits shall be provided to the manufacturer.

6.9.2.2.2.5 Maintenance of the quality system

The manufacturer shall maintain the quality system as approved in order that it remains adequate and efficient.

The manufacturer shall notify the competent authority that approved the quality system of any intended changes. The proposed changes shall be evaluated to determine whether the amended quality system will still satisfy the requirements in 6.9.2.2.2.1 to 6.9.2.2.2.3.

6.9.2.2.3 FRP Shells

6.9.2.2.3.1 FRP shells shall have a secure connection with structural elements of the portable tank frame. FRP shell supports and attachments to the frame shall cause no local stress concentrations exceeding the design allowables of the shell structure in accordance with the provisions stated in this Chapter for all operating and test conditions.

6.9.2.2.3.2 Shells shall be made of suitable materials, capable of operating within a minimum design temperature range of -40 °C to +50 °C, unless temperature ranges are specified for specific more severe climatic or operating conditions (e.g. heating elements), by the competent authority of the country where the transport operation is being performed.

6.9.2.2.3.3 If a heating system is installed, it shall comply with 6.7.2.5.12 to 6.7.2.5.15 and with the following requirements:

- (a) The maximum operating temperature of the heating elements integrated or connected to the shell shall not exceed the maximum design temperature of the tank;
- (b) The heating elements shall be designed, controlled and utilized so that the temperature of the carried substance cannot exceed the maximum design temperature of the tank or a value at which the internal pressure exceeds MAWP; and
- (c) Structures of the tank and its heating elements shall allow examination of the shell with respect to possible effects of overheating.

6.9.2.2.3.4 Shells shall consist of the following elements:

- Liner;
- Structural layer;
- External layer.

NOTE: The elements may be combined if all applicable functional criteria are met.

6.9.2.2.3.5 The liner is the inner element of the shell designed as the primary barrier to provide for the long-term chemical resistance in relation to the substances to be carried, to prevent any dangerous reaction with the contents or the formation of dangerous compounds and any substantial weakening of the structural layer owing to the diffusion of products through the liner. Chemical compatibility shall be verified in accordance with 6.9.2.7.1.3.

The liner may be an FRP liner or a thermoplastic liner.

6.9.2.2.3.6 FRP liners shall consist of the following two components:

- (a) Surface layer ("gel-coat"): adequate resin rich surface layer, reinforced with a veil, compatible with the resin and contents. This layer shall have a maximum fibre mass content of 30% and have a minimum thickness of 0.25 mm and a maximum thickness of 0.60 mm;
- (b) Strengthening layer(s): layer or several layers with a minimum thickness of 2 mm, containing a minimum of 900 g/m² of glass mat or chopped fibres with a mass content in glass of not less than 30% unless equivalent safety is demonstrated for a lower glass content.

6.9.2.2.3.7 If the liner consists of thermoplastic sheets, they shall be welded together in the required shape, using a qualified welding procedure and personnel. Welded liners shall have a layer of electrically conductive media placed against the non-liquid contact surface of the welds to facilitate spark testing. Durable bonding between liners and the structural layer shall be achieved by the use of an appropriate method.

6.9.2.2.3.8 The structural layer shall be designed to withstand the design loads according to 6.7.2.2.12, 6.9.2.2.3.1, 6.9.2.3.2, 6.9.2.3.4 and 6.9.2.3.6.

6.9.2.2.3.9 The external layer of resin or paint shall provide adequate protection of the structural layers of the tank from environmental and service exposure, including to UV radiation and salt fog, and occasional splash exposure to cargoes.

6.9.2.2.3.10 Resins

The processing of the resin mixture shall be carried out in compliance with the recommendations of the supplier. These resins can be:

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

The resin heat distortion temperature (HDT), determined in accordance with 6.9.2.7.1.1 shall be at least 20 °C higher than the maximum design temperature of the shell as defined in 6.9.2.2.3.2, but shall in any case not be lower than 70 °C.

6.9.2.2.3.11 Reinforcement material

The reinforcement material of the structural layers shall be selected such that they meet the requirements of the structural layer.

For the liner glass fibres of at a minimum type C or ECR according to ISO 2078:1993 + Amd 1:2015 shall be used. Thermoplastic veils may only be used for the liner when their compatibility with the intended contents has been demonstrated.

6.9.2.2.3.12 Additives

Additives necessary for the treatment of the resin, such as catalysts, accelerators, hardeners and thixotropic substances as well as materials used to improve the tank, such as fillers, colours, pigments etc. shall not cause weakening of the material, taking into account lifetime and temperature expectancy of the design.

6.9.2.2.3.13 FRP shells, their attachments and their service and structural equipment shall be designed to withstand the loads mentioned in 6.7.2.2.12, 6.9.2.2.3, 6.9.2.3.2, 6.9.2.3.4 and 6.9.2.3.6 without loss of contents (other than quantities of gas escaping through any degassing vents) during the design lifetime.

6.9.2.2.3.14 Special requirements for the carriage of substances with a flash-point of not more than 60 °C

6.9.2.2.3.14.1 FRP tanks used for the carriage of flammable liquids with a flash-point of not more than 60 °C shall be constructed to ensure the elimination of static electricity from the various component parts to avoid the accumulation of dangerous charges.

6.9.2.2.3.14.2 The electrical surface resistance of the inside and outside of the shell as established by measurements shall not be higher than $10^9 \Omega$. This may be achieved by the use of additives in the resin or interlaminar conducting sheets, such as metal or carbon network.

6.9.2.2.3.14.3 The discharge resistance to earth as established by measurements shall not be higher than $10^7 \Omega$.

6.9.2.2.3.14.4 All components of the shell shall be electrically connected to each other and to the metal parts of the service and structural equipment of the tank. The electrical resistance between components and equipment in contact with each other shall not exceed 10 Ω .

6.9.2.2.3.14.5 The electrical surface-resistance and discharge resistance shall be measured initially on each manufactured tank or a specimen of the shell in accordance with the procedure recognized by the competent authority. In the event of damage to the shell, requiring repair, the electrical resistance shall be re-measured.

6.9.2.2.3.15 The tank shall be designed to withstand, without significant leakage, the effects of a full engulfment in fire for 30 minutes as specified by the test requirements in 6.9.2.7.1.5. Testing may be waived with the agreement of the competent authority, where sufficient proof can be provided by tests with comparable tank designs.

6.9.2.2.3.16 Construction process for FRP shells

6.9.2.2.3.16.1 Filament winding, hand layup, resin infusion or other appropriate composite production processes shall be used for construction of FRP shells.

6.9.2.2.3.16.2 The weight of the fibre reinforcement shall conform to that set forth in the procedure specification with a tolerance of +10 % and -0 %. One or more of the fibre types specified in 6.9.2.2.3.11 and in the procedure specification shall be used for reinforcement of shells.

6.9.2.2.3.16.3 The resin system shall be one of the resin systems specified in 6.9.2.2.3.10. No filler, pigment or dye additions shall be used which will interfere with the natural colour of the resin except as permitted by the procedure specification.

6.9.2.3 Design criteria

- 6.9.2.3.1** FRP shells shall be of a design capable of being stress-analysed mathematically or experimentally by resistance strain gauges or by other methods approved by the competent authority.
- 6.9.2.3.2** FRP shells shall be designed and constructed to withstand the test pressure. Specific provisions are laid down for certain substances in the applicable portable tank instruction indicated in column (10) of Table A of Chapter 3.2 and described in 4.2.5, or by a portable tank special provision indicated in column (11) of Table A of Chapter 3.2 and described in 4.2.5.3. The minimum wall thickness of the FRP shell shall not be less than that specified in 6.9.2.4.
- 6.9.2.3.3** At the specified test pressure the maximum tensile relative deformation measured in mm/mm in the shell shall not result in the formation of microcracks, and therefore not be greater than the first measured point of elongation based fracture or damage of the resin, measured during tensile tests prescribed under 6.9.2.7.1.2 (c).
- 6.9.2.3.4** For internal test pressure, external design pressure specified in 6.7.2.2.10, static loads specified in 6.7.2.2.12 and static gravity loads caused by the contents with the maximum density specified for the design and at maximum filling degree, failure criteria (FC) in the longitudinal direction, circumferential direction, and any other in-plane direction of the composite layup shall not exceed the following value:

$$FC \leq \frac{1}{K}$$

where:

$$K = K_0 \times K_1 \times K_2 \times K_3 \times K_4 \times K_5$$

where:

K shall have a minimum value of 4;

K₀ is a strength factor. For the general design the value for K₀ shall be equal to or more than 1.5. The value of K₀ shall be multiplied by a factor of two, unless the shell is provided with protection against damage consisting of a complete metal skeleton including longitudinal and transverse structural members;

K₁ is a factor related to the deterioration in the material properties due to creep and ageing. It shall be determined by the formula:

$$K_1 = \frac{1}{\alpha \cdot \beta}$$

where α is the creep factor and β is the ageing factor determined in accordance with 6.9.2.7.1.2 (e) and (f), respectively. When used in calculation, factors α and β shall be between 0 and 1.

Alternatively, a conservative value of K₁ = 2 may be applied for the purpose of undertaking the numerical validation exercise in 6.9.2.3.4 (this does not remove the need to perform testing to determine α and β);

K₂ is a factor related to the service temperature and the thermal properties of the resin, determined by the following equation, with a minimum value of 1:

$$K_2 = 1,25 - 0,0125(\text{HDT} - 70)$$

where HDT is the heat distortion temperature of the resin, in °C;

K₃ is a factor related to the fatigue of the material; the value of K₃ = 1.75 shall be used unless otherwise agreed with the competent authority. For the dynamic design as outlined in 6.7.2.2.12 the value of K₃ = 1.1 shall be used;

K₄ is a factor related to resin curing and has the following values:

1.0 where curing is carried out in accordance with an approved and documented process, and the quality system described under 6.9.2.2.2 includes verification of degree of cure for each FRP portable tank using a direct measurement approach, such as differential scanning calorimetry (DSC) determined via ISO 11357-2:2016, as per 6.9.2.7.1.2 (h);

1.1 where thermoplastic resin forming or thermoset resin curing is carried out in accordance with an approved and documented process, and the quality system described under 6.9.2.2.2 includes verification of whichever is applicable formed thermoplastic resin characteristics or degree of cure of thermoset resin, for each FRP portable tank using an indirect measurement approach as per 6.9.2.7.1.2 (h), such as Barcol testing via ASTM D2583:2013-03 or EN 59:2016, HDT via ISO 75-1:2013, thermo-mechanical analysis (TMA) via ISO 11359-1:2014 or dynamic thermo-mechanical analysis (DMA) via ISO 6721-11:2019;

1.5 in other cases.

K₅ is a factor related to the portable tank instruction in 4.2.5.2.6:

1.0 for T 1 to T 19;

1.33 for T 20;

1.67 for T 21 to T 22.

A design validation exercise using numerical analysis and a suitable composite failure criterion is to be undertaken to verify that the stresses in the plies in the shell are below the allowables. Suitable composite failure criteria include, but are not limited to, Tsai-Wu, Tsai-Hill, Hashin, Yamada-Sun, Strain Invariant Failure Theory, Maximum Strain, or Maximum Stress. Other relations for the strength criteria are allowed upon agreement with the competent authority. The method and results of this design validation exercise are to be submitted to the competent authority.

The allowables are to be determined using experiments to derive parameters required by the chosen failure criteria combined with factor of safety K , the strength values measured as per 6.9.2.7.1.2 (c), and the maximum elongation strain criteria prescribed in 6.9.2.3.5. The analysis of joints is to be undertaken in accordance with the allowables determined in 6.9.2.3.7 and the strength values measured as per 6.9.2.7.1.2 (g). Buckling is to be considered in accordance with 6.9.2.3.6. Design of openings and metallic inclusions is to be considered in accordance with 6.9.2.3.8.

- 6.9.2.3.5** At any of the stresses as defined in 6.7.2.2.12 and 6.9.2.3.4, the resulting elongation in any direction shall not exceed the value indicated in the following table or one tenth of the elongation at fracture of the resin determined by ISO 527-2:2012, whichever is lower.

Examples of known limits are presented in the table below.

Type of resin	Maximum strain in tension (%)
Unsaturated polyester or phenolic	0.2
Vinylester	0.25
Epoxy	0.3
Thermoplastic	See 6.9.2.3.3

- 6.9.2.3.6** For the external design pressure the minimum safety factor for linear buckling analysis of the shell shall be as defined in the applicable pressure vessel code but not less than three.

- 6.9.2.3.7** The adhesive bondlines and/or overlay laminates used in the joints, including the end joints, connection between the equipment and shell, the joints of the surge plates and the partitions with the shell shall be capable of withstanding the loads of 6.7.2.2.12, 6.9.2.3.1, 6.9.2.3.2, 6.9.2.3.4 and 6.9.2.3.6. In order to avoid concentrations of stresses in the overlay lamination, the applied taper shall not be steeper than 1:6.

The shear strength between the overlay laminate and the tank components to which it is bonded shall not be less than:

$$\tau = \gamma \frac{Q}{l} \leq \frac{\tau_R}{K}$$

where:

τ_R is the interlaminar shear strength according to ISO 14130:1997 and Cor 1:2003;

Q is the load per unit width of the interconnection;

K is the safety factor determined as per 6.9.2.3.4;

l is the length of the overlay laminate;

γ is the notch factor relating average joint stress to peak joint stress at failure initiation location.

Other calculation methods for the joints are allowed following approval with the competent authority.

- 6.9.2.3.8** Metallic flanges and their closures are permitted to be used in FRP shells, under design requirements of 6.7.2. Openings in the FRP shell shall be reinforced to provide at least the same safety factors against the static and dynamic stresses as specified in 6.7.2.2.12, 6.9.2.3.2, 6.9.2.3.4 and 6.9.2.3.6 as that for the shell itself. The number of openings shall be minimized. The axis ratio of oval-shaped openings shall be not more than 2.

If metallic flanges or componentry are integrated into the FRP shell using bonding, then the characterisation method stated in 6.9.2.3.7 shall apply to the joint between the metal and FRP. If the metallic flanges or componentry are fixed in an alternative fashion, e.g. threaded fastener connections, then the appropriate provisions of the relevant pressure vessel standard shall apply.

- 6.9.2.3.9** Check calculations of the strength of the shell shall be performed by finite element method simulating the shell layups, joints within FRP shell, joints between the FRP shell and the container frame, and openings. Treatment of singularities shall be undertaken using an appropriate method according to the applicable pressure vessel code.

6.9.2.4 Minimum wall thickness of the shell

6.9.2.4.1 Minimum thickness of the FRP shell shall be confirmed by check calculations of the strength of the shell considering strength requirements given in 6.9.2.3.4.

6.9.2.4.2 Minimum thickness of the FRP shell structural layers shall be determined in accordance with 6.9.2.3.4, however, in any case the minimum thickness of the structural layers shall be at least 3 mm.

6.9.2.5 Equipment components for portable tanks with FRP shell

Service equipment, bottom openings, pressure relief devices, gauging devices, supports, frameworks, lifting and tie-down attachments of portable tanks shall meet the requirements of 6.7.2.5 to 6.7.2.17. If any other metallic features are required to be integrated into the FRP shell, then the provisions of 6.9.2.3.8 shall apply.

6.9.2.6 Design approval

6.9.2.6.1 Design approval of FRP portable tanks shall be as per 6.7.2.18 requirements. The following additional requirements apply to FRP portable tanks.

6.9.2.6.2 The prototype test report for the purpose of the design approval shall additionally include the following:

- (a) Results of the material tests used for FRP shell fabrication in accordance with 6.9.2.7.1 requirements;
- (b) Results of the ball drop test in accordance with the requirements of 6.9.2.7.1.4.
- (c) Results the fire resistance test in accordance with provisions of 6.9.2.7.1.5.

6.9.2.6.3 A service life inspection programme shall be established, which shall be a part of the operation manual, to monitor the condition of the tank at periodic inspections. The inspection programme shall focus on the critical stress locations identified in the design analysis performed under 6.9.2.3.4. The inspection method shall take into account the potential damage mode at the critical stress location (e.g. tensile stress or interlaminar stress). The inspection shall be a combination of visual and non-destructive testing (e.g. acoustic emissions, ultrasonic evaluation, thermographic). For heating elements, the service life inspection programme shall allow an examination of the shell or its representative locations to take into account the effects of overheating.

6.9.2.6.4 A representative prototype tank shall be subjected to tests as specified below. For this purpose, service equipment may be replaced by other items if necessary.

6.9.2.6.4.1 The prototype shall be inspected for compliance with the design type specification. This shall include an internal and external inspection and measurement of the main dimensions.

6.9.2.6.4.2 The prototype, equipped with strain gauges at all locations of high strain, as identified by the design validation exercise in accordance with 6.9.2.3.4, shall be subjected to the following loads and the strain shall be recorded:

- (a) Filled with water to the maximum filling degree. The measuring results shall be used to calibrate the design calculations according to 6.9.2.3.4;
- (b) Filled with water to the maximum filling degree and subjected to static loads in all three directions mounted by the base corner castings without additional mass applied external to the shell. For comparison with the design calculation according to 6.9.2.3.4 the strains recorded shall be extrapolated in relation to the quotient of the accelerations required in 6.7.2.2.12 and measured;
- (c) Filled with water and subjected to the specified test pressure. Under this load, the shell shall exhibit no visual damage or leakage.

The stress corresponding to the measured strain level shall not exceed the minimum factor of safety calculated in 6.9.2.3.4 under any of these loading conditions.

6.9.2.7 Additional provisions applicable to FRP portable tanks**6.9.2.7.1 Material testing****6.9.2.7.1.1 Resins**

Resin tensile elongation shall be determined in accordance with ISO 527-2:2012. The heat distortion temperature (HDT) of the resin shall be determined in accordance with ISO 75-1:2013.

6.9.2.7.1.2 Shell-samples

Prior to testing, all coatings shall be removed from the samples. If shell samples are not possible then parallel shell-samples may be used. The tests shall cover:

- (a) The thickness of the laminates of the central shell wall and the ends;
- (b) The mass content and composition of composite reinforcement by ISO 1172:1996 or ISO 14127:2008, as well as orientation and arrangement of reinforcement layers;

- (c) The tensile strength, elongation at fracture and modulus of elasticity according to ISO 527-4:1997 or ISO 527-5:2009 for the circumferential and longitudinal directions of the shell. For areas of the FRP shell, tests shall be performed on representative laminates in accordance with ISO 527-4:1997 or ISO 527-5:2009, to permit evaluation of the suitability of safety factor (K). A minimum of six specimens per measure of tensile strength shall be used, and the tensile strength shall be taken as the average minus two standard deviations;
- (d) The bending deflection and strength established by the three-point or four-point bending test according to ISO 14125:1998 + Amd 1:2011 using a sample with a minimum width of 50 mm and a support distance of at least 20 times the wall thickness. A minimum of five specimens shall be used.
- (e) The creep factor α determined by taking the average result of at least two specimens with the configuration described in (d), subject to creep in three-point or four-point bending, at the maximum design temperature nominated under 6.9.2.2.3.2, for a period of 1 000 hours. The following test is to be undertaken for each specimen:
 - (i) Place specimen into bending apparatus, unloaded, in oven set to maximum design temperature and allow to acclimatise for a period of not less than 60 minutes;
 - (ii) Load specimen bending in accordance with ISO 14125:1998 + Amd 1:2011 at flexural stress equal to the strength determined in (d) divided by four. Maintain mechanical load at maximum design temperature without interruption for not less than 1 000 hours;
 - (iii) Measure the initial deflection six minutes after full load application in (e) (ii). Specimen shall remain loaded in test rig;
 - (iv) Measure the final deflection 1 000 hours after full load application in (e) (ii); and
 - (v) Calculate the creep factor α by dividing the initial deflection from (e) (iii) by the final deflection from (e) (iv);
- (f) The ageing factor β determined by taking the average result of at least two specimens with the configuration described in (d), subject to loading in static three-point or four-point bending, in conjunction with immersion in water at the maximum design temperature nominated under 6.9.2.2.3.2 for a period of 1 000 hours. The following test is to be undertaken for each specimen:
 - (i) Prior to testing or conditioning, specimens shall be dried in an oven at 80 °C for a period of 24 hours;
 - (ii) The specimen shall be loaded in three-point or four-point bending at ambient temperature, in accordance with ISO 14125:1998 + Amd 1:2011, at the flexural stress level equal to the strength determined in (d) divided by four. Measure the initial deflection six minutes after full load application. Remove specimen from test rig;
 - (iii) Immerse unloaded specimen in water at the maximum design temperature for a period of not less than 1 000 hours without interruption to the water conditioning period. When conditioning period has lapsed, remove specimens, keep damp at ambient temperature, and complete (f) (iv) within three days;
 - (iv) The specimen shall be subject to second round of static loading, in a manner identical to (f) (ii). Measure the final deflection six minutes after full load application. Remove specimen from test rig; and
 - (v) Calculate the ageing factor β by dividing the initial deflection from (f) (ii) by the final deflection from (f) (iv);
- (g) The interlaminar shear strength of the joints measured by testing representative samples in accordance with ISO 14130:1997;
- (h) The efficiency of whichever is applicable of thermoplastic resin forming characteristics or thermoset resin cure and post-cure processes for laminates determined using one or more of the following methods:
 - (i) Direct measurement of formed thermoplastic resin characteristics or thermoset resin degree of cure: glass transition temperature (T_g) or melting temperature (T_m) determined using differential scanning calorimetry (DSC) via ISO 11357-2:2016; or
 - (ii) Indirect measurement of formed thermoplastic resin characteristics or thermoset resin degree of cure:
 - HDT via ISO 75-1:2013;
 - T_g or T_m using thermo-mechanical analysis (TMA) via ISO 11359-1:2014;
 - Dynamic thermo-mechanical analysis (DMA) via ISO 6721-11:2019;
 - Barcol testing via ASTM D2583:2013-03 or EN 59:2016.

6.9.2.7.1.3 The chemical compatibility of the liner and chemical contact surfaces of service equipment with the substances to be carried shall be demonstrated by one of the following methods. This demonstration shall account for all aspects of the compatibility of the materials of the shell and its equipment with the substances to be carried, including chemical deterioration of the shell, initiation of critical reactions of the contents and dangerous reactions between both.

- (a) In order to establish any deterioration of the shell, representative samples taken from the shell, including any liners with welds, shall be subjected to the chemical compatibility test according to EN 977:1997 for a period of 1 000 hours at 50 °C or the maximum temperature at which a particular substance is approved for carriage. Compared with a virgin sample, the loss of strength and elasticity modulus measured by the bending test according to EN 978:1997 shall not exceed 25 %. Cracks, bubbles, pitting effects as well as separation of layers and liners and roughness shall not be acceptable;
- (b) Certified and documented data of positive experiences on the compatibility of filling substances in question with the materials of the shell with which they come into contact at given temperatures, times and other relevant service conditions;
- (c) Technical data published in relevant literature, standards or other sources, acceptable to the competent authority;
- (d) Upon agreement with the competent authority other methods of chemical compatibility verification may be used.

6.9.2.7.1.4 Ball drop test as per EN 976-1:1997

The prototype shall be subjected to the ball drop test according to EN 976-1:1997, No. 6.6. No visible damage inside or outside the tank shall occur.

6.9.2.7.1.5 Fire resistance test

- 6.9.2.7.1.5.1** A representative prototype tank with its service and structural equipment in place and filled to 80 % of its maximum capacity with water, shall be exposed to a full engulfment in fire for 30 minutes, caused by an open heating oil pool fire or any other type of fire with the same effect. The fire shall be equivalent to a theoretical fire with a flame temperature of 800 °C, emissivity of 0.9 and to the tank a heat transfer coefficient of 10 W/(m²K) and surface absorptivity of 0.8. A minimum net heat flux of 75 kW/m² shall be calibrated according to ISO 21843:2018. The dimensions of the pool shall exceed those of the tank by at least 50 cm to each side and the distance between fuel level and tank shall be between 50 cm and 80 cm. The rest of the tank below liquid level, including openings and closures, shall remain leakproof except for drips.

6.9.2.8 **Inspection and testing**

- 6.9.2.8.1** Inspection and testing of portable FRP tanks shall be carried out as per provisions of 6.7.2.19. In addition, welded thermoplastic liners shall be spark tested under a suitable standard, after pressure tests performed in accordance with the periodic inspections specified in 6.7.2.19.4.
- 6.9.2.8.2** In addition, the initial and periodic inspections shall follow the service life inspection programme and any associated inspection methods per 6.9.2.6.3.
- 6.9.2.8.3** The initial inspection and test shall verify that construction of the tank is made in accordance with the quality system required by 6.9.2.2.2.
- 6.9.2.8.4** Additionally, during inspection of the shell the position of the areas heated by heating elements shall be indicated or marked, be available on design drawings or shall be made visible by a suitable technique (e.g. infrared). Examination of the shell shall take into account the effects of overheating, corrosion, erosion, over-pressure and mechanical overloading.

6.9.2.9 **Retention of samples**

Shell samples (e.g. from manhole cut out) for each tank manufactured shall be maintained for future inspection and shell verification for a period of five years from the date of the initial inspection and test and until successful completion of the required five-year periodic inspection.

6.9.2.10 **Marking**

- 6.9.2.10.1** The requirements of 6.7.2.20.1 apply to portable tanks with an FRP shell except those of 6.7.2.20.1 (f) (ii).
- 6.9.2.10.2** The information required in 6.7.2.20.1 (f) (i) shall be:
"Shell structural material: Fibre-reinforced plastic", the reinforcement fibre e.g. "Reinforcement: E-glass" and resin e.g. "Resin: Vinyl Ester".
- 6.9.2.10.3** Requirements of provision 6.7.2.20.2 apply to portable tank with an FRP shell.

Chapter 6.10 Requirements for the construction, equipment, type approval, inspection and marking of vacuum-operated waste tanks

NOTE 1: For portable tanks and UN multiple element gas containers (MEGCs), see Chapter 6.7; for tank-wagons, demountable tanks, tank-containers and tank swap bodies, with shells made of metallic materials, and battery-wagons and multiple element gas containers (MEGCs) other than UN MEGCs see Chapter 6.8; for portable tanks with shells made of fibre-reinforced plastics (FRP) materials, see Chapter 6.9.

2: This Chapter applies to tank-containers and tank swap bodies.

6.10.1 General

6.10.1.1 Definitions

NOTE: A tank which fully complies with the requirements of Chapter 6.8 is not considered to be a "vacuum-operated waste tank".

6.10.1.1.1 The term "protected area" means the areas located as follows:

- (a) The lower part of the tank in a zone which extends over a 60 ° angle on either side of the lower generating line;
- (b) The top part of a tank in a zone which extends over a 30 ° angle on either side of the top generating line.

6.10.1.2 Scope

6.10.1.2.1 The special requirements of 6.10.2 to 6.10.4 complete or modify Chapter 6.8 and are applied to vacuum-operated waste tanks.

Vacuum-operated waste tanks may be equipped with openable ends, if the requirements of Chapter 4.3 allow bottom discharge of the substances to be carried (indicated by the letters "A" or "B" in Part 3 of the tank code given in Column (12) of Table A of Chapter 3.2, in accordance with 4.3.4.1.1).

Vacuum-operated waste tanks shall comply with all the requirements of Chapter 6.8, except where overtaken by special requirements in this Chapter. However, the requirements of 6.8.2.1.19 and 6.8.2.1.20 shall not apply.

6.10.2 Construction

6.10.2.1 Tanks shall be designed for a calculation pressure equal to 1.3 times the filling or discharge pressure but not less than 400 kPa (4 bar) (gauge pressure). For the carriage of substances for which a higher calculation pressure of the tank is specified in Chapter 6.8, this higher pressure shall apply.

6.10.2.2 Tanks shall be designed to withstand a negative internal pressure of 100 kPa (1 bar).

6.10.3 Items of equipment

6.10.3.1 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. This requirement can be fulfilled by placing the items of equipment in a so-called "protected area" (see 6.10.1.1.1).

6.10.3.2 The bottom discharge of shells may be constituted by external piping with a stop-valve fitted as close to the shell as practicable and a second closure which may be a blank flange or other equivalent device.

6.10.3.3 The position and closing direction of the stop-valve(s) connected to the shell, or to any compartment in the case of compartmented shells, shall be unambiguous, and be able to be checked from the ground.

6.10.3.4 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, or the first external stop-valve (where applicable), and its seatings 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 unintended opening.

6.10.3.5 The tanks may be equipped with openable ends. Openable ends shall comply with the following conditions:

- (a) The ends shall be designed to be secured leaktight when closed;
- (b) Unintentional opening shall not be possible;
- (c) Where the opening mechanism is power operated the end shall remain securely closed in the event of a power failure;

- (d) A safety or breakseal device shall be incorporated to ensure that the openable end cannot be opened when there is still a residual over pressure in the tank. This requirement does not apply to openable ends which are power-operated, where the movement is positively controlled. In this case the controls shall be of the dead-man type and be so positioned that the operator can observe the movement of the openable end at all times and is not endangered during opening and closing of the openable end; and
- (e) Provisions shall be made to protect the openable end and prevent it from being forced open during a roll-over of the tank-container or tank swap body.

6.10.3.6 Vacuum-operated waste tanks which are fitted with an internal piston to assist in the cleaning of the tank or discharging shall be provided with stop-devices to prevent the piston in every operational position being ejected from the tank when a force equivalent to the maximum working pressure of the tank is applied to the piston. The maximum working pressure for tanks or compartments with pneumatic operated piston shall not exceed 100 kPa (1.0 bar). The internal piston shall be constructed in a manner and of materials which will not cause an ignition source when the piston is moved.

The internal piston may be used as a compartment provided it is secured in position. Where any of the means by which the internal piston is secured is external to the tank, it shall be placed in a position not liable to accidental damage.

6.10.3.7 The tanks may be equipped with suction booms if:

- (a) The boom is fitted with an internal or external stop-valve fixed directly to the shell, or directly to a bend that is welded to the shell; a rotation crown wheel can be fitted between the shell or the bend and the external stop valve, if this rotation crown wheel is located in the protected area and the stop-valve control device is protected with a housing or cover against the danger of being wrenched off by external loads;
- (b) The stop-valve mentioned in (a) is so arranged that carriage with the valve in an open position is prevented; and
- (c) The boom is constructed in such a way that the tank will not leak as a result of accidental impact on the boom.

6.10.3.8 The tanks shall be fitted with the following additional service equipment:

- (a) The outlet of a pump/exhauster unit shall be so arranged as to ensure that any flammable or toxic vapours are diverted to a place where they will not cause a danger;
NOTE: This requirement may, for example, be complied with by the use of a vertical pipe discharging at the top, or a low-level outlet with a connection which allows attachment of a hose.
- (b) A device to prevent immediate passage of flame shall be fitted to all openings of a vacuum pump/exhauster unit which may provide a source of ignition and which is fitted on a tank used for the carriage of flammable wastes, or the tank shall be explosion pressure shock resistant, which means being capable of withstanding without leakage, but allowing deformation, an explosion resulting from the passage of the flame;
- (c) Pumps which can deliver a positive pressure shall have a safety device fitted in the pipework which can be pressurised. The safety device shall be set to discharge at a pressure not exceeding the maximum working pressure of the tank;
- (d) A stop-valve shall be fitted between the shell, or the outlet of the overfill prevention device fitted to the shell, and the pipework connecting the shell to the pump/exhauster unit;
- (e) The tank shall be fitted with a suitable pressure/vacuum manometer which shall be mounted in a position where it can be easily read by the person operating the pump/exhauster unit. A distinguishing line shall be marked on the scale to indicate the maximum working pressure of the tank;
- (f) The tank, or in case of compartmented tanks, every compartment, shall be equipped with a level indicating device. Glass level-gauges and level-gauges of other suitable transparent material may be used as level indicating devices, provided:
 - (i) they form a part of the tank wall and have a resistance to pressure comparable to that of the tank; or they are fitted external to the tank;
 - (ii) the top and bottom connections to the tank are equipped with shut-off valves fixed directly to the shell and so arranged that carriage with the valves in an open position is prevented;
 - (iii) they are suitable for operation at the maximum working pressure of the tank; and
 - (iv) they are placed in a position where they will not be liable to accidental damage.

6.10.3.9 The shells of vacuum-operated waste tanks shall be fitted with a safety valve preceded by a bursting disc.

The valve shall be capable of opening automatically at a pressure between 0.9 and 1.0 times the test pressure of the tank to which it is fitted. The use of dead weight or counterweight valves is prohibited.

The bursting disc shall burst at the earliest when the initial opening pressure of the valve is reached and at the latest when this pressure reaches the test pressure of the tank to which it is fitted.

Safety devices shall be of such a type as to resist dynamic stresses, including liquid surge.

The space between the bursting disc and the safety valve shall be provided with a pressure gauge or suitable tell-tale indicator for the detection of disc rupture, pinholing or leakage which could cause a malfunction of the safety valve.

6.10.4 Inspection

Vacuum-operated waste tanks shall be subject no later than every two and a half years to an examination of the internal condition, in addition to the inspection according to 6.8.2.4.3.

Chapter 6.11 Requirements for the design, construction, inspection and testing of bulk containers

6.11.1 (Reserved)

6.11.2 Application and general requirements

6.11.2.1 Bulk containers and their service and structural equipment shall be designed and constructed to withstand, without loss of contents, the internal pressure of the contents and the stresses of normal handling and carriage.

6.11.2.2 Where a discharge valve is fitted, it shall be capable of being made secure in the closed position and the whole discharge system shall be suitably protected from damage. Valves having lever closures shall be able to be secured against unintended opening and the open or closed position shall be readily apparent.

6.11.2.3 Code for designating types of bulk container

The following table indicates the codes to be used for designating types of bulk containers:

Types of bulk containers	Code
Sheeted bulk container	BK 1
Closed bulk container	BK 2
Flexible bulk container	BK 3

6.11.2.4 In order to take account of progress in science and technology, the use of alternative arrangements which offer at least equivalent safety as provided by the requirements of this chapter may be considered by the competent authority.

6.11.3 Requirements for the design, construction, inspection and testing of containers conforming to the CSC used as BK 1 or BK 2 bulk containers

6.11.3.1 Design and construction requirements

6.11.3.1.1 The general design and construction requirements of this sub-section are deemed to be met if the bulk container complies with the requirements of ISO 1496-4:1991 "Series 1 Freight containers – Specification and testing – Part 4: Non pressurized containers for dry bulk" and the container is siftproof.

6.11.3.1.2 Containers designed and tested in accordance with ISO 1496-1:1990 "Series 1 Freight containers – Specification and testing – Part 1: General cargo containers for general purposes" shall be equipped with operational equipment which, including its connection to the container, is designed to strengthen the end walls and to improve the longitudinal restraint as necessary to comply with the test requirements of ISO 1496-4:1991 as relevant.

6.11.3.1.3 Bulk containers shall be siftproof. Where a liner is used to make the container siftproof it shall be made of a suitable material. The strength of material used for, and the construction of, the liner shall be appropriate to the capacity of the container and its intended use. Joins and closures of the liner shall withstand pressures and impacts liable to occur under normal conditions of handling and carriage. For ventilated bulk containers any liner shall not impair the operation of ventilating devices.

6.11.3.1.4 The operational equipment of bulk containers designed to be emptied by tilting shall be capable of withstanding the total filling mass in the tilted orientation.

6.11.3.1.5 Any movable roof or side or end wall or roof section shall be fitted with locking devices with securing devices designed to show the locked state to an observer at ground level.

6.11.3.2 Service equipment

6.11.3.2.1 Filling and discharge devices shall be so constructed and arranged as to be protected against the risk of being wrenched off or damaged during carriage and handling. The filling and discharge devices shall be capable of being secured against unintended opening. The open and closed position and direction of closure shall be clearly indicated.

6.11.3.2.2 Seals of openings shall be so arranged as to avoid any damage by the operation, filling and emptying of the bulk container.

6.11.3.2.3 Where ventilation is required bulk containers shall be equipped with means of air exchange, either by natural convection, e.g. by openings, or active elements, e.g. fans. The ventilation shall be designed to prevent negative pressures in the container at all times. Ventilating elements of bulk containers for the carriage of flammable substances or substances emitting flammable gases or vapours shall be designed so as not to be a source of ignition.

6.11.3.3 Inspection and testing

6.11.3.3.1 Containers used, maintained and qualified as bulk containers in accordance with the requirements of this section shall be tested and approved in accordance with the CSC.

6.11.3.3.2 Containers used and qualified as bulk containers shall be inspected periodically according to the CSC.

6.11.3.4 Marking

6.11.3.4.1 Containers used as bulk containers shall be marked with a Safety Approval Plate in accordance with the CSC.

6.11.4 Requirements for the design, construction and approval of BK 1 and BK 2 bulk containers other than containers conforming to the CSC

NOTE: When containers conforming to the provisions of this section are used for the carriage of solids in bulk, the following statement shall be shown on the transport document:

"BULK CONTAINER BK (X)¹ APPROVED BY THE COMPETENT AUTHORITY OF ..." (see 5.4.1.1.17).

6.11.4.1 Bulk containers covered in this section include skips, offshore bulk containers, bulk bins, swap bodies, trough shaped containers, roller containers, and load compartments of wagons.

NOTE: These bulk containers also include containers conforming to IRS 50591 ("Roller units for horizontal transshipment – Technical conditions governing their use in international traffic")² and IRS 50592 ("Intermodal Transport Units (other than semi-trailers) for vertical transshipment and suitable for carriage on wagons – Minimum requirements")³ published by UIC as mentioned in 7.1.3 which do not conform to the CSC.

6.11.4.2 These bulk containers shall be designed and constructed so as to be strong enough to withstand the shocks and loadings normally encountered during carriage including, as applicable, transshipment between modes of transport.

6.11.4.3 (Reserved)

6.11.4.4 These bulk containers shall be approved by the competent authority and the approval shall include the code for designating types of bulk containers in accordance with 6.11.2.3 and the requirements for inspection and testing as appropriate.

6.11.4.5 Where it is necessary to use a liner in order to retain the dangerous goods it shall meet the provisions of 6.11.3.1.3.

6.11.5 Requirements for the design, construction, inspection and testing of BK 3 flexible bulk containers

6.11.5.1 Design and construction requirements

6.11.5.1.1 Flexible bulk containers shall be sift-proof.

6.11.5.1.2 Flexible bulk containers shall be completely closed to prevent the release of contents.

6.11.5.1.3 Flexible bulk containers shall be waterproof.

6.11.5.1.4 Parts of the flexible bulk container which are in direct contact with dangerous goods:

- (a) shall not be affected or significantly weakened by those dangerous goods;
- (b) shall not cause a dangerous effect, e.g. catalysing a reaction or reacting with the dangerous goods; and
- (c) shall not allow permeation of the dangerous goods that could constitute a danger under normal conditions of carriage.

¹ (x) shall be replaced with "1" or "2" as appropriate.

² First edition of IRS (International Railway Solution) applicable as from 1 June 2020.

³ Third edition of IRS (International Railway Solution) applicable as from 1 December 2023.

6.11.5.2 Service equipment and handling devices

6.11.5.2.1 Filling and discharge devices shall be so constructed as to be protected against damage during carriage and handling. The filling and discharge devices shall be secured against unintended opening.

6.11.5.2.2 Slings of the flexible bulk container, if fitted, shall withstand pressure and dynamic forces, which can appear in normal conditions of handling and carriage.

6.11.5.2.3 The handling devices shall be strong enough to withstand repeated use.

6.11.5.3 Inspection and testing

6.11.5.3.1 The design type of each flexible bulk container shall be tested as provided for in 6.11.5 in accordance with procedures established by the competent authority allowing the allocation of the mark and shall be approved by this competent authority.

6.11.5.3.2 Tests shall also be repeated after each modification of the design type, which alters the design, material or manner of construction of a flexible bulk container.

6.11.5.3.3 Tests shall be carried out on flexible bulk containers prepared as for carriage. Flexible bulk containers shall be filled to the maximum mass at which they may be used and the contents shall be evenly distributed. The substances to be carried in the flexible bulk container may be replaced by other substances, except where this would invalidate the results of the test. When another substance is used it shall have the same physical characteristics (mass, grain size, etc.) as the substance to be carried. It is permissible to use additives, such as bags of lead shot, to achieve the requisite total mass of the flexible bulk container, so long as they are placed so that the test results are not affected.

6.11.5.3.4 Flexible bulk containers shall be manufactured and tested under a quality assurance programme which satisfies the competent authority, in order to ensure that each manufactured flexible bulk container meets the requirements of this Chapter.

6.11.5.3.5 Drop test**6.11.5.3.5.1 Applicability**

For all types of flexible bulk containers, as a design type test.

6.11.5.3.5.2 Preparation for testing

The flexible bulk container shall be filled to its maximum permissible gross mass.

6.11.5.3.5.3 Method of testing

The flexible bulk container shall be dropped onto a target surface that is non-resilient and horizontal. The target surface shall be:

- (a) Integral and massive enough to be immovable;
- (b) Flat with a surface kept free from local defects capable of influencing the test results;
- (c) Rigid enough to be non-deformable under test conditions and not liable to become damaged by the tests; and
- (d) Sufficiently large to ensure that the test flexible bulk container falls entirely upon the surface.

Following the drop, the flexible bulk container shall be restored to the upright position for observation.

6.11.5.3.5.4 Drop height shall be:

Packing group III: 0.8 m.

6.11.5.3.5.5 Criteria for passing the test

- (a) There shall be no loss of contents. A slight discharge, e.g. from closures or stitch holes, upon impact shall not be considered to be a failure of the flexible bulk container provided that no further leakage occurs after the container has been restored to the upright position;
- (b) There shall be no damage, which renders the flexible bulk container unsafe to be carried for salvage or for disposal.

6.11.5.3.6 Top lift test**6.11.5.3.6.1 Applicability**

For all types of flexible bulk containers as a design type test.

6.11.5.3.6.2 Preparation for testing

Flexible bulk containers shall be filled to six times the maximum net mass, the load being evenly distributed.

6.11.5.3.6.3 Method of testing

A flexible bulk container shall be lifted in the manner for which it is designed until clear of the floor and maintained in that position for a period of five minutes.

6.11.5.3.6.4 Criteria for passing the test

There shall be no damage to the flexible bulk container or its lifting devices which renders the flexible bulk container unsafe for carriage or handling, and no loss of contents.

6.11.5.3.7 Topple test**6.11.5.3.7.1 Applicability**

For all types of flexible bulk containers as a design type test.

6.11.5.3.7.2 Preparation for testing

The flexible bulk container shall be filled to its maximum permissible gross mass.

6.11.5.3.7.3 Method of testing

A flexible bulk container shall be toppled onto any part of its top by lifting the side furthest from the drop edge upon a target surface that is non-resilient and horizontal. The target surface shall be:

- (a) Integral and massive enough to be immovable;
- (b) Flat with a surface kept free from local defects capable of influencing the test results;
- (c) Rigid enough to be non-deformable under test conditions and not liable to become damaged by the tests; and
- (d) Sufficiently large to ensure that the tested flexible bulk container falls entirely upon the surface.

6.11.5.3.7.4 For all flexible bulk containers, the topple height is specified as follows:

Packing group III: 0.8 m.

6.11.5.3.7.5 Criterion for passing the test

There shall be no loss of contents. A slight discharge, e.g. from closures or stitch holes, upon impact shall not be considered to be a failure of the flexible bulk container provided that no further leakage occurs.

6.11.5.3.8 Righting test**6.11.5.3.8.1 Applicability**

For all types of flexible bulk containers designed to be lifted by the top or side part, as a design type test.

6.11.5.3.8.2 Preparation for testing

The flexible bulk container shall be filled to not less than 95% of its capacity and to its maximum permissible gross mass.

6.11.5.3.8.3 Method of testing

The flexible bulk container, lying on its side, shall be lifted at a speed of at least 0.1 m/s to an upright position, clear of the floor, by no more than half of the lifting devices.

6.11.5.3.8.4 Criterion for passing the test

There shall be no damage to the flexible bulk container or its lifting devices which renders the flexible bulk container unsafe for carriage or handling.

6.11.5.3.9 Tear test**6.11.5.3.9.1 Applicability**

For all types of flexible bulk containers as a design type test.

6.11.5.3.9.2 Preparation for testing

The flexible bulk container shall be filled to its maximum permissible gross mass.

6.11.5.3.9.3 Method of testing

With the flexible bulk container placed on the ground, a 300 mm cut shall be made, completely penetrating all layers of the flexible bulk container on a wall of a wide face. The cut shall be made at a 45° angle to the principal axis of the flexible bulk container, halfway between the bottom surface and the top level of the contents. The flexible bulk container shall then be subjected to a uniformly distributed superimposed load equivalent to twice the maximum gross mass. The load must be applied for at least fifteen minutes. A flexible bulk container which is designed to be lifted from the top or the side shall, after removal of the superimposed load, be lifted clear of the floor and maintained in that position for a period of fifteen minutes.

6.11.5.3.9.4 Criterion for passing the test

The cut shall not propagate more than 25% of its original length.

6.11.5.3.10 Stacking test**6.11.5.3.10.1 Applicability**

For all types of flexible bulk containers as a design type test.

6.11.5.3.10.2 Preparation for testing

The flexible bulk container shall be filled to its maximum permissible gross mass.

6.11.5.3.10.3 Method of testing

The flexible bulk container shall be subjected to a force applied to its top surface that is four times the design load-carrying capacity for 24 hours.

6.11.5.3.10.4 Criterion for passing the test

There shall be no loss of contents during the test or after removal of the load.

6.11.5.4 Test report**6.11.5.4.1** A test report containing at least the following particulars shall be drawn up and shall be available to the users of the flexible bulk container:

1. Name and address of the test facility;
2. Name and address of applicant (where appropriate);
3. Unique test report identification;
4. Date of the test report;
5. Manufacturer of the flexible bulk container;
6. Description of the flexible bulk container design type (e.g. dimensions, materials, closures, thickness, etc) and/or photograph(s);
7. Maximum capacity/maximum permissible gross mass;
8. Characteristics of test contents, e.g. particle size for solids;
9. Test descriptions and results;
10. The test report shall be signed with the name and status of the signatory.

6.11.5.4.2 The test report shall contain statements that the flexible bulk container prepared as for carriage was tested in accordance with the appropriate provisions of this Chapter and that the use of other containment methods or components may render it invalid. A copy of the test report shall be available to the competent authority.**6.11.5.5 Marking****6.11.5.5.1** Each flexible bulk container manufactured and intended for use according to the provisions of RID shall bear marks that are durable, legible and placed in a location so as to be readily visible. Letters, numerals and symbols shall be at least 24 mm high and shall show:

- (a) The United Nations packaging symbol . This symbol shall not be used for any purpose other than certifying that a packaging, a flexible bulk container, a portable tank or an MEGC complies with the relevant requirements in Chapters 6.1, 6.2, 6.3, 6.5, 6.6, 6.7 or 6.11;
- (b) The code BK 3;
- (c) A capital letter designating the packing group(s) for which the design type has been approved:
Z for packing group III only;
- (d) The month and year (last two digits) of manufacture;

- (e) The character(s) identifying the country authorizing the allocation of the mark, indicated by the distinguishing sign used on vehicles in international road traffic⁴;
- (f) The name or symbol of the manufacturer and other identification of the flexible bulk container as specified by the competent authority;
- (g) The stacking test load in kg;
- (h) The maximum permissible gross mass in kg.

The marks shall be applied in the sequence shown in (a) to (h); each mark, required in these subparagraphs, shall be clearly separated, e.g. by a slash or space and presented in a way that ensures that all of the parts of the mark are easily identified.

6.11.5.5.2 Example of marking



BK3/Z/11 09
RUS/NTT/MK-14-10
56000/14000.

⁴ Distinguishing sign of the State of registration used on motor vehicles and trailers in international road traffic, e.g. in accordance with the Geneva Convention on Road Traffic of 1949 or the Vienna Convention on Road Traffic of 1968.

**Part 7 Provisions concerning the conditions
of carriage, loading, unloading and
handling**

Chapter 7.1 General provisions

- 7.1.1** The carriage of dangerous goods is subject to the mandatory use of a particular type of transport equipment in accordance with the provisions of this Chapter and Chapter 7.2 for carriage in packages and Chapter 7.3 for carriage in bulk. In addition, the provisions of Chapter 7.5 concerning loading, unloading and handling shall be observed.

Columns (16), (17) and (18) of Table A of Chapter 3.2 show the particular provisions of this Part that apply to specific dangerous goods.

NOTE: Wagons are allowed to be equipped with detection devices which indicate or react to the occurrence of a derailment, provided that the requirements for the authorisation for placing into service of such wagons are met.

The requirements for placing into service of wagons cannot prohibit or impose the use of such detection devices. The circulation of wagons shall not be restricted on the grounds of the presence or lack of such devices.

- 7.1.2** (Deleted)

- 7.1.3** Large containers, portable tanks, MEGCs and tank-containers which meet the definition of "container" given in the CSC (1972), as amended, or in IRS 50591 ("Roller units for horizontal transshipment – Technical conditions governing their use in international traffic")¹ and IRS 50592 ("Intermodal Transport Units (other than semi-trailers) for vertical transshipment and suitable for carriage on wagons – Minimum requirements")² published by UIC may not be used to carry dangerous goods unless the large container or the frame of the portable tank, MEGC or tank-container satisfies the provisions of the CSC or of IRS 50591 and IRS 50592 of UIC.

- 7.1.4** (Deleted)

- 7.1.5** (Reserved)

- 7.1.6** (Reserved)

- 7.1.7** (Deleted)

¹ First edition of IRS (International Railway Solution) applicable as from 1 June 2020.

² Third edition of IRS (International Railway Solution) applicable as from 1 December 2023.

Chapter 7.2 Provisions concerning carriage in packages

- 7.2.1** Unless otherwise provided in 7.2.2 to 7.2.4, packages may be loaded:
- (a) into closed wagons or into closed containers; or
 - (b) into sheeted wagons or into sheeted containers; or
 - (c) into open wagons (unsheeted) or into open containers (unsheeted).
- 7.2.2** Packages comprising packagings made of materials sensitive to moisture shall be loaded into closed or sheeted wagons or into closed or sheeted containers.
- 7.2.3** (Reserved)
- 7.2.4** When an alphanumeric code beginning with the letter "W" is shown in column (16) of Table A of Chapter 3.2, the following special provisions apply:
- W 1** Packages shall be loaded into closed or sheeted wagons or into closed or sheeted containers.
- W 2** Substances and articles of Class 1 shall be loaded into closed wagons or closed containers. Articles which, because of their dimensions or their mass, cannot be loaded into closed wagons or closed containers may equally be carried in open wagons or open containers. They shall be covered by sheets. Only wagons fitted with regulation sheet steel spark-guards shall be used for the carriage of substances and articles of divisions 1.1, 1.2, 1.3, 1.5 and 1.6, even when these substances and articles are loaded into large containers. For wagons fitted with a combustible floor, the sheet steel spark-guards shall not be fixed directly to the floor of the wagon.
- Military consignments of substances and articles of Class 1 which form part of military equipment and of the structure of military material, may also be loaded into open wagons under the following conditions:
- consignments shall be accompanied by the competent military authority or, by order of this authority,
 - means of initiation not having at least two effective protective devices shall be removed, unless the substances and articles are placed in locked military vehicles.
- W 3** For free-flowing powdery substances and for fireworks the floor of a wagon or container shall have a non-metallic surface or covering.
- W 4** (Reserved)
- W 5** Packages may not be carried in small containers.
- W 6** (Reserved)
- W 7** Packages shall be carried in a closed wagon or in a closed container provided with adequate ventilation.
- W 8** For the carriage of packages bearing an additional label in accordance with Model No. 1, only wagons fitted with regulation sheet steel spark-guards shall be used, even when these substances are loaded in large containers. For wagons fitted with a combustible floor, the sheet steel spark-guards shall not be fixed directly to the floor of the wagon.
- W 9** Packages shall be carried in closed wagons or in movable-roof wagons or in closed containers.
- W 10** IBCs shall be carried in closed or sheeted wagons or closed or sheeted containers.
- W 11** IBCs other than metal or rigid plastics IBCs shall be carried in closed or sheeted wagons or closed or sheeted containers.
- W 12** IBCs of type 31HZ2 (31HA2, 31HB2, 31HN2, 31HD2 and 31HH2) shall be carried in closed wagons or containers.
- W 13** When packed in 5H1, 5L1 or 5 M1 bags, shall be carried in closed wagons or containers.
- W 14** Aerosols and gas cartridges carried for the purposes of reprocessing or disposal under special provision 327 in Chapter 3.3 shall only be carried in ventilated or open wagons or containers.
- W 15** IBCs shall be carried in closed wagons or in closed containers.

Chapter 7.3 Provisions concerning carriage in bulk

7.3.1 General provisions

7.3.1.1 Goods may not be carried in bulk in bulk containers, containers or wagons unless:

- (a) either a special provision, identified by the code "BK" or a reference to a specific paragraph, explicitly authorizing this mode of carriage is indicated in column (10) of Table A of Chapter 3.2 and the relevant conditions of 7.3.2 are satisfied in addition to those of this section; or
- (b) a special provision, identified by the code "VC" or a reference to a specific paragraph, explicitly authorizing this mode of carriage is indicated in column (17) of Table A of Chapter 3.2 and the conditions of this special provision, together with any additional provision identified by the code "AP", as laid down in 7.3.3 are satisfied in addition to those of this section.

Nevertheless, empty packagings, uncleared, may be carried in bulk if the dangerous goods they have contained are allowed for this mode of carriage. The instructions for carriage in bulk mentioned in columns (10) or (17) of Table A of Chapter 3.2 for these goods shall be applied.

NOTE: For carriage in tanks, see Chapters 4.2 and 4.3.

7.3.1.2 Substances which may become liquid at temperatures likely to be encountered during carriage, are not permitted for carriage in bulk.

7.3.1.3 Bulk containers, containers or bodies of wagons shall be siftproof and shall be so closed that none of the contents can escape under normal conditions of carriage including the effect of vibration, or by changes of temperature, humidity or pressure.

7.3.1.4 Substances shall be loaded and evenly distributed in a manner that minimises movement that could result in damage to the bulk container, container or wagon or leakage of the dangerous goods.

7.3.1.5 Where venting devices are fitted they shall be kept clear and operable.

7.3.1.6 Substances shall not react dangerously with the material of the bulk container, container, wagon, gaskets, equipment including lids and tarpaulins and with protective coatings which are in contact with the contents or significantly weaken them. Bulk containers, containers or wagons shall be so constructed or adapted that the goods cannot penetrate between wooden floor coverings or come into contact with those parts of the bulk container, container or wagon that may be affected by the materials or residues thereof.

7.3.1.7 Before being filled and handed over for carriage, each bulk container, container or wagon shall be inspected and cleaned to ensure that it does not contain any residue on the interior or exterior of the bulk container, container or wagon that could:

- cause a dangerous reaction with the substance intended for carriage;
- detrimentally affect the structural integrity of the bulk container, container or wagon; or
- affect the dangerous goods retention capabilities of the bulk container, container or wagon.

7.3.1.8 During carriage, no dangerous residues shall adhere to the outer surfaces of bulk containers, containers or of the bodies of wagons.

7.3.1.9 If several closure systems are fitted in series, the system which is located nearest to the substance to be carried shall be closed first before filling.

7.3.1.10 Empty bulk containers, containers or wagons which have carried a dangerous solid substance in bulk shall be treated in the same manner as is required by RID for a filled bulk container, container or wagon, unless adequate measures have been taken to nullify any hazard.

7.3.1.11 If bulk containers, containers or wagons are used for the carriage in bulk of goods liable to cause a dust explosion, or evolve flammable vapours (e.g. for certain wastes) measures shall be taken to exclude sources of ignition and prevent dangerous electrostatic discharge during carriage, filling or discharge of the substance.

7.3.1.12 Substances, for example wastes, which may react dangerously with one another and substances of different classes and goods not subject to RID, which are liable to react dangerously with one another shall not be mixed together in the same bulk container, container or wagon. Dangerous reactions are:

- (a) combustion and/or evolution of considerable heat;
- (b) emission of flammable and/or toxic gases;
- (c) formation of corrosive liquids; or
- (d) formation of unstable substances.

- 7.3.1.13** Before a bulk container, container or wagon is filled it shall be visually examined to ensure it is structurally serviceable, its interior walls, ceiling and floors are free from protrusions or damage and that any inner liners or substance retaining equipment are free from rips, tears or any damage that would compromise its cargo retention capabilities. Structurally serviceable, where relevant to the means of transport concerned, means the bulk container, container or wagon does not have major defects in its structural components, such as top and bottom side rails, top and bottom end rails, door sill and header, floor cross members, corner posts, and corner fittings of a bulk container or container. Major defects, where relevant to the means of transport concerned, include:
- (a) Bends, cracks or breaks in the structural or supporting members, or any damage to service or operational equipment that affect the integrity of the bulk container, container or of the body of the wagon;
 - (b) Any distortion of the overall configuration or any damage to lifting attachments or handling equipment interface features great enough to prevent proper alignment of handling equipment, mounting and securing on a chassis or wagon or vehicle, or insertion into ships' cells; and, where applicable
 - (c) Door hinges, door seals and hardware that are seized, twisted, broken, missing, or otherwise inoperative.
- 7.3.2 Provisions for the carriage in bulk when the provisions of 7.3.1.1 (a) are applied**
- 7.3.2.1** In addition to the general provisions of section 7.3.1, the provisions of this section are applicable. The codes BK 1, BK 2 and BK 3 in column (10) of Table A of Chapter 3.2 have the following meanings:
- BK 1: Carriage in bulk in sheeted bulk containers is permitted;
- BK 2: Carriage in bulk in closed bulk containers is permitted;
- BK 3: Carriage in flexible bulk containers is permitted.
- 7.3.2.2** The bulk container used shall conform to the requirements of Chapter 6.11.
- 7.3.2.3 Goods of Class 4.2**
- The total mass carried in a bulk container shall be such that its spontaneous ignition temperature is greater than 55 °C.
- 7.3.2.4 Goods of Class 4.3**
- These goods shall be carried in bulk containers which are watertight.
- 7.3.2.5 Goods of Class 5.1**
- Bulk containers shall be so constructed or adapted that the goods cannot come into contact with wood or any other incompatible material.
- 7.3.2.6 Goods of Class 6.2**
- 7.3.2.6.1 Animal material of Class 6.2**
- Animal material containing infectious substances (UN Nos. 2814, 2900 and 3373) is authorized for carriage in bulk containers provided the following conditions are met:
- (a) Sheeted bulk containers BK 1 are permitted provided that they are not filled to maximum capacity to avoid substances coming into contact with the sheeting. Closed bulk containers BK 2 are also permitted;
 - (b) Closed and sheeted bulk containers, and their openings, shall be leak-proof by design or by the fitting of a suitable liner;
 - (c) The animal material shall be thoroughly treated with an appropriate disinfectant before loading prior to carriage;
 - (d) Sheeted bulk containers shall be covered by an additional top liner weighted down by absorbent material treated with an appropriate disinfectant;
 - (e) Closed or sheeted bulk containers shall not be re-used until after they have been thoroughly cleaned and disinfected.
- NOTE:** Additional provisions may be required by appropriate national health authorities.
- 7.3.2.6.2 Wastes of Class 6.2 (UN No. 3291)**
- (a) (Reserved);
 - (b) Closed bulk containers and their openings shall be leakproof by design. These bulk containers shall have non porous interior surfaces and shall be free from cracks or other features which could damage packagings inside, impede disinfection or permit inadvertent release;

- (c) Wastes of UN No. 3291 shall be contained within the closed bulk container in UN type tested and approved sealed leakproof plastics bags tested for solids of packing group II and marked in accordance with 6.1.3.1. Such plastics bags shall be capable of passing the tests for tear and impact resistance according to ISO 7765-1:1988 "Plastics film and sheeting – Determination of impact resistance by the free-falling dart method – Part 1: Staircase methods" and ISO 6383-2:1983 "Plastics – Film and sheeting – Determination of tear resistance – Part 2: Elmendorf method". Each bag shall have an impact resistance of at least 165 g and a tear resistance of at least 480 g in both parallel and perpendicular planes with respect to the length of the bag. The maximum net mass of each plastics bag shall be 30 kg;
- (d) Single articles exceeding 30 kg such as soiled mattresses may be carried without the need for a plastics bag when authorized by the competent authority;
- (e) Wastes of UN No. 3291 which contain liquids shall only be carried in plastics bags containing sufficient absorbent material to absorb the entire amount of liquid without it spilling in the bulk container;
- (f) Wastes of UN No. 3291 containing sharp objects shall only be carried in UN type tested and approved rigid packagings meeting the provisions of packing instructions P 621, IBC 620 or LP 621;
- (g) Rigid packagings specified in packing instructions P621, IBC620 or LP621 may also be used. They shall be properly secured to prevent damage during normal conditions of carriage. Wastes carried in rigid packagings and plastics bags together in the same closed bulk container shall be adequately segregated from each other, e.g. by suitable rigid barriers or dividers, mesh nets or otherwise securing, such that they prevent damage to the packagings during normal conditions of carriage;
- (h) Wastes of UN No. 3291 in plastics bags shall not be compressed in a closed bulk container in such a way that bags may be rendered no longer leakproof;
- (i) The closed bulk container shall be inspected for leakage or spillage after each journey. If any wastes of UN No. 3291 have leaked or been spilled in the closed bulk container, it shall not be re-used until after it has been thoroughly cleaned and, if necessary, disinfected or decontaminated with an appropriate agent. No other goods shall be carried together with UN No. 3291 other than medical or veterinary wastes. Any such other wastes carried in the same closed bulk container shall be inspected for possible contamination.

7.3.2.7 Material of Class 7

For the carriage of unpackaged radioactive material, see 4.1.9.2.4.

7.3.2.8 Goods of Class 8

These goods shall be carried in bulk containers which are watertight.

7.3.2.9 Goods of Class 9

- 7.3.2.9.1** For UN No. 3509, only closed bulk containers (code BK 2) may be used. Bulk containers shall be made leak tight or fitted with a leak tight and puncture resistant sealed liner or bag, and shall have a means of retaining any free liquid that might escape during carriage, e.g. absorbent material. Packagings, discarded, empty, uncleaned with residues of Class 5.1 shall be carried in bulk containers which have been so constructed or adapted that the goods cannot come into contact with wood or any other combustible material.

7.3.2.10 Use of flexible bulk containers

NOTE: Flexible bulk containers marked in accordance with 6.11.5.5 but which were approved in a country which is not an RID Contracting State may nevertheless be used for carriage under RID.

- 7.3.2.10.1** Before a flexible bulk container is filled it shall be visually examined to ensure it is structurally serviceable, its textile slings, load-bearing structure straps, body fabric, lock device parts including metal and textile parts are free from protrusions or damage and that inner liners are free from rips, tears or any damage.
- 7.3.2.10.2** For flexible bulk containers, the period of use permitted for the carriage of dangerous goods shall be two years from the date of manufacture of the flexible bulk container.
- 7.3.2.10.3** A venting device shall be fitted if a dangerous accumulation of gases may develop within the flexible bulk container. The vent shall be so designed that the penetration of foreign substances or ingress of water is prevented under normal conditions of carriage.
- 7.3.2.10.4** Flexible bulk containers shall be filled in such a way that when loaded the ratio of height to width does not exceed 1.1. The maximum gross mass of the flexible bulk containers shall not exceed 14 tonnes.

7.3.3 Provisions for carriage in bulk when the provisions of 7.3.1.1 (b) are applied

7.3.3.1 In addition to the general provisions of section 7.3.1, the provisions of this section are applicable, when they are shown under an entry in column (17) of Table A of Chapter 3.2. Sheeted or closed wagons or sheeted or closed containers used under this section need not be in conformity with the requirements of Chapter 6.11. The codes VC 1, VC 2 and VC 3 in column (17) of Table A of Chapter 3.2 have the following meanings:

NOTE: Where a VC 1 code is shown in column (17) of Table A of Chapter 3.2, a BK 1 bulk container may therefore also be used for land transport provided the additional provisions in 7.3.3.2 are fulfilled. Where a VC 2 code is shown in column (17) of Table A of Chapter 3.2, a BK 2 bulk container may therefore also be used for land transport provided the additional provisions in 7.3.3.2 are fulfilled.

VC 1 Carriage in bulk in sheeted wagons, sheeted containers or sheeted bulk containers is permitted;

VC 2 Carriage in bulk in closed wagons, closed containers or closed bulk containers is permitted;

VC 3 Carriage in bulk is permitted in specially equipped wagons or large containers in accordance with standards specified by the competent authority of the country of origin. If the country of origin is not an RID Contracting State, the conditions laid down shall be recognized by the competent authority of the first RID Contracting State reached by the consignment.

7.3.3.2 When the VC bulk codes are used, the following additional provisions shown in column (17) of Table A of Chapter 3.2 shall apply:

7.3.3.2.1 Goods of Class 4.1

AP 1 Wagons and containers shall have a metal body and where fitted the sheet shall be non-combustible.

AP 2 Wagons and containers shall have adequate ventilation.

7.3.3.2.2 Goods of Class 4.2

AP 1 Wagons and containers shall have a metal body and where fitted the sheet shall be non-combustible.

7.3.3.2.3 Goods of Class 4.3

AP 2 Wagons and containers shall have adequate ventilation.

AP 3 Sheeted wagons and sheeted containers shall be used only when the substance is in pieces (not in powder, granular, dust or ashes form).

AP 4 Closed wagons and closed containers shall be equipped with hermetically closed openings used for filling and discharging to prevent the exit of gas and exclude the ingress of moisture.

AP 5 The cargo doors of the closed wagons or closed containers shall be marked with the following in letters not less than 25 mm high:

"WARNING
NO VENTILATION
OPEN WITH CAUTION"

This shall be in a language considered appropriate by the consignor.

7.3.3.2.4 Goods of Class 5.1

AP 6 If the wagon or container is made of wood or other combustible material, an impermeable surfacing resistant to combustion or a coating of sodium silicate or similar substance shall be provided. Sheeting shall also be impermeable and non-combustible.

AP 7 Carriage in bulk shall only be as a full load.

7.3.3.2.5 Goods of Class 6.1

AP 7 Carriage in bulk shall only be as a full load.

7.3.3.2.6 Goods of Class 8

AP 7 Carriage in bulk shall only be as a full load.

AP 8 The design of the load compartment of wagons or containers shall take account of any residual currents and impacts from the batteries.

The load compartments of wagons or containers shall be of steel resistant to the corrosive substances contained in the batteries. Less resistant steels may be used when there is a sufficiently great wall thickness or a plastics lining/layer resistant to the corrosive substances.

NOTE: Steel exhibiting a maximum rate of progressive reduction of 0.1 mm per year under the effects of the corrosive substances may be considered as resistant.

The load compartments of wagons or containers shall not be loaded above the top of their walls.

Carriage is also permitted in small plastics containers which shall be capable of withstanding, when fully loaded, a drop from a height of 0.8 m onto a hard surface at -18 °C, without breakage.

7.3.3.2.7 Goods of Class 9

AP 2 Wagons and containers shall have adequate ventilation.

AP 9 Carriage in bulk is permitted for solids (substances or mixtures, such as preparations or wastes) containing on average not more than 1 000 mg/kg of substance to which this UN number is assigned. At no point of the load shall the concentration of this substance or these substances be higher than 10 000 mg/kg.

AP 10 Wagons and containers shall be made leak tight or fitted with a leak tight and puncture resistant sealed liner or bag, and shall have a means of retaining any free liquid that might escape during carriage, e.g. absorbent material. Packagings, discarded, empty, uncleaned with residues of Class 5.1 shall be carried in wagons and containers which have been so constructed or adapted that the goods cannot come into contact with wood or any other combustible material.

AP 11 In accordance with VC 3 in 7.3.3.1, for the purpose of carriage in bulk of molten aluminium, "standards specified by the competent authority of the country of origin" means that the following requirements shall be met.

1. General requirements

1.1 Vat means a containment intended for the carriage of molten aluminium of UN No. 3257, including its shell, refractory lining and service and structural equipment.

1.2 Vats shall be insulated so as not to exceed a surface temperature of 130 °C during carriage and shall be so positioned that the means of containment cannot be touched by other persons under normal conditions of carriage. The surface temperature shall in no case have a detrimental effect on the functioning of the wagon.

1.3 The vats shall be secured on the wagon in accordance with the load securing principles of 7.5.7.1.

1.4 Vats need not be affixed with placards and markings in accordance with Chapter 5.3 if these placards and markings have been affixed to the wagon.

2. Fire and explosion protection

The risk of fire by the thermal influence of the molten aluminium on the vat, the wagon or load securing aids, and the risk of explosion resulting from escaping vapours or chemical reaction of gases that have evolved, shall be prevented (e.g. by using inert gases).

3. Construction of vats

Vats shall be made of steel. Vats shall be designed and manufactured for a test pressure of 4 bar in accordance with EN 13445-3:2014. In the course of construction, the manufacturer shall specify the weld seams that are subject to the highest stresses. The hydrostatic pressure and surge effect of the molten aluminium shall be taken into account when deciding the dimensions of the vats and their attachment to the wagon. The forces in 6.8.2.1.2 shall be taken into account.

The vat closures shall be designed in accordance with EN 13445-3:2014 and shall remain leakproof if a vat with contents (lateral position and top of the vat) overturns.

The filling and discharge openings shall be protected by the construction of the vat, e.g. by collars, deflectors, cages or equivalent constructions.

The protective device on the top of the vat shall be designed so as to withstand, without permanent deformation, a static load, applied vertically on the filling cover, equal to twice the maximum permissible mass of the vat (2g).

The refractory lining shall be suitable to withstand the contents and it shall be suitable as insulation material.

The refractory 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).

The inspection body performing inspections in accordance with 6.8.2.4.1 or 6.8.2.4.4, shall verify and confirm the ability of the manufacturer or the maintenance or repair shop to perform welding operations and the operation of a weld quality assurance system. Welding work on the sheet metal jacket, in particular on load-bearing parts, may only be carried out by approved welding companies.

Seals on vat covers and closures shall be selected and applied so that they prevent molten aluminium from flowing out if a full vat overturns.

4. Inspection and tests of vats

The inspections and tests described in 4.1 to 4.5 shall be carried out by an inspection body approved by the competent authority. The inspections and tests shall be carried out in accordance with the applicable requirements of EN 12972:2018 + A1:2024. Test reports on the results of the tests performed shall be issued.

4.1 Type examination of vats

The construction design and workmanship shall be tested as part of a type examination procedure to ensure that the vats comply with the construction requirements of EN 13445-3:2014. The weld seams subject to the highest stresses shall be identified in the type examination report.

4.2 Initial inspection

Vats shall be tested and inspected before they are placed in service.

The test shall at least include:

- (a) A check to ensure that the vat is in line with the type examination documents;
- (b) A check of conformity to the type;
- (c) An examination of the external condition;
- (d) A hydraulic pressure test at a test pressure of 4 bar; at this stage, the vats shall not have a refractory lining;
- (e) An examination of the internal condition (visual inspection of the internal metal surface of the vat before the refractory lining is fitted and visual inspection of the refractory lining);
- (f) A check of satisfactory operation of the equipment.

The hydraulic pressure test can also be carried out with an alternative seal.

4.3 Intermediate inspection

Vats shall undergo an intermediate inspection no later than six years after the initial inspection and each periodic inspection.

The intermediate inspection shall at least include:

- (a) An examination of the documents;
- (b) An examination of the external condition, including the integrity of the flange and cover connections;
- (c) Measurement of the wall thickness to check the required minimum wall thickness;
- (d) Non-destructive testing of weld seams that are subject to the highest stresses by magnetic particle testing, penetration testing, ultrasonic testing or radiographic testing;
- (e) An examination of the internal condition (visual inspection of the refractory lining) by an expert under the responsibility of the operator;
- (f) A check of satisfactory operation of the equipment.

These intermediate inspections may be performed within three months before the specified date, without any influence on the time frame of other inspections according to 4.3 and 4.4.

4.4 Periodic inspection

Each time the refractory lining is renewed, or no later than twelve years after the initial or most recent periodic inspection, a periodic inspection shall be carried out.

The periodic inspection shall at least include:

- (a) An examination of the documents;
- (b) An examination of the external condition, including the integrity of the flange and cover connections;
- (c) An examination of the internal condition (visual inspection of the internal metal surface of the vat before the refractory lining is fitted and visual inspection of the refractory lining);
- (d) Non-destructive testing of all weld seams that are subject to the highest stresses shall be carried out by magnetic particle testing, penetration testing, ultrasonic testing or radiographic testing;
- (e) Measurement of the wall thickness to check the required minimum wall thickness;
- (f) Hydraulic pressure test at a test pressure of 4 bar, at this stage, the vats shall not have a refractory lining;
- (g) A check of satisfactory operation of the equipment.

The hydraulic pressure test can also be carried out with an alternative seal.

4.5 Exceptional inspection of vats

When the safety of the vat or of its equipment may have been impaired as a result of repairs, alterations or accident, an exceptional inspection shall be carried out on the parts affected by the repairs or alterations. If the exceptional inspection fulfilling the requirements of 4.4 has been performed, then the exceptional inspection may be considered to be a periodic inspection. If an exceptional inspection fulfilling the requirements of 4.3 has been performed, then the exceptional inspection may be considered to be an intermediate inspection. The inspection body shall decide the detailed scope of the exceptional inspection, taking into account EN 12972:2018 + A1:2024, Table A1.

5. Marking of vats

Vats shall be marked with a plate by analogy with 6.8.2.5.1, except the approval number and external design pressure. For the tests and inspections in accordance with 4.2 and 4.4, the marking shall be followed by "P". For the tests and inspections in accordance with 4.3, the marking shall be followed by "L".

6. Requirements for operation

The owner or the operator shall keep a copy of the type examination report, the results of the initial tests and inspections and all subsequent tests and inspections in the vat file.

Every renewal and repair of the refractory lining shall be recorded by the operator or manufacturer.

Seals shall be checked with each filling and renewed if necessary.

Vats shall be positioned on the wagons in such a way that the discharge openings face or are opposite to the direction of travel

AP 12 The waste may be carried in bulk provided that it is contained in a bag of the size of the load compartment, referred to as a "container-bag".

The container-bag is intended to be loaded only when placed inside a bulk load compartment with rigid walls. It is not intended for handling or to be used alone outside of this compartment.

For the purposes of this provision, container-bags shall have at least two components.

The inner component shall be dust-tight to prevent the release of dangerous quantities of asbestos fibres during carriage. The inner component shall be a polyethylene or polypropylene film.

The outer component shall be polypropylene and shall be fitted with a zipper system. It shall ensure the mechanical resistance of a container-bag loaded with waste to the shocks and stresses in normal conditions of carriage, in particular when a load compartment loaded with container-bags is transferred between wagons and storage facilities.

Container-bags shall:

- (a) Be designed to resist perforation or tearing by contaminated waste or objects due to their angles or roughness;
- (b) Have a zipper system that is sufficiently tight to prevent the release of dangerous quantities of asbestos fibres during carriage. Laced or flapped fasteners are not authorized.

The load compartment shall have rigid metal walls of sufficient strength for its intended use. The walls shall be sufficiently high to completely contain the container-bag. Provided the container-bag offers similar protection, the sheeting of the wagon can be omitted when using the VC 1 provision.

Objects contaminated with free asbestos from damaged structures or buildings, as well as construction site waste contaminated with free asbestos from demolished or rehabilitated structures or buildings as mentioned in special provision 678 (b) (iii), (iv) and (v), shall be carried in a container-bag placed inside a second container-bag of the same type. The total mass of the contained waste shall not exceed 7 tonnes.

In all cases, the maximum mass of the waste shall not exceed the capacity specified by the container-bag manufacturer.

Chapter 7.4 Provisions concerning carriage in tanks

Dangerous goods may only be carried in tanks when a portable tank instruction is shown in column (10) or when a tank code is shown in column (12) of Table A of Chapter 3.2, or when a competent authority has issued an approval in accordance with the conditions specified in 6.7.1.3. The requirements of Chapters 4.2, 4.3 or 4.5 as applicable shall be observed during carriage.

Chapter 7.5 Provisions concerning loading, unloading and handling

7.5.1 General provisions

7.5.1.1 The requirements in force at the forwarding station shall be complied with for the loading of goods, provided they do not conflict with the requirements of this Chapter.

7.5.1.2 Unless otherwise specified in RID, the loading shall not be carried out if:

- an examination of the documents or
- a visual inspection of the wagon or of the container(s), bulk container(s), MEGC(s), tank-container(s), portable tank(s) or road vehicle(s), if any, as well as of their equipment used in loading and unloading, shows that the wagon, a container, a bulk-container, an MEGC, a tank-container, a portable tank, a road vehicle or their equipment do not comply with the regulatory provisions.

The interior and the exterior of a wagon or container shall be inspected prior to loading to ensure that there is no damage that could affect its integrity or that of the cargo to be loaded in it.

The cargo transport unit shall be checked to ensure it is structurally serviceable, that it is free of possible residues incompatible with the cargo and that the interior floor, walls and ceiling, where applicable, are free from protrusions or deterioration that could affect the cargo inside and that large containers are free of damages that affect the weather-tight integrity of the container, when required.

Structurally serviceable means that the cargo transport unit is free from major defects in its structural components. Structural components of cargo transport units for multimodal purpose are e.g. top and bottom side rails, top and bottom end rails, corner posts, corner fittings and, for large containers, door sill, door header and floor cross members.

Major defects include:

- (a) Bends, cracks or breaks in structural or supporting members and any damage to service or operational equipment that affect the integrity of the cargo transport unit;
- (b) Any distortion of the over-all configuration or any damage to lifting attachments or handling equipment interface features great enough to prevent proper alignment of handling equipment, mounting and securing on a chassis or wagon or vehicle, or insertion into ships' cells; and, where applicable;
- (c) Door hinges, door seals and hardware that are seized, twisted, broken, missing or otherwise inoperative.

7.5.1.3 Unless otherwise specified in RID, the unloading shall not be carried out if the above-mentioned inspections reveal deficiencies that might affect the safety or the security of the unloading.

7.5.1.4 In accordance with the special provisions of 7.5.11 and in conformity with column (18) of Table A of Chapter 3.2, certain dangerous goods shall only be forwarded as a full load.

7.5.1.5 When orientation arrows are required packages and overpacks shall be oriented in accordance with such marks.

NOTE: Liquid dangerous goods shall be loaded below dry dangerous goods whenever practicable.

7.5.1.6 All means of containment shall be loaded and unloaded in conformity with a handling method for which they have been designed and, where required, tested.

7.5.2 Mixed loading prohibition

7.5.2.1 Packages bearing different danger labels shall not be loaded together in the same wagon or container unless mixed loading is permitted according to the following Table based on the danger labels they bear.

The mixed loading prohibitions for packages shall also apply to the mixed loading of packages and small containers and the mixed loading of small containers in a wagon or large container in which small containers are carried.

NOTE 1: In accordance with 5.4.1.4.2, separate transport documents shall be drawn up for consignments that cannot be loaded together in the same wagon or container.

- 2:** For packages containing substances or articles only of Class 1 and bearing a label conforming to models Nos. 1, 1.4, 1.5 or 1.6, irrespective of any other danger labels required for these packages, mixed loading shall be permitted in accordance with 7.5.2.2. The Table in 7.5.2.1 shall only apply when such packages are loaded together with packages containing substances or articles of other classes.

Labels Nos.	1	1.4	1.5	1.6	2.1, 2.2, 2.3	3	4.1	4.1 + 1	4.2	4.3	5.1	5.2	5.2 + 1	6.1	6.2	7A, 7B, 7C	8	9, 9A
1	See 7.5.2.2										(d)							(b)
1.4					(a)	(a)	(a)		(a)	(a)	(a)	(a)		(a)	(a)	(a)	(a)	(a), (b), (c)
1.5																		(b)
1.6																		(b)
2.1, 2.2, 2.3		(a)			X	X	X		X	X	X	X		X	X	X	X	X
3		(a)			X	X	X		X	X	X	X		X	X	X	X	X
4.1		(a)			X	X	X		X	X	X	X		X	X	X	X	X
4.1 + 1								X										
4.2		(a)			X	X	X		X	X	X	X		X	X	X	X	X
4.3		(a)			X	X	X		X	X	X	X		X	X	X	X	X
5.1	(d)	(a)			X	X	X		X	X	X	X		X	X	X	X	X
5.2		(a)			X	X	X		X	X	X	X	X	X	X	X	X	X
5.2 + 1												X	X					
6.1		(a)			X	X	X		X	X	X	X		X	X	X	X	X
6.2		(a)			X	X	X		X	X	X	X		X	X	X	X	X
7A, 7B, 7C		(a)			X	X	X		X	X	X	X		X	X	X	X	X
8		(a)			X	X	X		X	X	X	X		X	X	X	X	X
9, 9A	(b)	(a), (b), (c)	(b)	(b)	X	X	X		X	X	X	X		X	X	X	X	X

X Mixed loading permitted.

- (a) Mixed loading permitted with 1.4S substances and articles.
- (b) Mixed loading permitted between goods of Class 1 and life-saving appliances of Class 9 (UN Nos. 2990, 3072 and 3268).
- (c) Mixed loading permitted between safety devices, pyrotechnic of Division 1.4, compatibility group G, (UN No. 0503) and safety devices, electrically initiated of Class 9 (UN No. 3268).
- (d) Mixed loading permitted between blasting explosives (except UN 0083 explosive, blasting, type C) and ammonium nitrate (UN Nos. 1942 and 2067), ammonium nitrate emulsion or suspension or gel (UN No. 3375) and alkali metal nitrates and alkaline earth metal nitrates provided the aggregate is treated as blasting explosives under Class 1 for the purposes of placarding, segregation, stowage and maximum permissible load. Alkali metal nitrates include caesium nitrate (UN No. 1451), lithium nitrate (UN No. 2722), potassium nitrate (UN No. 1486), rubidium nitrate (UN No. 1477) and sodium nitrate (UN No. 1498). Alkaline earth metal nitrates include barium nitrate (UN No. 1446), beryllium nitrate (UN No. 2464), calcium nitrate (UN No. 1454), magnesium nitrate (UN No. 1474) and strontium nitrate (UN No. 1507).

7.5.2.2

Packages containing substances or articles of Class 1, bearing a label conforming to models Nos. 1, 1.4, 1.5 or 1.6 which are assigned to different compatibility groups shall not be loaded together in the same wagon or container, unless mixed loading is permitted in accordance with the following Table for the corresponding compatibility groups.

Compatibility Group	B	C	D	E	F	G	H	J	L	N	S
B	X		(a)								X
C		X	X	X		X				(b), (c)	X
D	(a)	X	X	X		X				(b), (c)	X
E		X	X	X		X				(b), (c)	X
F					X						X
G		X	X	X		X					X
H							X				X
J								X			X
L									(d)		
N		(b), (c)	(b), (c)	(b), (c)						(b)	X
S	X	X	X	X	X	X	X	X		X	X

X Mixed loading permitted.

- (a) Packages containing articles of compatibility group B and those containing substances or articles of compatibility group D may be loaded together in one wagon or in one container provided they are effectively segregated such that there is no danger of transmission of detonation from the articles of compatibility group B to the substances or articles of compatibility group D. Segregation shall be achieved by the use of separate compartments or by placing one of the two types of explosive in a special containment system. Either method of segregation shall be approved by the competent authority.

- (b) Different types of articles of division 1.6, compatibility group N, may be carried together as articles of division 1.6, compatibility group N, only when it is proven by testing or analogy that there is no additional hazard of sympathetic detonation between the articles. Otherwise they should be treated as hazard division 1.1.
- (c) When articles of compatibility group N are carried with substances or articles of compatibility groups C, D or E, the articles of compatibility group N should be considered as having the characteristics of compatibility group D.
- (d) Packages containing substances and articles of compatibility group L may be loaded together in one wagon or in one container with packages containing the same type of substances and articles of that compatibility group.

7.5.2.3 (Reserved)

7.5.2.4 Mixed loading of dangerous goods packed in limited quantities with any type of explosive substances and articles, except those of Division 1.4 and UN Nos. 0161 and 0499, is prohibited.

7.5.3 Protective distance

Every wagon, large container, portable tank or road vehicle containing substances or articles of Class 1 and bearing a placard conforming to models Nos. 1, 1.5 or 1.6, shall be separated on the same train from wagons, large containers, portable tanks, tank-containers, MEGCs or road vehicles bearing a placard conforming to models Nos. 2.1, 3, 4.1, 4.2, 4.3, 5.1 or 5.2 or road vehicles for which the transport document indicates that they are containing packages bearing a label conforming to models Nos. 2.1, 3, 4.1, 4.2, 4.3, 5.1 or 5.2 by a protective distance.

The requirement for this protective distance is met if the space between the buffer head of a wagon or the end wall of a large container, portable tank or road vehicle and the buffer head of another wagon or the end wall of another large container, portable tank, tank-container, MEGC or road vehicle is:

- (a) at least 18 m, or
- (b) occupied by two 2-axle wagons or a wagon with 4 or more axles.

7.5.4 Precautions with respect to foodstuffs, other articles of consumption and animal feeds

If special provision CW 28 is indicated for a substance or article in column (18) of Table A of Chapter 3.2, precautions with respect to foodstuffs, other articles of consumption and animal feeds shall be taken as follows:

Packages as well as uncleaned empty packagings, including large packagings and intermediate bulk containers (IBCs), bearing labels conforming to models Nos. 6.1 or 6.2 and those bearing labels conforming to model No. 9 containing goods of UN Nos. 2212, 2315, 2590, 3151, 3152 or 3245, shall not be stacked on or loaded in immediate proximity to packages known to contain foodstuffs, other articles of consumption or animal feeds in wagons, in containers and at places of loading, unloading or transhipment.

When these packages, bearing the said labels, are loaded in immediate proximity of packages known to contain foodstuffs, other articles of consumption or animal feeds, they shall be kept apart from the latter:

- (a) by complete partitions which should be as high as the packages bearing the said labels;
- (b) by packages not bearing labels conforming to models Nos. 6.1, 6.2 or 9 or packages bearing labels conforming to model No.9 but not containing goods of UN Nos. 2212, 2315, 2590, 3151, 3152 or 3245; or
- (c) by a space of at least 0.8 m;

unless the packages bearing the said labels are provided with an additional packaging or are completely covered (e.g. by a sheeting, a fibreboard cover or other measures).

7.5.5 (Reserved)

7.5.6 (Reserved)

7.5.7 Handling and stowage

7.5.7.1 Where appropriate the wagon or container shall be fitted with devices to facilitate securing and handling of the dangerous goods. Packages containing dangerous substances and unpackaged dangerous articles shall be secured by suitable means capable of restraining the goods (such as fastening straps, sliding slatboards, adjustable brackets) in the wagon or container in a manner that will prevent any movement during carriage which would change the orientation of the packages or cause them to be damaged. When dangerous goods are carried with other goods (e.g. heavy machinery or crates), all goods shall be securely fixed or packed in the wagons or containers so as to prevent the release of dangerous goods. Movement of packages may also be prevented by filling any voids by the use of dunnage or by blocking and bracing. Where restraints such

as banding or straps are used, these shall not be over-tightened to cause damage or deformation of the package.³

7.5.7.2 Packages shall not be stacked unless designed for that purpose. Where different design types of packages that have been designed for stacking are to be loaded together, consideration shall be given to their compatibility for stacking with each other. Where necessary, stacked packages shall be prevented from damaging the package below by the use of load-bearing devices.

7.5.7.3 During loading and unloading, packages containing dangerous goods shall be protected from being damaged.

NOTE: Particular attention shall be paid to the handling of packages during their preparation for carriage, the type of wagon or container on which they are to be carried and to the method of loading or unloading, so that accidental damage is not caused through dragging or mishandling the packages.

7.5.7.4 The provisions of 7.5.7.1 shall also apply to the loading, stowage and removal of containers, tank-containers, portable tanks and MEGCs on to and from wagons. When tank-containers, portable tanks and MEGCs do not include, by construction, corner castings as defined in ISO 1496-1 Series 1 freight containers – Specification and testing – Part 1: General cargo containers for general purposes, it shall be verified that the systems used on the tank-containers, portable tanks or MEGCs are compatible with the system on the wagon.

7.5.7.5 (Reserved)

7.5.7.6 Loading of flexible bulk containers

7.5.7.6.1 Flexible bulk containers shall be carried within a wagon or container with rigid sides and ends that extend at least two-thirds of the height of the flexible bulk container.

NOTE: When loading flexible bulk containers in a wagon or container particular attention shall be paid to the guidance on the handling and stowage of dangerous goods referred to in 7.5.7.1.

7.5.7.6.2 Flexible bulk containers shall be secured by suitable means capable of restraining them in the wagon or container in a manner that will prevent any movement during carriage which would change the position of the flexible bulk container or cause it to be damaged. Movement of the flexible bulk containers may also be prevented by filling any voids by the use of dunnage or by blocking and bracing. Where restraints such as banding or straps are used, these shall not be over-tightened to cause damage or deformation to the flexible bulk containers.

7.5.7.6.3 Flexible bulk containers shall not be stacked.

7.5.8 Cleaning after unloading

7.5.8.1 If, when a wagon or container which has contained packaged dangerous goods is unloaded, some of the contents are found to have escaped, the wagon or container shall be cleaned as soon as possible and in any case before reloading.

If it is not possible to do the cleaning locally, the wagon or container shall be carried, with due regard to adequate safety, to the nearest suitable place where cleaning can be carried out.

Carriage is adequately safe if suitable measures have been taken to prevent the uncontrolled release of the dangerous goods that have escaped.

7.5.8.2 Wagons or containers which have been loaded with dangerous goods in bulk shall be properly cleaned before reloading unless the new load consists of the same dangerous goods as the preceding load.

7.5.9 (Reserved)

7.5.10 (Reserved)

³ Guidance on the stowage of dangerous goods can be found in the IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units (CTU Code) (see e.g. Chapter 9 Packing cargo into CTUs and Chapter 10 Additional advice on the packing of dangerous goods). Other guidance is also available from competent authorities and industry and transport bodies, particularly in the "Loading Guidelines – Code of practice for the loading and securing of goods on railway wagons", published by the International Union of Railways (UIC).

7.5.11 Additional provisions applicable to certain classes or specific goods

In addition to the provisions of 7.5.1 to 7.5.4 and 7.5.8, the following special provisions shall apply when an alphanumeric code beginning with "CW" is shown in column (18) of Table A of Chapter 3.2.

CW 1 Before loading, the floor of the wagon or container shall be carefully cleaned by the consignor.

No metal objects in the interior of the wagon or container other than those forming part of the construction of the wagon or container shall be allowed to protrude.

The doors and ventilator shutters of the wagons or containers shall be closed.

Packages shall be so loaded and stowed in the wagon or container that they cannot move or shift. They shall be protected against any chafing or bumping.

CW 2 (Reserved)

CW 3 (Reserved)

CW 4 Substances and articles of compatibility group L shall only be carried as a full load.

CW 5 (Reserved)

CW 6 (Reserved)

CW 7 (Reserved)

CW 8 (Reserved)

CW 9 Packages shall not be thrown or subjected to impact.

CW 10 Cylinders as defined in 1.2.1, shall be laid parallel to or at right angles to the longitudinal axis of the wagon or container; however, those situated near the forward transverse wall shall be laid at right angles to the said axis.

Short cylinders of large diameter (about 30 cm and over) may be stowed longitudinally with their valve-protecting devices directed towards the middle of the wagon or container.

Cylinders which are sufficiently stable or are carried in suitable devices effectively preventing them from overturning may be placed upright.

Cylinders which are laid flat shall be securely and appropriately wedged, attached or secured so that they cannot shift.

Receptacles designed to be rolled shall be laid with their longitudinal axis parallel to that of the wagon or container and shall be secured against any lateral movement.

CW 11 Receptacles shall always be placed in the position for which they were designed and be protected against any possibility of being damaged by other packages.

CW 12 When pallets loaded with articles are stacked, each tier of pallets shall be evenly distributed over the lower tier, if necessary by the interposition of a material of adequate strength.

CW 13 If any substances have leaked and been spilled in a wagon or container, it may not be re-used until after it has been thoroughly cleaned and, if necessary, disinfected or decontaminated. Any other goods and articles carried in the same wagon or container shall be examined for possible contamination.

CW 14 Goods shall be shielded from direct sunlight and heat during carriage.

Packages shall be stored only in cool, well-ventilated places away from heat sources.

CW 15 (Reserved)

CW 16 Consignments of UN 1749 chlorine trifluoride with a gross mass of more than 500 kg shall only be carried as a full load and in quantities not exceeding 5000 kg per wagon or large container.

CW 17 Packages containing substances of this Class which are to be carried at a specific ambient temperature shall only be carried as a full load. The conditions of carriage shall be agreed between the consignor and the carrier.

CW 18 Packages shall be so stowed that they are readily accessible.

CW 19 (Reserved)

CW 20 (Reserved)

CW 21 (Reserved)

CW 22 Wagons and large containers shall be thoroughly cleaned before loading.

Packages shall be loaded so that a free circulation of air within the loading space provides a uniform temperature of the load. If the contents of one wagon or large container exceed 5000 kg of these substances, the load shall be divided into stacks of not more than 5000 kg separated by air spaces of at least 0.05 m. Packages shall be protected from being damaged by other packages.

CW 23 When handling packages, special measures shall be taken to ensure that they do not come into contact with water.

CW 24 Before loading, wagons and containers shall be thoroughly cleaned and in particular be free of any combustible debris (straw, hay, paper, etc.).

The use of readily flammable materials for stowing packages is prohibited.

CW 25 (Reserved)

CW 26 The wooden parts of a wagon or container which have come into contact with these substances shall be removed and burnt.

CW 27 (Reserved)

CW 28 See 7.5.4.

CW 29 Packages shall be stored upright.

CW 30 (Deleted)

CW 31 Wagons or large containers in which substances of this Class have been carried as full loads, or small containers in which these substances have been carried, shall be checked, after unloading, for any residues of the load.

CW 32 (Reserved)

CW 33 NOTE 1: "Critical group" means a group of members of the public which is reasonably homogeneous with respect to its exposure for a given radiation source and given exposure pathway and is typical of individual receiving the highest effective dose by the given exposure pathway from the given source.

2: "Members of the public" means in a general sense, any individuals in the population except when subject to occupational or medical exposure.

3: "Workers" are any persons who work, whether full time, part-time or temporarily, for an employer and who have recognised rights and duties in relation to occupational radiation protection.

(1) Segregation

(1.1) Packages, overpacks, containers and tanks containing radioactive material and unpackaged radioactive material shall be segregated during carriage:

(a) from workers in regularly occupied working areas:

- (i) in accordance with Table A below; or
- (ii) by distances calculated using a dose criterion of 5 mSv in a year and conservative model parameters;

NOTE: Workers subject to individual monitoring for the purposes of radiation protection shall not be considered for the purposes of segregation.

(b) from members of the public, in areas where the public has regular access:

- (i) in accordance with Table A below; or
- (ii) by distances calculated using a dose criterion of 1 mSv in a year and conservative model parameters;

(c) from undeveloped photographic film and mailbags:

- (i) in accordance with Table B below; or
- (ii) by distances calculated using a radiation exposure criterion for undeveloped photographic film due to the transport of radioactive material for 0.1 mSv per consignment of such film; and

NOTE: Mailbags shall be assumed to contain undeveloped film and plates and therefore be separated from radioactive material in the same way.

(d) from other dangerous goods in accordance with 7.5.2.

Table A: Minimum distances between packages of category II-YELLOW or of category III-YELLOW and persons

Sum of transport indexes not more than	Exposure time per year (hours)			
	Areas where members of the public have regular access		Regularly occupied working areas	
	50	250	50	250
	Segregation distance in metres, no shielding material intervening, from:			
2	1	3	0.5	1
4	1.5	4	0.5	1.5
8	2.5	6	1.0	2.5
12	3	7.5	1.0	3
20	4	9.5	1.5	4
30	5	12	2	5
40	5.5	13.5	2.5	5.5
50	6.5	15.5	3	6.5

Table B: Minimum distances between packages of category II-YELLOW or of category III-YELLOW and packages bearing the word "FOTO", or mailbags

Total number of packages not more than		Sum of transport indexes not more than	Journey or storage duration, in hours							
			1	2	4	10	24	48	120	240
III-YEL-LOW	II-YEL-LOW	Category	Minimum distances in metres							
		0.2	0.5	0.5	0.5	0.5	1	1	2	3
		0.5	0.5	0.5	0.5	1	1	2	3	5
	1	1	0.5	0.5	1	1	2	3	5	7
	2	2	0.5	1	1	1.5	3	4	7	9
	4	4	1	1	1.5	3	4	6	9	13
	8	8	1	1.5	2	4	6	8	13	18
1	10	10	1	2	3	4	7	9	14	20
2	20	20	1.5	3	4	6	9	13	20	30
3	30	30	2	3	5	7	11	16	25	35
4	40	40	3	4	5	8	13	18	30	40
5	50	50	3	4	6	9	14	20	32	45

(1.2) Category II-YELLOW or III-YELLOW packages or overpacks shall not be carried in compartments occupied by passengers, except those exclusively reserved for couriers specially authorized to accompany such packages or overpacks.

(1.3) (Reserved)

(2) Activity limits

The total activity in a wagon, for carriage of LSA material or SCO in Industrial Packages Type 1 (Type IP-1), Type 2 (Type IP-2), Type 3 (Type IP-3) or unpackaged, shall not exceed the limits shown in Table C below. For SCO-III, the limits in Table C below may be exceeded provided that the transport plan contains precautions which are to be employed during carriage to obtain an overall level of safety at least equivalent to that which would be provided if the limits had been applied.

Table C: Wagon activity limits for LSA material and SCO in industrial packages or unpackaged

Nature of material or object	Activity limit for wagon
LSA-I	No limit
LSA-II and LSA-III non-combustible solids	No limit
LSA-II and LSA-III combustible solids, and all liquids and gases	100 A ₂
SCO	100 A ₂

(3) Stowage during carriage and storage in transit

(3.1) Consignments shall be securely stowed.

(3.2) Provided that its average surface heat flux does not exceed 15 W/m² and that the immediately surrounding cargo is not in bags, a package or overpack may be carried or stored among packaged general cargo without any special stowage provisions except as may be specifically required by the competent authority in an applicable certificate of approval.

(3.3) Loading of containers and accumulation of packages, overpacks and containers shall be controlled as follows:

- (a) Except under the condition of exclusive use, and for consignments of LSA-I material, the total number of packages, overpacks and containers in a single wagon shall be so limited that the total sum of the transport indexes in the wagon does not exceed the values shown in Table D below.
- (b) The dose rate under routine conditions of carriage shall not exceed 2 mSv/h at any point on the external surface of the wagon or container, and 0.1 mSv/h at 2 m from the external surface of the wagon or container, except for consignments carried under exclusive use for which the dose rate limits around the wagon are set forth in (3.5) (b) and (c).
- (c) The total sum of the criticality safety indexes in a container and a wagon shall not exceed the values shown in Table E below.

Table D: Transport Index limits for containers and wagons not under exclusive use

Type of container or wagon	Limit on total sum of transport indexes in a container or wagon
Small container	50
Large container	50
Wagon	50

Table E: Criticality Safety Index for containers and wagons containing fissile material

Type of container or wagon	Limit on total sum of criticality safety indexes in a container or wagon	
	Not under exclusive use	Under exclusive use
Small container	50	n.a.
Large container	50	100
Wagon	50	100

(3.4) Any package or overpack having either a transport index greater than 10, or any consignment having a criticality safety index greater than 50, shall be carried only under exclusive use.

(3.5) For consignments under exclusive use, the dose rate shall not exceed:

- (a) 10 mSv/h at any point on the external surface of any package or overpack, and may only exceed 2 mSv/h provided that:
 - (i) the wagon is equipped with an enclosure which, during routine conditions of carriage, prevents the access of unauthorized persons to the interior of the enclosure;
 - (ii) provisions are made to secure the package or overpack so that its position within the wagon enclosure remains fixed during routine conditions of carriage, and
 - (iii) there is no loading or unloading during the shipment;
- (b) 2 mSv/h at any point on the outer surfaces of the wagon, including the upper and lower surfaces, or, in the case of an open wagon, at any point on the vertical planes projected from the outer edges of the wagon, on the upper surface of the load, and on the lower external surface of the wagon; and

- (c) 0.1 mSv/h at any point 2 m from the vertical planes represented by the outer lateral surfaces of the wagon, or, if the load is carried in an open wagon, at any point 2 m from the vertical planes projected from the outer edges of the wagon.

(4) Additional requirements relating to carriage and storage in transit of fissile material

- (4.1) Any group of packages, overpacks, and containers containing fissile material stored in transit in any one storage area shall be so limited that the total sum of the CSIs in the group does not exceed 50. Each group shall be stored so as to maintain a spacing of at least 6 m from other such groups.
- (4.2) Where the total sum of the criticality safety indexes in a wagon or container exceeds 50, as permitted in Table E above, storage shall be such as to maintain a spacing of at least 6 m from other groups of packages, overpacks or containers containing fissile material or other wagons carrying radioactive material.
- (4.3) Fissile material meeting one of the provisions (a) to (f) of 2.2.7.2.3.5 shall meet the following requirements:
 - (a) Only one of the provisions (a) to (f) of 2.2.7.2.3.5 is allowed per consignment;
 - (b) Only one approved fissile material in packages classified in accordance with 2.2.7.2.3.5 (f) is allowed per consignment unless multiple materials are authorized in the certificate of approval;
 - (c) Fissile material in packages classified in accordance with 2.2.7.2.3.5 (c) shall be carried in a consignment with no more than 45 g of fissile nuclides;
 - (d) Fissile material in packages classified in accordance with 2.2.7.2.3.5 (d) shall be carried in a consignment with no more than 15 g of fissile nuclides;
 - (e) Unpackaged or packaged fissile material classified in accordance with 2.2.7.2.3.5 (e) shall be carried under exclusive use on a wagon with no more than 45 g of fissile nuclides.

(5) Damaged or leaking packages, contaminated packagings

- (5.1) If it is evident that a package is damaged or leaking, or if it is suspected that the package may have leaked or been damaged, access to the package shall be restricted and a qualified person shall, as soon as possible, assess the extent of contamination and the resultant dose rate of the package. The scope of the assessment shall include the package, the wagon, the adjacent loading and unloading areas, and, if necessary, all other material which has been carried in the wagon. When necessary, additional steps for the protection of people, property and the environment, in accordance with provisions established by the competent authority, shall be taken to overcome and minimize the consequences of such leakage or damage.
- (5.2) Packages damaged or leaking radioactive contents in excess of allowable limits for normal conditions of carriage may be removed to an acceptable interim location under supervision, but shall not be forwarded until repaired or reconditioned and decontaminated.
- (5.3) A wagon and equipment used regularly for the carriage of radioactive material shall be periodically checked to determine the level of contamination. The frequency of such checks shall be related to the likelihood of contamination and the extent to which radioactive material is carried.
- (5.4) Except as provided in paragraph (5.5), any wagon, or equipment or part thereof which has become contaminated above the limits specified in 4.1.9.1.2 in the course of carriage of radioactive material, or which shows a dose rate in excess of 5 μ Sv/h at the surface, shall be decontaminated as soon as possible by a qualified person and shall not be re-used unless the following conditions are fulfilled:
 - (a) the non-fixed contamination shall not exceed the limits specified in 4.1.9.1.2;
 - (b) the dose rate resulting from the fixed contamination shall not exceed 5 μ Sv/h at the surface.
- (5.5) A container or wagon dedicated to the carriage of unpackaged radioactive material under exclusive use shall be excepted from the requirements of the previous paragraph (5.4) and in 4.1.9.1.2 solely with regard to its internal surfaces and only for as long as it remains under that specific exclusive use.

(6) Other provisions

Where a consignment is undeliverable, the consignment shall be placed in a safe location and the competent authority shall be informed as soon as possible and a request made for instructions on further action.

CW 34 Prior to carriage of pressure receptacles it shall be ensured that the pressure has not risen due to potential hydrogen generation.

CW 35 If bags are used as single packagings, they shall be adequately separated to allow for the dissipation of heat.

CW 36 Packages shall preferably be loaded in open or ventilated wagons or open or ventilated containers. If this is not feasible and packages are carried in other closed wagons or containers, gas exchange between the load compartment and accessible compartments during carriage shall be prevented and the cargo doors of the wagons or containers shall be marked with the following in letters not less than 25 mm high:

"WARNING
NO VENTILATION
OPEN WITH CAUTION"

This shall be in a language considered appropriate by the consignor.

For UN Nos. 2211 and 3314 this mark is not required when the wagon or container is already marked according to special provision 965 of the IMDG Code⁴.

- CW 37** Before loading, these by-products shall be cooled to ambient temperature, unless they have been calcined to remove moisture. Wagons and containers containing bulk loads shall be adequately ventilated and protected against ingress of water throughout the journey. The cargo doors of the closed wagons and closed containers shall be marked with the following in letters not less than 25 mm high:

"WARNING
CLOSED MEANS OF CONTAINMENT
OPEN WITH CAUTION"

This shall be in a language considered appropriate by the consignor.

- CW 38** The load compartments shall have no sharp internal edges (internal steps, etc.) capable of tearing container-bags during unloading. They shall be inspected before any loading operation.

The container-bags shall be placed in the load compartments for carriage prior to any filling. The outer component of the container-bags shall be positioned so that the slider of the zipper is placed on the front side of the load compartment when closed. After filling, the container-bags shall be closed in accordance with the manufacturer's instructions.

Once loaded, the container-bags shall not be lifted or transferred from one load compartment to another. Multiple filled container-bags shall not be loaded into the same load compartment.

After any filling operation and after closing, the outer surfaces of the container-bags shall be decontaminated.

Container-bags carried in removable load compartments shall be unloaded with the latter placed on the ground.

The unloading of container-bags filled with roadworks waste or with soil contaminated with free asbestos by tipping the load compartment is authorized, provided that an unloading protocol agreed jointly between the carrier and the consignee is respected to prevent the container-bags from tearing during unloading. The protocol shall ensure that the container-bags do not fall or tear during the unloading operation.

⁴ Warning mark including the words "CAUTION – MAY CONTAIN FLAMMABLE VAPOUR" with lettering not less than 25 mm high, affixed at each access point in a location where it will be easily seen by persons prior to opening or entering the cargo transport unit.

Chapter 7.6 Provisions for carriage as colis express (express parcels)

In accordance with Article 5 § 1 of Appendix C to COTIF, dangerous goods are only permitted for carriage as express parcels when a special provision with an alphanumeric code beginning with the letters "CE" is shown in column (19) of Table A of Chapter 3.2 specifically authorizing this form of transport, and the conditions of this special provision are complied with.

The following special provisions apply when they are shown under an entry in column (19) of Table A of Chapter 3.2.

- CE 1** An express parcels package shall not weigh more than 40 kg. Express parcels consignments may be loaded in railway wagons which can simultaneously serve for the carriage of persons, but only up to a limit of 100 kg per wagon.
- CE 2** An express parcels package shall not weigh more than 40 kg.
- CE 3** An express parcels package shall not weigh more than 50 kg.
- CE 4** An express parcels package shall not contain more than 45 litres of this substance and shall not weigh more than 50 kg.
- CE 5** An express parcels package shall not contain more than 2 litres of this substance.
- CE 6** An express parcels package shall not contain more than 4 litres of this substance.
- CE 7** An express parcels package shall not contain more than 6 litres of this substance.
- CE 8** An express parcels package shall not contain more than 12 litres of this substance.
- CE 9** An express parcels package shall not contain more than 4 kg of this substance.
- CE 10** An express parcels package shall not contain more than 12 kg of this substance.
- CE 11** An express parcels package shall not contain more than 24 kg of this substance.
- CE 12** When sent as an express parcel, the substance shall be contained in unbreakable receptacles. An express parcels package shall not weigh more than 25 kg.
- CE 13** Only inorganic cyanides containing precious metals, and mixtures of these may be sent as express parcels. In this case, combination packagings with inner packagings of glass, plastics or metal in accordance with 6.1.4.21 shall be used. An express parcels package shall not contain more than 2 kg of the substance.
- Carriage in luggage vans or luggage compartments accessible to passengers shall be authorized if, by means of appropriate measures, packages are placed out of reach of non-authorized persons.
- CE 14** Only substances which are not to be carried at a specific ambient temperature may be forwarded as express parcels. In this case, the following quantity limits shall apply:
- for substances other than those assigned to UN No. 3373 up to 50 ml per package for liquids and up to 50 g per package for solids.
 - for substances assigned to UN No. 3373 in quantities as specified in packing instruction P 650 in 4.1.4.1.
 - for body parts or organs, a package shall not weigh more than 50 kg.
- CE 15** For express parcels packages, the sum of the transport indexes on the danger labels in a luggage van or luggage compartment shall not be more than 10. For packages of category III-YELLOW, the carrier may determine the time of delivery of the consignment. An express parcels package shall not weigh more than 50 kg.

Chapter 7.7 Piggyback transport in mixed trains (combined passenger and freight transport)

The carriage of dangerous goods in piggyback transport in trains in which passengers are also travelling shall only be possible with the agreement of, and under the conditions specified by the competent authorities of all the countries involved in the transport operation.

- NOTE 1:** These provisions shall not affect restrictions arising from the carriers' conditions of carriage under private law.
- 2:** For carriage in the context of the rolling road (accompanied or unaccompanied) (see definition of "piggyback transport" in 1.2.1), see 1.1.4.4.

Unofficial Part of RID

Requirements for the testing of plastics receptacles

Guidelines for 6.1.5.2.7 and 6.5.6.3.6

Laboratory methods using samples for proving chemical compatibility of polyethylene in accordance with the definition in 6.1.5.2.6 and 6.5.6.3.5 with filling substances (substances, mixtures and preparations) as compared with the standard liquids according to 6.1.6.

Carrying out laboratory methods A to C described below will enable determination of the possible deterioration mechanisms on the material of the receptacle for the substances intended to be carried, as compared with the standard liquids in each case.

The deterioration mechanisms to be expected will determine the choice of test method.

The laboratory methods will establish

- softening through swelling (laboratory method A),
- formation of stress cracking (laboratory method B),
- reaction by oxidizing and molecular degradation (laboratory method C),

in the material of the receptacle, where these cannot already be determined on the basis of the formulation, and will in each case be compared with the appropriate standard liquids with similar effects.

Test samples of the same thickness within the tolerance limits indicated shall be used.

Laboratory method A

The increase in mass through swelling is determined using flat test samples from the receptacle material stored at 40°C in the substance intended to be carried and in the standard liquid to be compared.

The change in mass through swelling is determined by weighing the test samples before storage and if the test samples are not more than 2 mm, after a reaction period of 4 weeks, otherwise after a reaction time sufficient for the test samples to reach mass constancy.

In each case, the average value of 3 test samples shall be determined. Test samples shall only be used once.

Laboratory method B (pin insertion procedure)

1. Short description

The performance of a receptacle material made of high density polyethylene with respect to the substance intended to be carried and the appropriate standard liquid is tested using the pin impression test, to the extent that this performance can be influenced by the formation of stress cracking, with or without simultaneous swelling up to 4%.

For the test, the test samples are provided with a drilled hole and a notch, and undergo preliminary storage in the filling substance to be tested and in the appropriate standard liquid. After preliminary storage, a pin of a defined oversize is inserted into the drilled hole.

The test samples prepared thus are then stored in the filling substance to be tested and in the appropriate standard liquid and are removed after storage periods of different duration and tested for residual tensile strength (procedure 3.1) or for the length of time until the test samples crack (procedure 3.2).

By making comparative measurements with the standard liquids "wetting solution", "acetic acid", "normal butyl acetate/normal butyl acetate-saturated wetting solution" or "water" as the test substance, it can be determined whether the degree of deterioration caused by the filling substance to be tested is equal to, more than or less than that of the standard liquid.

2. Test samples

2.1 Form and dimensions

The form and dimensions of the test sample are shown in figure 1. The thickness of the sample should not vary by $\pm 15\%$ of the average value within a test series.

The filling substance to be tested and the appropriate standard liquid are part of the test procedure.

Figure 1

Extrusionsrichtung = direction of extrusion

Probekörper ohne Stift = test sample without pin

Mindestwanddicke: 2mm = minimum wall thickness: 2mm

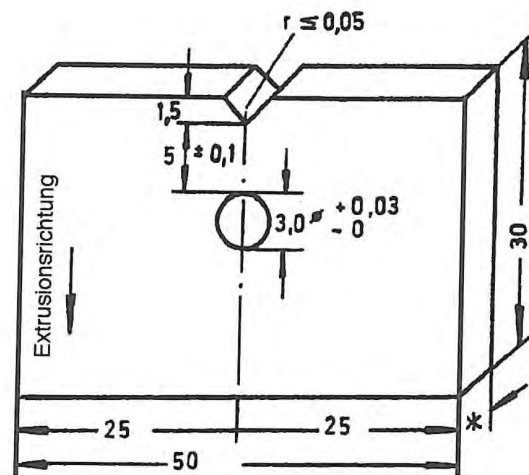


Abbildung 1

Probekörper ohne Stift

* Mindestwanddicke: 2mm

2.2 Manufacture

The test samples of a test series may be taken from receptacles of the same design type or from the same piece of an extruded semi-finished product.

With regard to machining of test samples, the surface quality obtained by cutting with a saw is sufficient. Ridges that occur during manufacture should simply be removed from the surface which is later to be notched. The test samples shall be notched parallel to the direction of extrusion.

A hole with a diameter of $3 \text{ mm } {}^{+0.03}_{-0}$ is to be drilled into each test sample as shown in Figure 1.

The test sample shall then be provided with a V notch as shown in Figure 1, with a notch radius of ≤ 0.05 mm.

The distance between the bottom of the notch and the perimeter of the hole shall be 5 mm $\pm$ 0.1 mm.

2.3 Number of test samples

To determine the residual tensile strength in accordance with paragraph 3.2, 10 test samples per storage period shall be used. As a rule, at least 5 storage periods shall be used.

In order to determine the time required until the test samples crack in accordance with paragraph 3.3, a total of 15 samples is required.

2.4 Pins

See Figure 2 for the dimensions of the 4 mm thick pins.

Figure 2

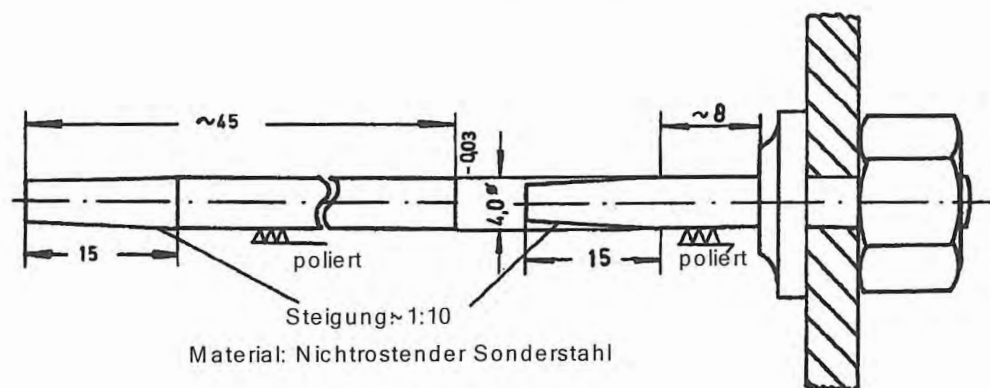
a: Pin to determine residual tensile strength

b: Pin to determine the standing time until the test sample cracks

poliert = polished

Steigung = gradient

Material: Nichtrostender Sonderstahl = Material: stainless (rust-resistant) steel



The preferred material for the pin is stainless steel (e.g. X 12 Cr Si 17).

For substances which can corrode this steel, glass pins shall be used.

3. Test procedure and evaluation

3.1 Preliminary storage of the samples

Before having the pin inserted, the test samples shall undergo preliminary storage for 21 days at $40^{\circ}\text{C} \pm 1^{\circ}\text{C}$ in the test liquids and standard liquids. For standard liquid c) in accordance with 6.1.6.1, preliminary storage shall be in n-butyl acetate.

3.2 Procedure to determine the residual tensile strength curve

3.2.1 Method

The pin in accordance with Figure 2a is inserted into the drilled hole in the test samples past the tapered part on to the cylindrical section.

The samples prepared thus are then immersed in storage receptacles filled with the respective test liquid, thermally conditioned to a temperature of 40°C , and then stored in an oven at $40^{\circ}\text{C} \pm 1^{\circ}\text{C}$. For standard liquid c), this test is carried out using wetting solution with the addition of 2% n-butyl acetate.

The period of time between inserting the pin into the test samples and continuing the storage in the test liquid must be uniformly selected and kept constant for a test series.

The storage periods for determining the time and test liquid related formation of stress cracking shall be selected such that a clear differentiation can be demonstrated between the residual tensile strength curves of the standard liquids tested and the filling substances to be classified with sufficient certainty.

After being removed from the storage receptacle, the pins shall immediately be removed from the test samples and any residual test liquid shall be cleaned off.

After being cooled to room temperature, the test samples shall be split parallel to the notched side through the middle of the drilled hole using a saw cut. Only the notched parts of the test samples shall be used for further testing.

These notched test samples shall then, no later than 8 hours after being removed from the test liquid, be subjected in a tensile testing machine to a uniaxial tensile stress, at a test speed (speed of the moving clamp) of 20 mm/min, until they break. The maximum strength shall be determined. The tensile test shall be carried out at room temperature ($23^{\circ}\text{C} \pm 2^{\circ}\text{C}$) in accordance with ISO/R 527.

3.2.2 Evaluation

The evaluation to determine the effect of the test liquid comprises calculation of the maximum tensile strength of the pre-stored test sample parts without the pin as the zero value, and the maximum tensile strength of the sample after the storage periods t_y where $y \geq 5$ (days). After converting these maximum tensile strength values at t_y into %, compared to the zero value, these values are plotted on a graph as in Figure 3.

A comparison with the corresponding residual tensile strength curves from measurements using the standard liquids "wetting solution" or "acetic acid" or "n-butyl acetate/n-butyl acetate-saturated wetting solution" or "water" then shows whether the filling substance tested has a stronger, weaker or no effect on the same receptacle material (see Figure 3).

Figure 3

Spannungsrißprüfung (Stifteindrückmethode) = stress cracking test (pin impression method)

Füllgut = filling substance

Standardflüssigkeit = standard liquid

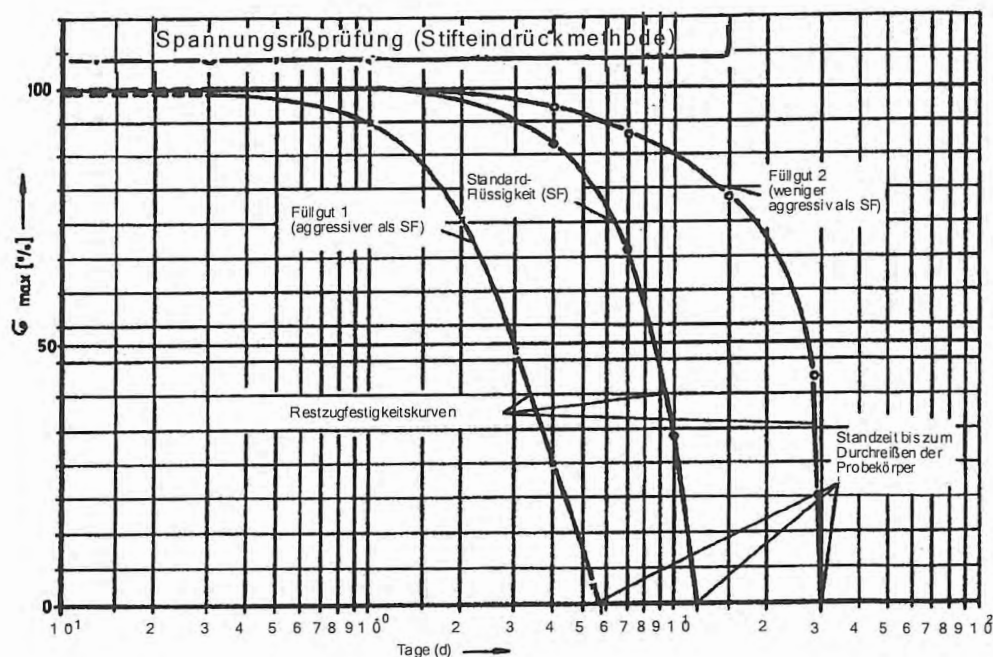
Aggressiver = more aggressive

Weniger aggressiv als = less aggressive than

Restzugfestigkeitskurven = residual tensile strength curves

Standzeit bis zum Durchreißen der Probekörper = time until the test samples crack

Tage = days



3.3 Procedure to determine the time until the test samples crack

3.3.1 Method

15 pins are fully inserted into 15 individual upright test samples in accordance with diagram 2b, which are then placed into a glass tube thermally conditioned to 40°C and filled with the test liquid.

The test temperature is kept constant $\pm 1^\circ\text{C}$. The cracking of the test samples on each pin is ascertained by visual observation. Experience shows that the crack always grows from the base of the notch to the surface of the pin.

3.3.2 Evaluation

The elapsed time T_{SF} with the standard liquid until 8 samples have cracked is decisive for the assessment. It is not necessary to wait for any further cracks to form.

The evaluation is carried out by comparing with the number of samples that cracked using the filling substance. There shall be no more than 8 samples that crack during the time T_{SF} .

3.4 Comment

For this test procedure, the test parameters "storage temperature" and "distance between the bottom of the notch and perimeter of the hole" were selected in such a way that in corresponding tests with the standard liquids "wetting solution", "acetic acid" and "normal butyl acetate/normal butyl acetate-saturated wetting solution", meaningful results in the context of this test procedure can be obtained within an overall test duration of about 28 days. In this case, a high molecular mass polyethylene with a density of $\sim 0.952 \text{ g/cm}^3$ and a Melt Flow Rate (MFR $190^\circ\text{C}/21.6 \text{ kg load}$) of $\sim 2.0 \text{ g/10 min}$ was taken as a basis.

As the conclusion of this test procedure should always be a relative conclusion, it is also possible to modify the relative values of the test parameters above in order to reduce the period required for the test. This information must be specified in the test report.

4. Criteria for a satisfactory test result

- 4.1 The test result according to laboratory method A shall not exceed 1% increase in mass through swelling if standard liquid a), "wetting solution" or standard liquid b), "acetic acid" is to be used for making a comparison.

The test result according to laboratory method A with the filling substance being tested shall not exceed the increase in mass through swelling obtained with normal butyl acetate (about 4%) if standard liquid c), "normal butyl acetate/normal butyl acetate-saturated wetting solution" is to be used for making a comparison.

- 4.2 The test result according to laboratory method B shall yield the same or a longer standing time for the filling substance than that for the standard liquids used for the comparison.

Laboratory method C

In order to assess whether the filling substance poses a potential risk of oxidation or molecular degradation for a receptacle material made of high density polyethylene in accordance with 6.1.5.2.6 and 6.5.6.3.5 respectively, the Melt Flow Rate (MFR $190^\circ\text{C}/21.6 \text{ kg load}$ in accordance with ISO 1133 – Condition 7) of test samples with a thickness range equivalent to the design type, shall be determined before and after storage of these samples in the filling substance to be assessed.

By storing geometrically identical samples in the standard liquid "55% nitric acid" in accordance with 6.1.6.1 (e) and by means of melt flow rate data, it shall be ascertained whether the degree of degradation caused by the filling substance to the material of the receptacle is less, equal or greater.

Samples shall be stored at 40°C until it is possible to make a final assessment, up to a maximum of 42 days.

If the filling substance to be approved produces swelling with an increase in mass of $\geq 1\%$ in accordance with laboratory method A, in order not to affect the result of the measurement, the sample shall be "post-dried" whilst simultaneously checking the mass before the melt flow rate is measured, e.g. by storage in a vacuum drying cabinet at 50°C until mass constancy is reached, as a rule for not more than 7 days.

Criterion for a satisfactory test result:

The increase in the melt flow rate of the receptacle material caused by the filling substance to be approved shall not be greater than the change caused by the standard liquid "55% nitric acid", including a tolerance limit of 15% necessitated by the test method.