

## Chapter 6.2

### Requirements for the construction and testing of pressure receptacles, aerosol dispensers, small receptacles containing gas (gas cartridges) and fuel cell cartridges containing liquefied flammable gas

#### 6.2.1 General requirements

**NOTE:** Aerosol dispensers, small receptacles containing gas (gas cartridges) and fuel cell cartridges containing liquefied flammable gas are not subject to the requirements of 6.2.1 to 6.2.5.

#### 6.2.1.1 Design and construction

6.2.1.1.1 Pressure receptacles and their closures shall be designed, manufactured, tested and equipped in such a way as to withstand all conditions, including fatigue, to which they will be subjected during normal conditions of carriage and use.

6.2.1.1.2 (Reserved)

6.2.1.1.3 In no case shall the minimum wall thickness be less than that specified in the design and construction technical standards.

6.2.1.1.4 For welded pressure receptacles, only metals of weldable quality shall be used.

6.2.1.1.5 The test pressure of cylinders, tubes, pressure drums and bundles of cylinders shall be in accordance with packing instruction P200 of 4.1.4.1. The test pressure for closed cryogenic receptacles shall be in accordance with packing instruction P203 of 4.1.4.1.

6.2.1.1.6 Pressure receptacles assembled in bundles shall be structurally supported and held together as a unit. Pressure receptacles shall be secured in a manner that prevents movement in relation to the structural assembly and movement that would result in the concentration of harmful local stresses. Manifold assemblies (e.g. manifold, valves, and pressure gauges) shall be designed and constructed such that they are protected from impact damage and forces normally encountered in carriage. Manifolds shall have at least the same test pressure as the cylinders. For toxic liquefied gases, each pressure receptacle shall have an isolation valve to ensure that each pressure receptacle can be filled separately and that no interchange of pressure receptacle contents can occur during carriage.

**NOTE:** Toxic liquefied gases have the classification codes 2T, 2TF, 2TC, 2TO, 2TFC or 2TOC.

6.2.1.1.7 Contact between dissimilar metals which could result in damage by galvanic action shall be avoided.

#### 6.2.1.1.8 Additional requirements for the construction of closed cryogenic receptacles for refrigerated liquefied gases

6.2.1.1.8.1 The mechanical properties of the metal used shall be established for each pressure receptacle, including the impact strength and the bending coefficient.

**NOTE:** With regard to the impact strength, sub-section 6.8.5.3 gives details of test requirements which may be used.

6.2.1.1.8.2 The pressure receptacles shall be thermally insulated. The thermal insulation shall be protected against impact by means of a jacket. If the space between the pressure receptacle and the jacket is evacuated of air (vacuum-insulation), the jacket shall be designed to withstand without permanent deformation an external pressure of at least 100 kPa (1 bar) calculated in accordance with a recognised technical code or a calculated critical collapsing pressure of not less than 200 kPa (2 bar) gauge pressure. If the jacket is so closed as to be gas-tight (e.g. in the case of vacuum-insulation), 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 pressure receptacle or its fittings. The device shall prevent moisture from penetrating into the insulation.

6.2.1.1.8.3 Closed cryogenic receptacles intended for the carriage of refrigerated liquefied gases having a boiling point below  $-182^{\circ}\text{C}$  at atmospheric pressure shall not include materials which may react with oxygen or oxygen enriched atmospheres in a dangerous manner, when located in parts of the thermal insulation where there is a risk of contact with oxygen or with oxygen enriched liquid.

6.2.1.1.8.4 Closed cryogenic receptacles shall be designed and constructed with suitable lifting and securing arrangements.

#### 6.2.1.1.9 Additional requirements for the construction of pressure receptacles for acetylene

Pressure receptacles for UN 1001 acetylene, dissolved, and UN 3374 acetylene, solvent free, shall be filled with a porous material, uniformly distributed, of a type that conforms to the requirements and testing specified by the competent authority and which:

- (a) Is compatible with the pressure receptacle and does not form harmful or dangerous compounds either with the acetylene or with the solvent in the case of UN 1001; and
- (b) Is capable of preventing the spread of decomposition of the acetylene in the porous material.

In the case of UN 1001, the solvent shall be compatible with the pressure receptacle.

#### **6.2.1.2 Materials**

**6.2.1.2.1** Construction materials of pressure receptacles and their closures which are in direct contact with dangerous goods shall not be affected or weakened by the dangerous goods intended to be carried and shall not cause a dangerous effect e.g. catalysing a reaction or reacting with the dangerous goods.

**6.2.1.2.2** Pressure receptacles and their closures shall be made of the materials specified in the design and construction technical standards and the applicable packing instruction for the substances intended for carriage in the pressure receptacle. The materials shall be resistant to brittle fracture and to stress corrosion cracking as indicated in the design and construction technical standards.

#### **6.2.1.3 Service equipment**

**6.2.1.3.1** Valves, piping and other fittings subjected to pressure, excluding pressure relief devices, shall be designed and constructed so that the burst pressure is at least 1.5 times the test pressure of the pressure receptacle.

**6.2.1.3.2** 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. 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 valves and any protective caps shall be capable of being secured against unintended opening. Valves shall be protected as specified in 4.1.6.8.

**6.2.1.3.3** Pressure receptacles which are not capable of being handled manually or rolled, shall be fitted with devices (skids, rings, straps) ensuring that they can be safely handled by mechanical means and so arranged as not to impair the strength of, nor cause undue stresses in, the pressure receptacle.

**6.2.1.3.4** Individual pressure receptacles shall be equipped with pressure relief devices as specified in packing provision P200 (2) of 4.1.4.1 or in 6.2.1.3.6.4 and 6.2.1.3.6.5. Pressure-relief devices shall be designed to prevent the entry of foreign matter, the leakage of gas and the development of any dangerous excess pressure. When fitted, pressure relief devices on manifolded horizontal pressure receptacles filled with flammable gas shall be arranged to discharge freely to the open air in such a manner as to prevent any impingement of escaping gas upon the pressure receptacle itself under normal conditions of carriage.

**6.2.1.3.5** Pressure receptacles whose filling is measured by volume shall be provided with a level indicator.

#### **6.2.1.3.6 Additional requirements for closed cryogenic receptacles**

**6.2.1.3.6.1** Each filling and discharge opening in a closed cryogenic receptacle used for the carriage of flammable refrigerated liquefied gases shall be fitted with at least two mutually independent shut-off devices in series, the first being a stop-valve, the second being a cap or equivalent device.

**6.2.1.3.6.2** For sections of piping which can be closed at both ends and where liquid product can be trapped, a method of automatic pressure-relief shall be provided to prevent excess pressure build-up within the piping.

**6.2.1.3.6.3** Each connection on a closed cryogenic receptacle shall be clearly marked to indicate its function (e.g. vapour or liquid phase).

#### **6.2.1.3.6.4 Pressure-relief devices**

**6.2.1.3.6.4.1** Every closed cryogenic receptacle shall be provided with at least one pressure-relief device. The pressure-relief device shall be of the type that will resist dynamic forces including surge.

**6.2.1.3.6.4.2** Closed cryogenic receptacles may, in addition, have a frangible disc in parallel with the spring loaded device(s) in order to meet the requirements of 6.2.1.3.6.5.

**6.2.1.3.6.4.3** Connections to pressure-relief devices shall be of sufficient size to enable the required discharge to pass unrestricted to the pressure-relief device.

**6.2.1.3.6.4.4** All pressure-relief device inlets shall under maximum filling conditions be situated in the vapour space of the closed cryogenic receptacle and the devices shall be so arranged as to ensure that the escaping vapour is discharged unrestrictedly.

#### **6.2.1.3.6.5 Capacity and setting of pressure-relief devices**

**NOTE:** In relation to pressure-relief devices of closed cryogenic receptacles, maximum allowable working pressure (MAWP) means the maximum effective gauge pressure permissible at the top of a loaded

closed cryogenic receptacle in its operating position including the highest effective pressure during filling and discharge.

- 6.2.1.3.6.5.1** The pressure-relief device shall open automatically at a pressure not less than the MAWP and be fully open at a pressure equal to 110% of the MAWP. It shall, after discharge, close at a pressure not lower than 10% below the pressure at which discharge starts and shall remain closed at all lower pressures.
- 6.2.1.3.6.5.2** Frangible discs shall be set to rupture at a nominal pressure which is the lower of either the test pressure or 150% of the MAWP.
- 6.2.1.3.6.5.3** In the case of the loss of vacuum in a vacuum-insulated closed cryogenic receptacle the combined capacity of all pressure-relief devices installed shall be sufficient so that the pressure (including accumulation) inside the closed cryogenic receptacle does not exceed 120% of the MAWP.
- 6.2.1.3.6.5.4** The required capacity of the pressure-relief devices shall be calculated in accordance with an established technical code recognized by the competent authority<sup>1</sup>.

#### **6.2.1.4 Approval of pressure receptacles**

**6.2.1.4.1** The conformity of pressure receptacles shall be assessed at time of manufacture as required by the competent authority. Pressure receptacles shall be inspected, tested and approved by an inspection body. The technical documentation shall include full specifications on design and construction, and full documentation on the manufacturing and testing.

**6.2.1.4.2** Quality assurance systems shall conform to the requirements of the competent authority.

#### **6.2.1.5 Initial inspection and test**

**6.2.1.5.1** New pressure receptacles, other than closed cryogenic receptacles, shall be subjected to testing and inspection during and after manufacture in accordance with the applicable design standards including the following:

On an adequate sample of pressure receptacles:

- (a) Testing of the mechanical characteristics of the material of construction;
- (b) Verification of the minimum wall thickness;
- (c) Verification of the homogeneity of the material for each manufacturing batch;
- (d) Inspection of the external and internal conditions of the pressure receptacles;
- (e) Inspection of the neck threads;
- (f) Verification of the conformance with the design standard;

For all pressure receptacles:

(g) A hydraulic pressure test. Pressure receptacles shall withstand the test pressure without expansion greater than that allowed in the design specification;

**NOTE:** With the agreement of the competent authority, the hydraulic pressure test may be replaced by a test using a gas, where such an operation does not entail any danger.

(h) Inspection and assessment of manufacturing defects and either repairing them or rendering the pressure receptacles unserviceable. In the case of welded pressure receptacles, particular attention shall be paid to the quality of the welds;

(i) An inspection of the markings on the pressure receptacles;

(j) In addition, pressure receptacles intended for the carriage of UN No. 1001 acetylene, dissolved, and UN No. 3374 acetylene, solvent free, shall be inspected to ensure proper installation and condition of the porous material and, if applicable, the quantity of solvent.

**6.2.1.5.2** On an adequate sample of closed cryogenic receptacles, the inspections and tests specified in 6.2.1.5.1 (a), (b), (d) and (f) shall be performed. In addition, welds shall be inspected by radiographic, ultrasonic or another suitable non-destructive test method on a sample of closed cryogenic receptacles according to the applicable design and construction standard. This weld inspection does not apply to the jacket.

Additionally, all closed cryogenic receptacles shall undergo the initial inspections and tests specified in 6.2.1.5.1 (g), (h) and (i), as well as a leakproofness test and a test of the satisfactory operation of the service equipment after assembly.

---

<sup>1</sup> See for example CGA Publications S-1.2-2003 "Pressure Relief Device Standards – Part 2 – Cargo and Portable Tanks for Compressed Gases" and S-1.1-2003 "Pressure Relief Device Standards – Part 1 – Cylinders for Compressed Gases".

## 6.2.1.6 Periodic inspection and test

6.2.1.6.1 Refillable pressure receptacles, other than cryogenic receptacles, shall be subjected to periodic inspections and tests by a body authorised by the competent authority, in accordance with the following:

- (a) Check of the external conditions of the pressure receptacle and verification of the equipment and the external markings;
- (b) Check of the internal conditions of the pressure receptacle (e.g. internal inspection, verification of minimum wall thickness);
- (c) Checking of the threads if there is evidence of corrosion or if the fittings are removed;
- (d) A hydraulic pressure test and, if necessary, verification of the characteristics of the material by suitable tests;
- (e) Check of service equipment, other accessories and pressure-relief devices, if to be reintroduced into service.

**NOTE 1:** With the agreement of the competent authority, the hydraulic pressure test may be replaced by a test using a gas, where such an operation does not entail any danger.

**2:** With the agreement of the competent authority, the hydraulic pressure test of cylinders or tubes may be replaced by an equivalent method based on acoustic emission testing, ultrasonic examination or a combination of acoustic emission testing and ultrasonic examination.

**3:** For the periodic inspection and test frequencies, see packing instruction P200 in 4.1.4.1.

6.2.1.6.2 Pressure receptacles intended for the carriage of UN No. 1001 acetylene, dissolved and UN No. 3374 acetylene, solvent free, shall be examined only as specified in 6.2.1.6.1 (a), (c) and (e). In addition the condition of the porous material (e.g. cracks, top clearance, loosening, settlement) shall be examined.

## 6.2.1.7 Requirements for manufacturers

6.2.1.7.1 The manufacturer shall be technically able and shall possess all resources required for the satisfactory manufacture of pressure receptacles; this relates in particular to qualified personnel:

- (a) To supervise the entire manufacturing process;
- (b) To carry out joining of materials; and
- (c) To carry out the relevant tests.

6.2.1.7.2 The proficiency test of a manufacturer shall in all instances be carried out by an inspection body approved by the competent authority of the country of approval.

## 6.2.1.8 Requirements for inspection bodies

6.2.1.8.1 Inspection bodies shall be independent from manufacturing enterprises and competent to perform the tests, inspections and approvals required.

## 6.2.2 Requirements for UN pressure receptacles

In addition to the general requirements of section 6.2.1, UN pressure receptacles shall comply with the requirements of this section, including the standards, as applicable.

### 6.2.2.1 Design, construction and initial inspection and test

6.2.2.1.1 The following standards apply for the design, construction, and initial inspection and test of UN cylinders, except that inspection requirements related to the conformity assessment system and approval shall be in accordance with 6.2.2.5:

ISO 9809-1:1999	Gas cylinders – Refillable seamless steel gas cylinders – Design, construction and testing – Part 1: Quenched and tempered steel cylinders with tensile strength less than 1 100 MPa <b>NOTE:</b> The note concerning the F factor in section 7.3 of this standard shall not be applied for UN cylinders.
ISO 9809-2:2000	Gas cylinders – Refillable seamless steel gas cylinders – Design, construction and testing – Part 2: Quenched and tempered steel cylinders with tensile strength greater than or equal to 1 100 MPa
ISO 9809-3:2000	Gas cylinders – Refillable seamless steel gas cylinders – Design, construction and testing – Part 3: Normalized steel cylinders

ISO 7866:1999	Gas cylinders – Refillable seamless aluminium alloy gas cylinders – Design, construction and testing <b>NOTE:</b> The note concerning the F factor in section 7.2 of this standard shall not be applied for UN cylinders. Aluminium alloy 6351A - T6 or equivalent shall not be authorized.
ISO 11118:1999	Gas cylinders – Non-refillable metallic gas cylinders – Specification and test methods
ISO 11119-1:2002	Gas cylinders of composite construction – Specification and test methods – Part 1: Hoop wrapped composite gas cylinders
ISO 11119-2:2002	Gas cylinders of composite construction – Specification and test methods – Part 2: Fully wrapped fibre reinforced composite gas cylinders with load-sharing metal liners
ISO 11119-3:2002	Gas cylinders of composite construction – Specification and test methods – Part 3: Fully wrapped fibre reinforced composite gas cylinders with non-load-sharing metallic or non-metallic liners

**NOTE 1:** In the above referenced standards composite cylinders shall be designed for unlimited service life.

**2:** After the first 15 years of service, composite cylinders manufactured according to these standards, may be approved for extended service by the competent authority which was responsible for the original approval of the cylinders and which will base its decision on the test information supplied by the manufacturer or owner or user.

**6.2.2.1.2** The following **standard** apply for the design, construction, and initial inspection and test of UN tubes, except that inspection requirements related to the conformity assessment system and approval shall be in accordance with 6.2.2.5:

ISO 11120:1999	Gas cylinders – Refillable seamless steel tubes for compressed gas transport, of water capacity between 150 l and 3 000 l – Design, construction and testing <b>NOTE:</b> The note concerning the F factor in section 7.1 of this standard shall not be applied for UN tubes.
----------------	--

**6.2.2.1.3** The following standards apply for the design, construction and initial inspection and test of UN acetylene cylinders, except that inspection requirements related to the conformity assessment system and approval shall be in accordance with 6.2.2.5:

For the cylinder shell:

ISO 9809-1:1999	Gas cylinders – Refillable seamless steel gas cylinders – Design, construction and testing – Part 1: Quenched and tempered steel cylinders with tensile strength less than 1 100 MPa <b>NOTE:</b> The note concerning the F factor in section 7.3 of this standard shall not be applied for UN cylinders.
ISO 9809-3:2000	Gas cylinders – Refillable seamless steel gas cylinders – Design, construction and testing – Part 3: Normalized steel <b>cylinders</b>

**For** the porous material in the cylinder:

ISO 3807-1:2000	Cylinders for acetylene – Basic requirements – Part 1: Cylinders without fusible plugs
ISO 3807-2:2000	Cylinders for acetylene – Basic requirements – Part 2: Cylinders with fusible plugs

**6.2.2.1.4** The following standard apply **for** the design, construction, and initial inspection and test of UN cryogenic receptacles, except that inspection requirements related to the conformity assessment system and approval shall be in accordance with 6.2.2.5:

ISO 21029-1:2004	Cryogenic vessels – Transportable vacuum insulated vessels of not more than 1 000 l volume – Part 1: Design, fabrication, inspection and tests
------------------	--

### 6.2.2.2 Materials

In addition to the material requirements specified in the pressure receptacle design and construction standards, and any restrictions specified in the applicable packing instruction for the gas(es) to be carried (e.g. packing instruction P200 of 4.1.4.1), the following standards apply to material compatibility:

ISO 11114-1:1997	Transportable gas cylinders – Compatibility of cylinder and valve materials with gas contents – Part 1: Metallic materials
ISO 11114-2:2000	Transportable gas cylinders – Compatibility of cylinder and valve materials with gas contents – Part 2: Non-metallic materials

**NOTE:** The limitations imposed in ISO 11114-1 on high strength steel alloys at ultimate tensile strength levels up to 1 100 MPa do not apply to UN No. 2203 silane.

### 6.2.2.3 Service equipment

The following standards apply to closures and their protection:

ISO 11117:1998	Gas cylinders – Valve protection caps and valve guards for industrial and medical gas cylinders – Design, construction and tests
ISO 10297:2006	Transportable gas cylinders – Cylinder valves – Specification and type testing <b>NOTE:</b> The EN version of this ISO standard fulfils the requirements and may also be used.

### 6.2.2.4 Periodic inspection and test

The following standards apply to the periodic inspection and testing of UN cylinders:

ISO 6406:2005	Periodic inspection and testing of seamless steel gas cylinders
ISO 10461:2005 + A1:2006	Seamless aluminium–alloy gas cylinders – Periodic inspection and testing
ISO 10462:2005	Gas cylinders – Transportable cylinders for dissolved acetylene – Periodic inspection and maintenance
ISO 11623:2002	Transportable gas cylinders – Periodic inspection and testing of composite gas cylinders

### 6.2.2.5 Conformity assessment system and approval for manufacture of pressure receptacles

#### 6.2.2.5.1 Definitions

For the purposes of this sub-section:

*Conformity assessment system* means a system for competent authority approval of a manufacturer, by pressure receptacle design type approval, approval of manufacturer's quality system and approval of inspection bodies;

*Design type* means a pressure receptacle design as specified by a particular pressure receptacle standard;

*Verify* means confirm by examination or provision of objective evidence that specified requirements have been fulfilled.

#### 6.2.2.5.2 General requirements

##### Competent authority

6.2.2.5.2.1 The competent authority that approves the pressure receptacle shall approve the conformity assessment system for the purpose of ensuring that pressure receptacles conform to the requirements of RID. In instances where the competent authority that approves a pressure receptacle is not the competent authority in the country of manufacture, the marks of the approval country and the country of manufacture shall be indicated in the pressure receptacle marking (see 6.2.2.7 and 6.2.2.8).

The competent authority of the country of approval shall supply, upon request, evidence demonstrating compliance to this conformity assessment system to its counterpart in a country of use.

- 6.2.2.5.2.2** The competent authority may delegate its functions in this conformity assessment system in whole or in part.
- 6.2.2.5.2.3** The competent authority shall ensure that a current list of approved inspection bodies and their identity marks and approved manufacturers and their identity marks is available.

#### **Inspection body**

- 6.2.2.5.2.4** The inspection body shall be approved by the competent authority for the inspection of pressure receptacles and shall:
- (a) Have a staff with an organisational structure, capable, trained, competent, and skilled, to satisfactorily perform its technical functions;
  - (b) Have access to suitable and adequate facilities and equipment;
  - (c) Operate in an impartial manner and be free from any influence which could prevent it from doing so;
  - (d) Ensure commercial confidentiality of the commercial and proprietary activities of the manufacturer and other bodies;
  - (e) Maintain clear demarcation between actual inspection body functions and unrelated functions;
  - (f) Operate a documented quality system;
  - (g) Ensure that the tests and inspections specified in the relevant pressure receptacle standard and RID are performed; and
  - (h) Maintain an effective and appropriate report and record system in accordance with 6.2.2.5.6.
- 6.2.2.5.2.5** The inspection body shall perform design type approval, pressure receptacle production testing and inspection, and certification to verify conformity with the relevant pressure receptacle standard (see 6.2.2.5.4 and 6.2.2.5.5).

#### **Manufacturer**

- 6.2.2.5.2.6** The manufacturer shall:
- (a) Operate a documented quality system in accordance with 6.2.2.5.3;
  - (b) Apply for design type approvals in accordance with 6.2.2.5.4;
  - (c) Select an inspection body from the list of approved inspection bodies maintained by the competent authority in the country of approval; and
  - (d) Maintain records in accordance with 6.2.2.5.6.

#### **Testing laboratory**

- 6.2.2.5.2.7** The testing laboratory shall have:
- (a) Staff with an organisational structure, sufficient in number, competence, and skill; and
  - (b) Suitable and adequate facilities and equipment to perform the tests required by the manufacturing standard to the satisfaction of the inspection body.

#### **6.2.2.5.3 Manufacturer's quality system**

- 6.2.2.5.3.1** 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.

The contents shall in particular include adequate descriptions of:

- (a) The organisational 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 pressure receptacles;
- (c) The relevant pressure receptacle 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 6.2.2.5.3.2;
- (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 pressure receptacles, purchased components, in-process and final materials; and
- (i) Training programmes and qualification procedures for relevant personnel.

### **6.2.2.5.3.2** Audit of the quality system

The quality system shall be initially assessed to determine whether it meets the requirements in 6.2.2.5.3.1 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.

### **6.2.2.5.3.3** 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 in order to determine whether the amended quality system will still satisfy the requirements in 6.2.2.5.3.1.

## **6.2.2.5.4** Approval process

### **Initial design type approval**

**6.2.2.5.4.1** The initial design type approval shall consist of approval of the manufacturer's quality system and approval of the pressure receptacle design to be produced. An application for an initial design type approval shall meet the requirements of 6.2.2.5.4.2 to 6.2.2.5.4.6 and 6.2.2.5.4.9.

**6.2.2.5.4.2** A manufacturer desiring to produce pressure receptacles in accordance with a pressure receptacle standard and RID shall apply for, obtain, and retain a design type approval certificate issued by the competent authority in the country of approval for at least one pressure receptacle design type in accordance with the procedure given in 6.2.2.5.4.9. This certificate shall, on request, be submitted to the competent authority of the country of use.

**6.2.2.5.4.3** An application shall be made for each manufacturing facility and shall include:

- (a) The name and registered address of the manufacturer and in addition, if the application is submitted by an authorised representative, its name and address;
- (b) The address of the manufacturing facility (if different from the above);
- (c) The name and title of the person(s) responsible for the quality system;
- (d) The designation of the pressure receptacle and the relevant pressure receptacle standard;
- (e) Details of any refusal of approval of a similar application by any other competent authority;
- (f) The identity of the inspection body for design type approval;
- (g) Documentation on the manufacturing facility as specified under 6.2.2.5.3.1; and
- (h) The technical documentation required for design type approval, which shall enable verification of the conformity of the pressure receptacles with the requirements of the relevant pressure receptacle design standard. The technical documentation shall cover the design and method of manufacture and shall contain, as far as is relevant for assessment, at least the following:
  - (i) pressure receptacle design standard, design and manufacturing drawings, showing components and subassemblies, if any;
  - (ii) descriptions and explanations necessary for the understanding of the drawings and intended use of the pressure receptacles;
  - (iii) a list of the standards necessary to fully define the manufacturing process;
  - (iv) design calculations and material specifications; and
  - (v) design type approval test reports, describing the results of examinations and tests carried out in accordance with 6.2.2.5.4.9.

**6.2.2.5.4.4** An initial audit in accordance with 6.2.2.5.3.2 shall be performed to the satisfaction of the competent authority.

**6.2.2.5.4.5** If the manufacturer is denied approval, the competent authority shall provide written detailed reasons for such denial.

**6.2.2.5.4.6** Following approval, changes to the information submitted under 6.2.2.5.4.3 relating to the initial approval shall be provided to the competent authority.



### Subsequent design type approvals

- 6.2.2.5.4.7** An application for a subsequent design type approval shall meet the requirements of 6.2.2.5.4.8 and 6.2.2.5.4.9, provided a manufacturer is in the possession of an initial design type approval. In such a case, the manufacturer's quality system according to 6.2.2.5.3 shall have been approved during the initial design type approval and shall be applicable for the new design.
- 6.2.2.5.4.8** The application shall include:
- (a) The name and address of the manufacturer and in addition, if the application is submitted by an authorised representative, its name and address;
  - (b) Details of any refusal of approval of a similar application by any other competent authority;
  - (c) Evidence that initial design type approval has been granted; and
  - (d) The technical documentation, as described in 6.2.2.5.4.3 (h).

### Procedure for design type approval

- 6.2.2.5.4.9** The inspection body shall:
- (a) Examine the technical documentation to verify that:
    - (i) the design is in accordance with the relevant provisions of the standard, and
    - (ii) the prototype lot has been manufactured in conformity with the technical documentation and is representative of the design;
  - (b) Verify that the production inspections have been carried out as required in accordance with 6.2.2.5.5;
  - (c) Select pressure receptacles from a prototype production lot and supervise the tests of these pressure receptacles as required for design type approval;
  - (d) Perform or have performed the examinations and tests specified in the pressure receptacle standard to determine that:
    - (i) the standard has been applied and fulfilled, and
    - (ii) the procedures adopted by the manufacturer meet the requirements of the standard; and
  - (e) Ensure that the various type approval examinations and tests are correctly and competently carried out.

After prototype testing has been carried out with satisfactory results and all applicable requirements of 6.2.2.5.4 have been satisfied, a design type approval certificate shall be issued, which shall include the name and address of the manufacturer, results and conclusions of the examination, and the necessary data for identification of the design type.

If the manufacturer is denied a design type approval, the competent authority shall provide written detailed reasons for such denial.

### **6.2.2.5.4.10** Modifications to approved design types

The manufacturer shall either:

- (a) Inform the issuing competent authority of modifications to the approved design type, where such modifications do not constitute a new design, as specified in the pressure receptacle standard; or
- (b) Request a subsequent design type approval where such modifications constitute a new design according to the relevant pressure receptacle standard. This additional approval shall be given in the form of an amendment to the original design type approval certificate.

### **6.2.2.5.4.11** Upon request, the competent authority shall communicate to any other competent authority, information concerning design type approval, modifications of approvals and withdrawn approvals.

## **6.2.2.5.5** Production inspection and certification

### **General requirements**

An inspection body, or its delegate, shall carry out the inspection and certification of each pressure receptacle. The inspection body selected by the manufacturer for inspection and testing during production may be different from the inspection body used for the design type approval testing.

Where it can be demonstrated to the satisfaction of the inspection body that the manufacturer has trained competent inspectors, independent of the manufacturing operations, inspection may be performed by those inspectors. In such a case, the manufacturer shall maintain training records of the inspectors.

The inspection body shall verify that the inspections by the manufacturer, and tests performed on those pressure receptacles, fully conform to the standard and the requirements of RID. Should non-conformance in conjunction with this inspection and testing be determined, the permission to have inspection performed by the manufacturer's inspectors may be withdrawn.

The manufacturer shall, after approval by the inspection body, make a declaration of conformity with the certified design type. The application of the pressure receptacle certification marking shall be considered a declaration that the pressure receptacle complies with the applicable pressure receptacle standards and the requirements of this conformity assessment system and RID. The inspection body shall affix or delegate the manufacturer to affix the pressure receptacle certification marking and the registered mark of the inspection body to each approved pressure receptacle.

A certificate of compliance, signed by the inspection body and the manufacturer, shall be issued before the pressure receptacles are filled.

#### **6.2.2.5.6 Records**

Design type approval and certificate of compliance records shall be retained by the manufacturer and the inspection body for not less than 20 years.

#### **6.2.2.6 Approval system for periodic inspection and test of pressure receptacles**

##### **6.2.2.6.1 Definition**

For the purposes of this section:

*Approval system* means a system for competent authority approval of a body performing periodic inspection and test of pressure receptacles (hereinafter referred to as "periodic inspection and test body"), including approval of that body's quality system.

##### **6.2.2.6.2 General requirements**

###### **Competent authority**

**6.2.2.6.2.1** The competent authority shall establish an approval system for the purpose of ensuring that the periodic inspection and test of pressure receptacles conform to the requirements of RID. In instances where the competent authority that approves a body performing periodic inspection and test of a pressure receptacle is not the competent authority of the country approving the manufacture of the pressure receptacle, the marks of the approval country of periodic inspection and test shall be indicated in the pressure receptacle marking (see 6.2.2.7).

The competent authority of the country of approval for the periodic inspection and test shall supply, upon request, evidence demonstrating compliance to this approval system including the records of the periodic inspection and test to its counterpart in a country of use.

The competent authority of the country of approval may terminate the approval certificate referred to in 6.2.2.6.4.1, upon evidence demonstrating non-compliance with the approval system.

**6.2.2.6.2.2** The competent authority may delegate its functions in this approval system, in whole or in part.

**6.2.2.6.2.3** The competent authority shall ensure that a current list of approved periodic inspection and test bodies and their identity marks is available.

###### **Periodic inspection and test body**

**6.2.2.6.2.4** The periodic inspection and test body shall be approved by the competent authority and shall:

- (a) Have a staff with an organisational structure, capable, trained, competent, and skilled, to satisfactorily perform its technical functions;
- (b) Have access to suitable and adequate facilities and equipment;
- (c) Operate in an impartial manner and be free from any influence which could prevent it from doing so;
- (d) Ensure commercial confidentiality;
- (e) Maintain clear demarcation between actual periodic inspection and test body functions and unrelated functions;
- (f) Operate a documented quality system accordance with 6.2.2.6.3;
- (g) Apply for approval in accordance with 6.2.2.6.4;
- (h) Ensure that the periodic inspections and tests are performed in accordance with 6.2.2.6.5; and
- (i) Maintain an effective and appropriate report and record system in accordance with 6.2.2.6.6.

##### **6.2.2.6.3 Quality system and audit of the periodic inspection and test body**

###### **6.2.2.6.3.1 Quality system**

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

The quality system shall include:

- (a) A description of the organisational structure and responsibilities;
- (b) The relevant inspection and test, quality control, quality assurance, and process operation instructions that will be used;
- (c) Quality records, such as inspection reports, test data, calibration data and certificates;
- (d) Management reviews to ensure the effective operation of the quality system arising from the audits performed in accordance with 6.2.2.6.3.2;
- (e) A process for control of documents and their revision;
- (f) A means for control of non-conforming pressure receptacles; and
- (g) Training programmes and qualification procedures for relevant personnel.

#### **6.2.2.6.3.2 Audit**

The periodic inspection and test body and its quality system shall be audited in order to determine whether it meets the requirements of RID to the satisfaction of the competent authority.

An audit shall be conducted as part of the initial approval process (see 6.2.2.6.4.3). An audit may be required as part of the process to modify an approval (see 6.2.2.6.4.6).

Periodic audits shall be conducted, to the satisfaction of the competent authority, to ensure that the periodic inspection and test body continues to meet the requirements of RID.

The periodic inspection and test body shall be notified of the results of any audit. The notification shall contain the conclusions of the audit and any corrective actions required.

#### **6.2.2.6.3.3 Maintenance of the quality system**

The periodic inspection and test body shall maintain the quality system as approved in order that it remains adequate and efficient.

The periodic inspection and test body shall notify the competent authority that approved the quality system, of any intended changes, in accordance with the process for modification of an approval in 6.2.2.6.4.6.

#### **6.2.2.6.4 Approval process for periodic inspection and test bodies**

##### **Initial approval**

- 6.2.2.6.4.1** A body desiring to perform periodic inspection and test of pressure receptacles in accordance with a pressure receptacle standard and RID shall apply for, obtain, and retain an approval certificate issued by the competent authority.

This written approval shall, on request, be submitted to the competent authority of a country of use.

- 6.2.2.6.4.2** An application shall be made for each periodic inspection and test body and shall include:

- (a) The name and address of the periodic inspection and test body and, if the application is submitted by an authorised representative, its name and address;
- (b) The address of each facility performing periodic inspection and test;
- (c) The name and title of the person(s) responsible for the quality system;
- (d) The designation of the pressure receptacles, the periodic inspection and test methods, and the relevant pressure receptacle standards met by the quality system;
- (e) Documentation on each facility, the equipment, and the quality system as specified under 6.2.2.6.3.1;
- (f) The qualifications and training records of the periodic inspection and test personnel; and
- (g) Details of any refusal of approval of a similar application by any other competent authority.

- 6.2.2.6.4.3** The competent authority shall:

- (a) Examine the documentation to verify that the procedures are in accordance with the requirements of the relevant pressure receptacle standards and RID; and
- (b) Conduct an audit in accordance with 6.2.2.6.3.2 to verify that the inspections and tests are carried out as required by the relevant pressure receptacle standards and RID, to the satisfaction of the competent authority.

- 6.2.2.6.4.4** After the audit has been carried out with satisfactory results and all applicable requirements of 6.2.2.6.4 have been satisfied, an approval certificate shall be issued. It shall include the name of the periodic inspection and test body, the registered mark, the address of each facility, and the necessary data for identification of its approved activities (e.g. designation of pressure receptacles, periodic inspection and test method and pressure receptacle standards).

- 6.2.2.6.4.5** If the periodic inspection and test body is denied approval, the competent authority shall provide written detailed reasons for such denial.

#### **Modifications to periodic inspection and test body approvals**

- 6.2.2.6.4.6** Following approval, the periodic inspection and test body shall notify the issuing competent authority of any modifications to the information submitted under 6.2.2.6.4.2 relating to the initial approval.

The modifications shall be evaluated in order to determine whether the requirements of the relevant pressure receptacle standards and RID will be satisfied. An audit in accordance with 6.2.2.6.3.2 may be required. The competent authority shall accept or reject these modifications in writing, and an amended approval certificate shall be issued as necessary.

- 6.2.2.6.4.7** Upon request, the competent authority shall communicate to any other competent authority, information concerning initial approvals, modifications of approvals, and withdrawn approvals.

#### **6.2.2.6.5 Periodic inspection and test and certification**

The application of the periodic inspection and test marking to a pressure receptacle shall be considered a declaration that the pressure receptacle complies with the applicable pressure receptacle standards and the requirements of RID. The periodic inspection and test body shall affix the periodic inspection and test marking, including its registered mark, to each approved pressure receptacle (see 6.2.2.7.6).

A record certifying that a pressure receptacle has passed the periodic inspection and test shall be issued by the periodic inspection and test body, before the pressure receptacle is filled.

#### **6.2.2.6.6 Records**


The periodic inspection and test body shall retain records of pressure receptacle periodic inspection and tests (both passed and failed) including the location of the test facility, for not less than 15 years.

The owner of the pressure receptacle shall retain an identical record until the next periodic inspection and test unless the pressure receptacle is permanently removed from service.

#### **6.2.2.7 Marking of refillable UN pressure receptacles**

Refillable UN pressure receptacles shall be marked clearly and legibly with certification, operational and manufacturing marks. These marks shall be permanently affixed (e.g. stamped, engraved, or etched) on the pressure receptacle. The marks shall be on the shoulder, top end or neck of the pressure receptacle or on a permanently affixed component of the pressure receptacle (e.g. welded collar or corrosion resistant plate welded on the outer jacket of a closed cryogenic receptacle). Except for the UN packaging symbol, the minimum size of the marks shall be 5 mm for pressure receptacles with a diameter greater than or equal to 140 mm and 2.5 mm for pressure receptacles with a diameter less than 140 mm. The minimum size of the UN packaging symbol shall be 10 mm for pressure receptacles with a diameter greater than or equal to 140 mm and 5 mm for pressure receptacles with a diameter less than 140 mm.

- 6.2.2.7.1** The following certification marks shall be applied:

- (a) The United Nations packaging symbol .

This symbol shall not be used for any purpose other than certifying that a packaging complies with the relevant requirements in Chapter 6.1, 6.2, 6.3, 6.5 or 6.6. This symbol shall not be used for pressure receptacles which only conform to the requirements of 6.2.3 to 6.2.5 (see 6.2.3.9).

- (b) The technical standard (e.g. ISO 9809-1) used for design, manufacture and testing;
- (c) The character(s) identifying the country of approval as indicated by the distinguishing signs for motor vehicles in international traffic<sup>2</sup>;

**NOTE:** The country of approval shall be understood to be the country that approved the body which inspected the individual receptacle at time of manufacture.

- (d) The identity mark or stamp of the inspection body that is registered with the competent authority of the country authorizing the marking;
- (e) The date of the initial inspection, the year (four digits) followed by the month (two digits) separated by a slash (i.e. "/");

- 6.2.2.7.2** The following operational marks shall be applied:

- (f) The test pressure in bar, preceded by the letters "PH" and followed by the letters "BAR";

---

<sup>2</sup> Distinguishing signs for motor vehicles in international traffic prescribed in the Vienna Convention on Road Traffic (1968).

- (g) The mass of the empty pressure receptacle including all permanently attached integral parts (e.g. neck ring, foot ring, etc.) in kilograms, followed by the letters "KG". This mass shall not include the mass of valve, valve cap or valve guard, any coating, or porous material for acetylene. The mass shall be expressed to three significant figures rounded up to the last digit. For cylinders of less than 1 kg, the mass shall be expressed to two significant figures rounded up to the last digit. In the case of pressure receptacles for UN No. 1001 acetylene, dissolved and UN No. 3374 acetylene, solvent free, at least one decimal shall be shown after the decimal point and two digits for pressure receptacles of less than 1 kg;
- (h) The minimum guaranteed wall thickness of the pressure receptacle in millimetres followed by the letters "MM". This mark is not required for pressure receptacles with a water capacity less than or equal to 1 litre or for composite cylinders or for closed cryogenic receptacles;
- (i) In the case of pressure receptacles for compressed gases, UN No. 1001 acetylene, dissolved, and UN No. 3374 acetylene, solvent free, the working pressure in bar, preceded by the letters "PW". In the case of closed cryogenic receptacles, the maximum allowable working pressure preceded by the letters "MAWP";
- (j) In the case of pressure receptacles for liquefied gases and refrigerated liquefied gases, the water capacity in litres expressed to three significant figures rounded down to the last digit, followed by the letter "L". If the value of the minimum or nominal water capacity is an integer, the figures after the decimal point may be neglected;
- (k) In the case of pressure receptacles for UN No. 1001 acetylene, dissolved, the total of the mass of the empty receptacle, the fittings and accessories not removed during filling, any coating, the porous material, the solvent and the saturation gas expressed to three significant figures rounded down to the last digit followed by the letters "KG". At least one decimal shall be shown after the decimal point. For pressure receptacles of less than 1 kg, the mass shall be expressed to two significant figures rounded down to the last digit;
- (l) In the case of pressure receptacles for UN No. 3374 acetylene, solvent free, the total of the mass of the empty receptacle, the fittings and accessories not removed during filling, any coating, and the porous material expressed to three significant figures rounded down to the last digit followed by the letters "KG". At least one decimal shall be shown after the decimal point. For pressure receptacles of less than 1 kg, the mass shall be expressed to two significant figures rounded down to the last digit;

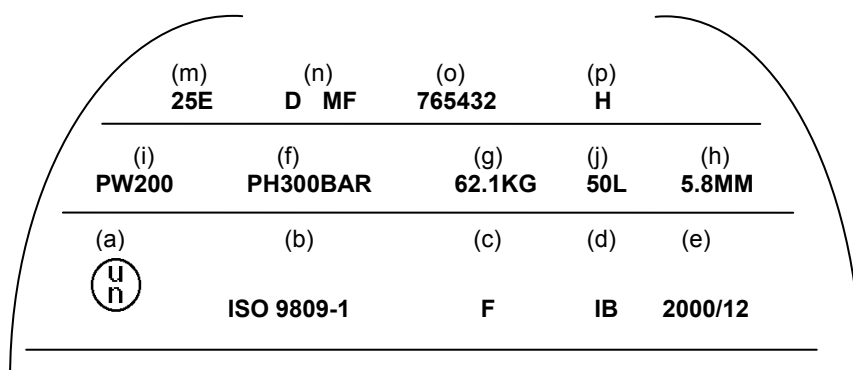
**6.2.2.7.3** The following manufacturing marks shall be applied:

- (m) Identification of the cylinder thread (e.g. 25E). This mark is not required for closed cryogenic receptacles;
- (n) The manufacturer's mark registered by the competent authority. When the country of manufacture is not the same as the country of approval, then the manufacturer's mark shall be preceded by the character(s) identifying the country of manufacture as indicated by the distinguishing signs for motor vehicles in international traffic. The country mark and the manufacturer's mark shall be separated by a space or slash;
- (o) The serial number assigned by the manufacturer;
- (p) In the case of steel pressure receptacles and composite pressure receptacles with steel liner intended for the carriage of gases with a risk of hydrogen embrittlement, the letter "H" showing compatibility of the steel (see ISO 11114-1:1997).

**6.2.2.7.4** The above marks shall be placed in three groups:

- Manufacturing marks shall be the top grouping and shall appear consecutively in the sequence given in 6.2.2.7.3.
- The operational marks in 6.2.2.7.2 shall be the middle grouping and the test pressure (f) shall be immediately preceded by the working pressure (i) when the latter is required.
- Certification marks shall be the bottom grouping and shall appear in the sequence given in 6.2.2.7.1.

The following is an example of the markings applied to a cylinder.



**6.2.2.7.5** Other marks are allowed in areas other than the side wall, provided they are made in low stress areas and are not of a size and depth that will create harmful stress concentrations. In the case of closed cryogenic receptacles, such marks may be on a separate plate attached to the outer jacket. Such marks shall not conflict with required marks.

**6.2.2.7.6** In addition to the preceding marks, each refillable pressure receptacle that meets the periodic inspection and test requirements of 6.2.2.4 shall be marked indicating:

- (a) The character(s) identifying the country authorizing the body performing the periodic inspection and test. This marking is not required if this body is approved by the competent authority of the country approving manufacture;
- (b) The registered mark of the body authorised by the competent authority for performing periodic inspection and test;
- (c) The date of the periodic inspection and test, the year (two digits) followed by the month (two digits) separated by a slash (i.e. "/" ). Four digits may be used to indicate the year.

The above marks shall appear consecutively in the sequence given.

**6.2.2.7.7** For acetylene cylinders, with the agreement of the competent authority, the date of the most recent periodic inspection and the stamp of the body performing the periodic inspection and test may be engraved on a ring held on the cylinder by the valve. The ring shall be configured so that it can only be removed by disconnecting the valve from the cylinder.

**6.2.2.8 Marking of non-refillable UN pressure receptacles**

Non-refillable UN pressure receptacles shall be marked clearly and legibly with certification and gas or pressure receptacle specific marks. These marks shall be permanently affixed (e.g. stencilled, stamped, engraved, or etched) on the pressure receptacle. Except when stencilled, the marks shall be on the shoulder, top end or neck of the pressure receptacle or on a permanently affixed component of the pressure receptacle (e.g. welded collar). Except for the UN packaging symbol and the "DO NOT REFILL" mark, the minimum size of the marks shall be 5 mm for pressure receptacles with a diameter greater than or equal to 140 mm and 2.5 mm for pressure receptacles with a diameter less than 140 mm. The minimum size of the UN packaging symbol shall be 10 mm for pressure receptacles with a diameter greater than or equal to 140 mm and 5 mm for pressure receptacles with a diameter less than 140 mm. The minimum size of the "DO NOT REFILL" mark shall be 5 mm.

**6.2.2.8.1** The marks listed in 6.2.2.7.1 to 6.2.2.7.3 shall be applied with the exception of (g), (h) and (m). The serial number (o) may be replaced by the batch number. In addition, the words "DO NOT REFILL" in letters of at least 5 mm in height are required.

**6.2.2.8.2** The requirements of 6.2.2.7.4 shall apply.

**NOTE:** Non-refillable pressure receptacles may, on account of their size, substitute this marking by a label.

**6.2.2.8.3** Other marks are allowed provided they are made in low stress areas other than the side wall and are not of a size and depth that will create harmful stress concentrations. Such marks shall not conflict with required marks.

**6.2.2.9 Equivalent procedures for conformity assessment and periodic inspection and test**

For UN pressure receptacles the requirements of 6.2.2.5 and 6.2.2.6 are considered to have been complied with when the following procedures are applied:

Procedure	Relevant body
Type approval (1.8.7.2)	Xa
Supervision of manufacture (1.8.7.3)	Xa or IS
Initial inspection and tests (1.8.7.4)	Xa or IS
Periodic inspection (1.8.7.5)	Xa or Xb or IS

Xa means the competent authority, its delegate or inspection body conforming to 1.8.6.4 and accredited according to EN ISO/IEC 17020: 2004 type A.

Xb means inspection body conforming to 1.8.6.4 and accredited according to EN ISO/IEC 17020: 2004 type B.

IS means an in-house inspection service of the applicant under the surveillance of an inspection body conforming to 1.8.6.4 and accredited according to EN ISO/IEC 17020:2004 type A. The in-house inspection service shall be independent from design process, manufacturing operations, repair and maintenance.

## 6.2.3 General requirements for non-UN pressure receptacles

### 6.2.3.1 Design and construction

6.2.3.1.1 Pressure receptacles and their closures not designed, constructed, inspected, tested and approved according to the requirements of 6.2.2 shall be designed, constructed, inspected, tested and approved in accordance with the general requirements of 6.2.1 as supplemented or modified by the requirements of this section and those of 6.2.4 or 6.2.5.

6.2.3.1.2 Whenever possible the wall thickness shall be determined by calculation, accompanied, if needed, by experimental stress analysis. Otherwise the wall thickness may be determined by experimental means.

Appropriate design calculations for the pressure envelope and supporting components shall be used to ensure the safety of the pressure receptacles concerned.

The minimum wall thickness to withstand pressure shall be calculated in particular with regard to:

- the calculation pressures, which shall not be less than the test pressure;
- the calculation temperatures allowing for appropriate safety margins;
- the maximum stresses and peak stress concentrations where necessary;
- factors inherent to the properties of the material.

6.2.3.1.3 For welded pressure receptacles, only metals of weldable quality whose adequate impact strength at an ambient temperature of  $-20\text{ }^{\circ}\text{C}$  can be guaranteed shall be used.

6.2.3.1.4 For closed cryogenic receptacles, the impact strength to be established as required by 6.2.1.1.8.1 shall be tested as laid down in 6.8.5.3.

6.2.3.2 (Reserved)

### 6.2.3.3 Service equipment

6.2.3.3.1 Service equipment shall comply with 6.2.1.3.

#### 6.2.3.3.2 Openings

Pressure drums may be provided with openings for filling and discharge and with other openings intended for level gauges, pressure gauges or relief devices. The number of openings shall be kept to a minimum consistent with safe operations. Pressure drums may also be provided with an inspection opening, which shall be closed by an effective closure.

#### 6.2.3.3.3 Fittings

- (a) If cylinders are fitted with a device to prevent rolling, this device shall not be integral with the valve cap;
- (b) Pressure drums which are capable of being rolled shall be equipped with rolling hoops or be otherwise protected against damage due to rolling (e.g. by corrosion resistant metal sprayed on to the pressure receptacle surface);
- (c) Bundles of cylinders shall be fitted with appropriate devices ensuring that they can be handled and carried safely;
- (d) If level gauges, pressure gauges or relief devices are installed, they shall be protected in the same way as is required for valves in 4.1.6.8.

### 6.2.3.4 Initial inspection and test

6.2.3.4.1 New pressure receptacles shall be subjected to testing and inspection during and after manufacture in accordance with the requirements of 6.2.1.5 except that 6.2.1.5.1 (g) shall be replaced by the following:

- (g) A hydraulic pressure test. Pressure receptacles shall withstand the test pressure without undergoing permanent deformation or exhibiting cracks.

#### 6.2.3.4.2 Specific provisions applying to aluminium alloy pressure receptacles

- (a) In addition to the initial inspection required by 6.2.1.5.1, it is necessary to test for possible intercrystalline corrosion of the inside wall of the pressure receptacles where use is made of an aluminium alloy containing copper, or where use is made of an aluminium alloy containing magnesium and manganese and the magnesium content is greater than 3.5% or the manganese content lower than 0.5%;
- (b) In the case of an aluminium/copper alloy the test shall be carried out by the manufacturer at the time of approval of a new alloy by the competent authority; it shall thereafter be repeated in the course of production, for each pour of the alloy;
- (c) In the case of an aluminium/magnesium alloy the test shall be carried out by the manufacturer at the time of approval of a new alloy and of the manufacturing process by the competent authority. The test

shall be repeated whenever a change is made in the composition of the alloy or in the manufacturing process.

### 6.2.3.5 Periodic inspection and test

6.2.3.5.1 Periodic inspection and test shall be in accordance with 6.2.1.6.1.

**NOTE:** With the agreement of the competent authority of the country that issued the type approval, the hydraulic pressure test of each welded steel cylinder intended for the carriage of gases of UN No. 1965, hydrocarbon gas mixture liquefied, n.o.s., with a capacity below 6.5 l may be replaced by another test ensuring an equivalent level of safety.

6.2.3.5.2 Closed cryogenic receptacles shall be subjected to periodic inspections and tests by a body authorised by the competent authority in accordance with the periodicity defined in packing instruction P203 of 4.1.4.1 to verify external conditions, condition and operation of pressure relief devices and be subjected to a leakproofness test at 90% of the maximum working pressure. The leakproofness test shall be carried out with the gas contained in the pressure receptacle or with an inert gas. Checking shall be performed by means of a pressure gauge or by vacuum measurement. The thermal insulation need not be removed.

### 6.2.3.6 Approval of pressure receptacles

6.2.3.6.1 The procedures for conformity assessment and periodic inspection of section 1.8.7 shall be performed by the relevant body according to the following Table.

Procedure	Relevant body
Type approval (1.8.7.2)	Xa
Supervision of manufacture (1.8.7.3)	Xa or IS
Initial inspection and tests (1.8.7.4)	Xa or IS
Periodic inspection (1.8.7.5)	Xa or Xb or IS

The conformity assessment of valves and other accessories having a direct safety function may be carried out separately from the receptacles and the conformity assessment procedure shall be at least as stringent as that undergone by the pressure receptacle to which they are fitted.

Xa means the competent authority, its delegate or inspection body conforming to 1.8.6.4 and accredited according to EN ISO/IEC 17020:2004 type A.

Xb means inspection body conforming to 1.8.6.4 and accredited according to EN ISO/IEC 17020:2004 type B.

IS means an in-house inspection service of the applicant under the surveillance of an inspection body conforming to 1.8.6.4 and accredited according to EN ISO/IEC 17020:2004 type A. The in-house inspection service shall be independent from design process, manufacturing operations, repair and maintenance.

6.2.3.6.2 If the country of approval is not a COTIF Member State or a Contracting Party to ADR, the competent authority mentioned in 6.2.1.7.2 shall be the competent authority of a COTIF Member State or a Contracting Party to ADR.

### 6.2.3.7 Requirements for manufacturers

6.2.3.7.1 The relevant requirements of 1.8.7 shall be met.

### 6.2.3.8 Requirements for inspection bodies

The requirements of 1.8.6 shall be met.

### 6.2.3.9 Marking of refillable pressure receptacles

6.2.3.9.1 Markings shall be in accordance with sub-section 6.2.2.7 with the following variations.

6.2.3.9.2 The United Nations packaging symbol specified in 6.2.2.7.1 (a) shall not be applied.

6.2.3.9.3 The requirements of 6.2.2.7.2 (j) shall be replaced by the following:

(j) The water capacity of the pressure receptacle in litres followed by the letter "L". In the case of pressure receptacles for liquefied gases the water capacity in litres shall be expressed to three significant figures rounded down to the last digit. If the value of the minimum or nominal water capacity is an integer, the figures after the decimal point may be neglected.



- 6.2.3.9.4** The marks specified in 6.2.2.7.2 (g) and (h) and 6.2.2.7.3 (m) are not required for pressure receptacles for UN No. 1965 hydrocarbon gas mixture, liquefied, n.o.s.
- 6.2.3.9.5** When marking the date required by 6.2.2.7.6 (c), the month need not be indicated for gases for which the interval between periodic inspections is 10 years or more (see packing instructions P200 and P203 of 4.1.4.1).
- 6.2.3.9.6** The marks in accordance with 6.2.2.7.6 may be engraved on a ring of an appropriate material affixed to the cylinder when the valve is installed and which is removable only by disconnecting the valve from the cylinder.
- 6.2.3.10** **Marking of non-refillable pressure receptacles**
- 6.2.3.10.1** Markings shall be in accordance with 6.2.2.8, except that the United Nations packaging symbol specified in 6.2.2.7.1 (a) shall not be applied.

**6.2.4** **Requirements for non-UN pressure receptacles designed, constructed and tested according to standards**

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

Depending on the date of construction of the pressure receptacle, the standards listed in the Table below shall be applied as indicated in column (4) to meet the requirements of Chapter 6.2 referred to in column (3) or may be applied as indicated in column (5). The requirements of Chapter 6.2 referred to in column (3) shall prevail in all cases.

If more than one standard is listed as mandatory for the application of the same requirements, only one of them shall be applied, but in full unless otherwise specified in the Table below.

Reference	Title of document	Applicable sub-sections and paragraphs	Mandatory application for pressure receptacles constructed	Application authorized for pressure receptacles constructed
(1)	(2)	(3)	(4)	(5)
<b>for materials</b>				
EN 1797-1:1998	Cryogenic vessels – Gas/material compatibility	6.2.1.2		Between 1 July 2001 and 30 June 2003
EN 1797:2001	Cryogenic vessels – Gas/material compatibility	6.2.1.2	As from 1 January 2009	Before 1 January 2009
EN ISO 11114-1:1997	Transportable gas cylinders – Compatibility of cylinder and valve materials with gas contents – Part 1: Metallic materials	6.2.1.2	As from 1 January 2009	Before 1 January 2009
EN ISO 11114-2:2000	Transportable gas cylinders – Compatibility of cylinder and valve materials with gas contents – Part 2: Non-metallic materials	6.2.1.2	As from 1 January 2009	Before 1 January 2009
EN ISO 11114-4:2005 (except method C in 5.3)	Transportable gas cylinders – Compatibility of cylinder and valve materials with gas contents – Part 4: Test methods for selecting metallic materials resistant to hydrogen embrittlement	6.2.1.2	As from 1 January 2009	Before 1 January 2009
EN 1252-1:1998	Cryogenic vessels – Materials – Part 1: Toughness requirements for temperature below -80 °C	6.2.1.2		Between 1 July 2001 and 30 June 2003
<b>for marking</b>				
EN 1442:1998 + AC:1999	Transportable refillable welded steel cylinders for liquefied petroleum gas (LPG) – Design and construction	6.2.2.7		Before 1 July 2003

Reference	Title of document	Applicable sub-sections and paragraphs	Mandatory application for pressure receptacles constructed	Application authorized for pressure receptacles constructed
(1)	(2)	(3)	(4)	(5)
EN 1251-1:2000	Cryogenic vessels – Transportable, vacuum insulated, of not more than 1 000 litres volume – Part 1: Fundamental requirements	6.2.2.7		Before 1 July 2003
EN 1089-1:1996	Transportable gas cylinders – Gas cylinder identification (excluding LPG) – Part 1: Stampmarking	6.2.2.7		Before 1 July 2003
<b>for design and construction</b>				
Annex I, Parts 1 to 3 to 84/525/EEC	Council directive on the approximation of the laws of the Member States relating to seamless steel gas cylinders, published in the Official Journal of the European Communities No. L 300 from 19.11.1984.	6.2.3.1 and 6.2.3.4	As from 1 January 2009	Before 1 January 2009
Annex I, Parts 1 to 3 to 84/526/EEC	Council directive on the approximation of the laws of the Member States relating to seamless, unalloyed aluminium and aluminium alloy gas cylinders, published in the Official Journal of the European Communities No. L 300 from 19.11.1984.	6.2.3.1 and 6.2.3.4	As from 1 January 2009	Before 1 January 2009
Annex I, Parts 1 to 3 to 84/527/EEC	Council directive on the approximation of the laws of the Member States relating to welded unalloyed steel gas cylinders, published in the Official Journal of the European Communities No. L 300 from 19.11.1984.	6.2.3.1 and 6.2.3.4	As from 1 January 2009	Before 1 January 2009
EN 1442:1998 + AC:1999	Transportable refillable welded steel cylinders for liquefied petroleum gas (LPG) – Design and construction	6.2.3.1 and 6.2.3.4		Between 1 July 2001 and 30 June 2007
EN 1442:1998 + A2:2005	Transportable refillable welded steel cylinders for liquefied petroleum gas (LPG) – Design and construction	6.2.3.1 and 6.2.3.4	Between 1 January 2009 and 31 December 2010 <sup>(a)</sup>	Before 1 January 2009
EN 1442:2006 + A1:2008	Transportable refillable welded steel cylinders for liquefied petroleum gas (LPG) – Design and construction	6.2.3.1 and 6.2.3.4	As from 1 January 2011	Before 1 January 2011
EN 1800:1998 + AC:1999	Transportable gas cylinders – Acetylene cylinders – Basic requirements and definitions	6.2.1.1.9	Between 1 January 2009 and 31 December 2010 <sup>(a)</sup>	Before 1 January 2009
EN 1800:2006	Transportable gas cylinders – Acetylene cylinders – Basic requirements, definitions and type testing	6.2.1.1.9	As from 1 January 2011	Before 1 January 2011

Reference	Title of document	Applicable sub-sections and paragraphs	Mandatory application for pressure receptacles constructed	Application authorized for pressure receptacles constructed
(1)	(2)	(3)	(4)	(5)
EN 1964-1:1999	Transportable gas cylinders – Specification for the design and construction of refillable transportable seamless steel gas cylinders of water capacities from 0.5 litre up to and including 150 litres – Part 1: Cylinders made of seamless steel with an Rm value of less than 1 100 MPa	6.2.3.1 and 6.2.3.4	As from 1 January 2009	Before 1 January 2009
EN 1975:1999 (except Annex 6)	Transportable gas cylinders – Specifications for the design and construction of refillable transportable seamless aluminium and aluminium alloy gas cylinders of capacity from 0.5 litres up to 150 litres	6.2.3.1 and 6.2.3.4		Before 1 July 2005
EN 1975:1999 + A1:2003	Transportable gas cylinders – Specifications for the design and construction of refillable transportable seamless aluminium and aluminium alloy gas cylinders of capacity from 0.5 litres up to 150 litres	6.2.3.1 and 6.2.3.4	As from 1 January 2009	Before 1 January 2009
EN ISO 11120:1999	Gas cylinders – Refillable seamless steel tubes for compressed gas transport of water capacity between 150 litres and 3 000 litres – Design, construction and testing	6.2.3.1 and 6.2.3.4	As from 1 January 2009	Before 1 January 2009
EN 1964-3:2000	Transportable gas cylinders – Specification for the design and construction of refillable transportable seamless steel gas cylinders of water capacities from 0.5 litre up to and including 150 litres – Part 3: Cylinders made of seamless stainless steel with an Rm value of less than 1 100 MPa	6.2.3.1 and 6.2.3.4	As from 1 January 2009	Before 1 January 2009
EN 12862:2000	Transportable gas cylinders – Specifications for the design and construction of refillable transportable welded aluminium alloy gas cylinders	6.2.3.1 and 6.2.3.4	As from 1 January 2009	Before 1 January 2009
EN 1251-2:2000	Cryogenic vessels – Transportable, vacuum insulated, of not more than 1 000 litres volume – Part 2: Design, fabrication, inspection and testing	6.2.3.1 and 6.2.3.4	As from 1 January 2009	Before 1 January 2009
EN 12257:2002	Transportable gas cylinders – Seamless, hoop wrapped composite cylinders	6.2.3.1 and 6.2.3.4	As from 1 January 2009	Before 1 January 2009
EN 12807:2001 (except Annex A)	Transportable refillable brazed steel cylinders for liquefied petroleum gas (LPG) – Design and construction	6.2.3.1 and 6.2.3.4	As from 1 January 2009	Before 1 January 2009

Reference	Title of document	Applicable sub-sections and paragraphs	Mandatory application for pressure receptacles constructed	Application authorized for pressure receptacles constructed
(1)	(2)	(3)	(4)	(5)
EN 1964-2:2001	Transportable gas cylinders – Specification for the design and construction of refillable transportable seamless steel gas cylinders of water capacities from 0.5 litre up to and including 150 litres – Part 2: Cylinders made of seamless steel with an Rm value of 1 100 MPa and above	6.2.3.1 and 6.2.3.4	As from 1 January 2009	Before 1 January 2009
EN 13293:2002	Transportable gas cylinders – Specification for the design and construction of refillable transportable seamless normalised carbon manganese steel gas cylinders of water capacity up to 0.5 litre for compressed, liquefied and dissolved gases and up to 1 litre for carbon dioxide	6.2.3.1 and 6.2.3.4	As from 1 January 2009	Before 1 January 2009
EN 13322-1:2003	Transportable gas cylinders – Refillable welded steel gas cylinders – Design and construction – Part 1: Welded steel	6.2.3.1 and 6.2.3.4		Before 1 July 2007
EN 13322-1:2003 + A1:2006	Transportable gas cylinders – Refillable welded steel gas cylinders – Design and construction – Part 1: Welded steel	6.2.3.1 and 6.2.3.4	As from 1 January 2009	Before 1 January 2009
EN 13322-2:2003	Transportable gas cylinders – Refillable welded stainless steel gas cylinders – Design and construction – Part 2: Welded stainless steel	6.2.3.1 and 6.2.3.4		Before 1 July 2007
EN 13322-2:2003 + A1:2006	Transportable gas cylinders – Refillable welded stainless steel gas cylinders – Design and construction – Part 2: Welded stainless steel	6.2.3.1 and 6.2.3.4	As from 1 January 2009	Before 1 January 2009
EN 12245:2002	Transportable gas cylinders – Fully wrapped composite cylinders	6.2.3.1 and 6.2.3.4	As from 1 January 2009	Before 1 January 2009
EN 12205:2001	Transportable gas cylinders – Non refillable metallic gas cylinders	6.2.3.1 and 6.2.3.4	As from 1 January 2009	Before 1 January 2009
EN 13110:2002	Transportable refillable welded aluminium cylinders for liquefied petroleum gas (LPG) – Design and construction	6.2.3.1, 6.2.3.4 and 6.2.3.9	As from 1 January 2009	Before 1 January 2009
EN 14427:2004	Transportable refillable fully wrapped composite cylinders for liquefied petroleum gases – Design and construction <b>NOTE:</b> This standard applies only to cylinders equipped with pressure relief valves.	6.2.3.1, 6.2.3.4 and 6.2.3.9		Before 1 July 2007

Reference	Title of document	Applicable sub-sections and paragraphs	Mandatory application for pressure receptacles constructed	Application authorized for pressure receptacles constructed
(1)	(2)	(3)	(4)	(5)
EN 14427:2004 + A1:2005	Transportable refillable fully wrapped composite cylinders for liquefied petroleum gases – Design and construction <b>NOTE 1:</b> This standard applies only to cylinders equipped with pressure relief valves. <b>2:</b> In 5.2.9.2.1 and 5.2.9.3.1, both cylinders shall be subject to the burst test when they show damage equal to or worse than the rejection criteria.	6.2.3.1, 6.2.3.4 and 6.2.3.9	As from 1 January 2009	Before 1 January 2009
EN 14208:2004	Transportable gas cylinders – Specification for welded pressure drums up to 1000 litres capacity for the transport of gases – Design and construction	6.2.3.1, 6.2.3.4 and 6.2.3.9	As from 1 January 2009	Before 1 January 2009
EN 14140:2003	Transportable refillable welded steel cylinders for Liquefied Petroleum Gas (LPG) – Alternative design and construction	6.2.3.1, 6.2.3.4 and 6.2.3.9	Between 1 January 2009 and 31 December 2010 <sup>(a)</sup>	Before 1 January 2009
EN 14140:2003 + A1:2006	LPG equipment and accessories – Transportable refillable welded steel cylinders for LPG – Alternative design and construction	6.2.3.1, 6.2.3.4 and 6.2.3.9	As from 1 January 2011	Before 1 January 2011
EN 13769:2003	Transportable gas cylinders – Cylinder bundles – Design, manufacture, identification and testing	6.2.3.1, 6.2.3.4 and 6.2.3.9		Before 1 July 2007
EN 13769:2003 + A1:2005	Transportable gas cylinders – Cylinder bundles – Design, manufacture, identification and testing	6.2.3.1, 6.2.3.4 and 6.2.3.9	As from 1 January 2009	Before 1 January 2009
EN 14638-1:2006	Transportable gas cylinders – Refillable welded receptacles of a capacity not exceeding 150 litres – Part 1: Welded austenitic stainless steel cylinders made to a design justified by experimental methods	6.2.3.1 and 6.2.3.4	As from 1 January 2011	Before 1 January 2011
EN 14893:2006 + AC:2007	LPG equipment and accessories – Transportable LPG welded steel pressure drums with a capacity between 150 litres and 1 000 litres	6.2.3.1 and 6.2.3.4	As from 1 January 2011	Before 1 January 2011
<b>for closures</b>				
EN 849:1996 (except Annex A)	Transportable gas cylinders – Cylinder valves: Specification and type testing	6.2.3.1		Before 1 July 2003
EN 849:1996/ A2:2001	Transportable gas cylinders – Cylinder valves: Specification and type testing	6.2.3.1		Before 1 July 2007

Reference	Title of document	Applicable sub-sections and paragraphs	Mandatory application for pressure receptacles constructed	Application authorized for pressure receptacles constructed
(1)	(2)	(3)	(4)	(5)
EN ISO 10297:2006	Transportable gas cylinders – Cylinder valves: Specification and type testing	6.2.3.1	As from 1 January 2009	Before 1 January 2009
EN 13152:2001	Specifications and testing of LPG – cylinder valves – Self closing	6.2.3.3		Between 1 July 2005 and 31 December 2010
EN 13152:2001 + A1:2003	Specifications and testing of LPG – cylinder valves – Self closing	6.2.3.3	As from 1 January 2011	Before 1 January 2011
EN 13153:2001	Specifications and testing of LPG – cylinder valves – Manually operated	6.2.3.3		Between 1 July 2005 and 31 December 2010
EN 13153:2001 + A1:2003	Specifications and testing of LPG – cylinder valves – Manually operated	6.2.3.3	As from 1 January 2011	Before 1 January 2011
<b>for periodic inspection and test</b>				
EN 1251-3:2000	Cryogenic vessels – Transportable, vacuum insulated, of not more than 1 000 litres volume – Part 3: Operational requirements	6.2.3.5	As from 1 January 2009	Before 1 January 2009
EN 1968:2002 except Annex B)	Transportable gas cylinders – Periodic inspection and testing of seamless steel gas cylinders	6.2.3.5		Before 1 July 2007
EN 1968:2002 + A1:2005 (except Annex B)	Transportable gas cylinders – Periodic inspection and testing of seamless steel gas cylinders	6.2.3.5	As from 1 January 2009	Before 1 January 2009
EN 1802:2002 (except Annex B)	Transportable gas cylinders – Periodic inspection and testing of seamless aluminium alloy gas cylinders	6.2.3.5	As from 1 January 2009	Before 1 January 2009
EN 12863:2002	Transportable gas cylinders – Periodic inspection and maintenance of dissolved acetylene cylinders <b>NOTE:</b> In this standard "initial inspection" is to be understood as the "first periodic inspection" after final approval of a new acetylene cylinder.	6.2.3.5		Before 1 July 2007
EN 12863:2002 + A1:2005	Transportable gas cylinders – Periodic inspection and maintenance of dissolved acetylene cylinders <b>NOTE:</b> In this standard "initial inspection" is to be understood as the "first periodic inspection" after final approval of a new acetylene cylinder.	6.2.3.5	As from 1 January 2009	Before 1 January 2009
EN 1803:2002 (except Annex B)	Transportable gas cylinders – Periodic inspection and testing of welded steel gas cylinders	6.2.3.5	As from 1 January 2009	Before 1 January 2009
EN ISO 11623:2002 (except clause 4)	Transportable gas cylinders – Periodic inspection and testing of composite gas cylinders	6.2.3.5	As from 1 January 2009	Before 1 January 2009

Reference	Title of document	Applicable sub-sections and paragraphs	Mandatory application for pressure receptacles constructed	Application authorized for pressure receptacles constructed
(1)	(2)	(3)	(4)	(5)
EN 14189:2003	Transportable gas cylinders – Inspection and maintenance of cylinder valves at time of periodic inspection of gas cylinders	6.2.3.5	As from 1 January 2009	Before 1 January 2009
EN 14876:2007	Transportable gas cylinders – Periodic inspection and testing of welded steel pressure drums	6.2.3.5	As from 1 January 2011	Before 1 January 2011
EN 14912:2005	LPG equipment and accessories – Inspection and maintenance of LPG cylinder valves at time of periodic inspection of cylinders	6.2.3.5	As from 1 January 2011	Before 1 January 2011

(a) Unless the application of another standard is authorized in column (5) for the same purposes for pressure receptacles constructed at the same date.

## 6.2.5 Requirements for non-UN pressure receptacles not designed, constructed and tested according to standards

To reflect scientific and technical progress or where no standard is listed in 6.2.2 or 6.2.4, or to deal with specific aspects not addressed in a standard listed in 6.2.2 or 6.2.4, the competent authority may recognize the use of a technical code providing the same level of safety.

The competent authority shall transmit to the secretariat of OTIF a list of the technical codes that it recognises. 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 web-site.

The requirements of 6.2.1, 6.2.3 and the following requirements however shall be met.

**NOTE:** For this section, the references to technical standards in 6.2.1 shall be considered as references to technical codes.

### 6.2.5.1 Materials

The following provisions contain examples of materials that may be used to comply with the requirements for materials in 6.2.1.2:

- (a) Carbon steel for compressed, liquefied, refrigerated liquefied gases and dissolved gases as well as for substances not in Class 2 listed in Table 3 of packing instruction P200 of 4.1.4.1;
- (b) Alloy steel (special steels), nickel, nickel alloy (such as monel) for compressed, liquefied, refrigerated liquefied gases and dissolved gases as well as for substances not in Class 2 listed in Table 3 of packing instruction P200 of 4.1.4.1;
- (c) Copper for:
  - (i) gases of classification codes 1A, 1O, 1F and 1TF, whose filling pressure referred to a temperature of 15 °C does not exceed 2 MPa (20 bar);
  - (ii) gases of classification code 2A and also UN No. 1033 dimethyl ether; UN No. 1037 ethyl chloride; UN No. 1063 methyl chloride; UN No. 1079 sulphur dioxide; UN No. 1085 vinyl bromide; UN No. 1086 vinyl chloride; and UN No. 3300 ethylene oxide and carbon dioxide mixture with more than 87% ethylene oxide;
  - (iii) gases of classification codes 3A, 3O and 3F;
- (d) Aluminium alloy: see special requirement "a" of packing instruction P200 (10) of 4.1.4.1;
- (e) Composite material for compressed, liquefied, refrigerated liquefied gases and dissolved gases;
- (f) Synthetic materials for refrigerated liquefied gases; and
- (g) Glass for the refrigerated liquefied gases of classification code 3A other than UN No. 2187 carbon dioxide, refrigerated, liquid or mixtures thereof, and gases of classification code 3O.

### 6.2.5.2 Service equipment

(Reserved)

### 6.2.5.3 Metal cylinders, tubes, pressure drums and bundles of cylinders

At the test pressure, the stress in the metal at the most severely stressed point of the pressure receptacle shall not exceed 77% of the guaranteed minimum yield stress (Re).

"Yield stress" means the stress at which a permanent elongation of 2 per thousand (i.e. 0.2%) or, for austenitic steels, 1% of the gauge length on the test-piece, has been produced.

**NOTE:** 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 a test-piece 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 cross-section are used, the gauge length "l" shall be calculated by the formula:

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

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

Pressure receptacles and their closures shall be made of suitable materials which shall be resistant to brittle fracture and to stress corrosion cracking between  $-20\text{ }^\circ\text{C}$  and  $+50\text{ }^\circ\text{C}$ .

Welds shall be skilfully made and shall afford the fullest safety.

### 6.2.5.4 Additional provisions relating to aluminium-alloy pressure receptacles for compressed gases, liquefied gases, dissolved gases and non pressurized gases subject to special requirements (gas samples) as well as articles containing gas under pressure other than aerosol dispensers and small receptacles containing gas (gas cartridges)

#### 6.2.5.4.1 The materials of aluminium-alloy pressure receptacles which are to be accepted shall satisfy the following requirements:

	A	B	C	D
Tensile strength, Rm, in MPa (= N/mm <sup>2</sup> )	49 to 186	196 to 372	196 to 372	343 to 490
Yield stress, Re, in MPa (= N/mm <sup>2</sup> ) (permanent set $\lambda = 0.2\%$ )	10 to 167	59 to 314	137 to 334	206 to 412
Permanent elongation at fracture (l = 5d) in per cent	12 to 40	12 to 30	12 to 30	11 to 16
Bend test (diameter of former d = n × e, where e is the thickness of the test piece)	n = 5 (Rm ≤ 98) n = 6 (Rm > 98)	n = 6 (Rm ≤ 325) n = 7 (Rm > 325)	n = 6 (Rm ≤ 325) n = 7 (Rm > 325)	n = 7 (Rm ≤ 392) n = 8 (Rm > 392)
Aluminium Association Series Number <sup>(a)</sup>	1000	5000	6000	2000

<sup>(a)</sup> See "Aluminium Standards and Data", Fifth edition, January 1976, published by the Aluminium Association, 750 Third Avenue, New York.

The actual properties will depend on the composition of the alloy concerned and on the final treatment of the pressure receptacle, but whatever alloy is used the thickness of the pressure receptacle shall be calculated by one of the following formulae:

$$e = \frac{P_{\text{MPa}} \times D}{\frac{2 \times \text{Re}}{1.30} + P_{\text{MPa}}} \quad \text{or} \quad e = \frac{P_{\text{bar}} \times D}{\frac{20 \times \text{Re}}{1.30} + P_{\text{bar}}}$$

where

e = minimum thickness of pressure receptacle wall, in mm;

$P_{\text{MPa}}$  = test pressure, in MPa

$P_{\text{bar}}$  = test pressure, in bar

D = nominal external diameter of the pressure receptacle, in mm

and

Re = guaranteed minimum proof stress with 0.2% proof stress, in MPa (=N/mm<sup>2</sup>)

In addition, the value of the minimum guaranteed proof stress (Re) introduced into the formula is in no case to be greater than 0.85 times the guaranteed minimum tensile strength (Rm), whatever the type of alloy used.

**NOTE 1:** The above characteristics are based on previous experience with the following materials used for pressure receptacles:

Column A: Aluminium, unalloyed, 99.5% pure;



Column B: Alloys of aluminium and magnesium;

Column C: Alloys of aluminium, silicon and magnesium, such as ISO/R209-Al-Si-Mg (Aluminium Association 6351);

Column D: Alloys of aluminium, copper and magnesium.

- 2: The permanent elongation at fracture is measured by means of 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  $F_0$  is the initial cross-section area of the test-piece.

- 3: (a) The bend test (see diagram) shall be carried out on specimens obtained by cutting into two equal parts of width  $3e$ , but in no case less than 25 mm, an annular section of a cylinder. The specimens shall not be machined elsewhere than on the edges;
- (b) The bend test shall be carried out between a mandrel of diameter ( $d$ ) and two circular supports separated by a distance of  $(d + 3e)$ . During the test the inner faces shall be separated by a distance not greater than the diameter of the mandrel;
- (c) The specimen shall not exhibit cracks when it has been bent inwards around the mandrel until the inner faces are separated by a distance not greater than the diameter of the mandrel;
- (d) The ratio ( $n$ ) between the diameter of the mandrel and the thickness of the specimen shall conform to the values given in the Table.

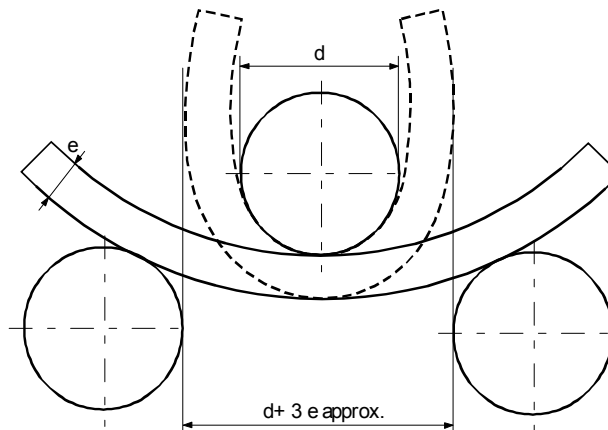


Diagram of bend test

**6.2.5.4.2** A lower minimum elongation value is acceptable on condition that an additional test approved by the competent authority of the country in which the pressure receptacles are made proves that safety of carriage is ensured to the same extent as in the case of pressure receptacles constructed to comply with the characteristics given in the Table in 6.2.5.4.1 (see also EN 1975: 1999 + A1:2003).

**6.2.5.4.3** The wall thickness of the pressure receptacles at the thinnest point shall be the following:

- where the diameter of the pressure receptacle is less than 50 mm: not less than 1.5 mm;
- where the diameter of the pressure receptacle is from 50 to 150 mm: not less than 2 mm; and
- where the diameter of the pressure receptacle is more than 150 mm: not less than 3 mm.

**6.2.5.4.4** The ends of the pressure receptacles shall have a semicircular, elliptical or "basket-handle" section; they shall afford the same degree of safety as the body of the pressure receptacle.

#### **6.2.5.5 Pressure receptacles in composite materials**

For cylinders, tubes, pressure drums and bundles of cylinders which make use of composite materials, the construction shall be such that a minimum burst ratio (burst pressure divided by test pressure) is:

- 1.67 for hoop wrapped pressure receptacles;
- 2.00 for fully wrapped pressure receptacles.

#### **6.2.5.6 Closed cryogenic receptacles**

The following requirements apply to the construction of closed cryogenic receptacles for refrigerated liquefied gases:

- 6.2.5.6.1** If non-metallic materials are used, they shall resist brittle fracture at the lowest working temperature of the pressure receptacle and its fittings.
- 6.2.5.6.2** The pressure relief devices shall be so constructed as to work perfectly even at their lowest working temperature. Their reliability of functioning at that temperature shall be established and checked by testing each device or a sample of devices of the same type of construction.
- 6.2.5.6.3** The vents and pressure relief devices of pressure receptacles shall be so designed as to prevent the liquid from splashing out.
- 6.2.6** **General requirements for aerosol dispensers, small receptacles containing gas (gas cartridges) and fuel cell cartridges containing liquefied flammable gas**
- 6.2.6.1** **Design and construction**
- 6.2.6.1.1** Aerosol dispensers (UN No.1950 aerosols) containing only a gas or a mixture of gases, and small receptacles containing gas (gas cartridges) (UN No. 2037), shall be made of metal. This requirement shall not apply to aerosols and small receptacles containing gas (gas cartridges) with a maximum capacity of 100 ml for UN No. 1011 butane. Other aerosol dispensers (UN No.1950 aerosols) shall be made of metal, synthetic material or glass. Receptacles made of metal and having an outside diameter of not less than 40 mm shall have a concave bottom.
- 6.2.6.1.2** The capacity of receptacles made of metal shall not exceed 1 000 ml; that of receptacles made of synthetic material or of glass shall not exceed 500 ml.
- 6.2.6.1.3** Each model of receptacles (aerosol dispensers or cartridges) shall, before being put into service, satisfy a hydraulic pressure test carried out in conformity with 6.2.6.2.
- 6.2.6.1.4** The release valves and dispersal devices of aerosol dispensers (UN No.1950 aerosols) and the valves of UN No. 2037 small receptacles containing gas (gas cartridges) shall ensure that the receptacles are so closed as to be leakproof and shall be protected against accidental opening. Valves and dispersal devices which close only by the action of the internal pressure are not to be accepted.
- 6.2.6.1.5** The internal pressure at 50 °C shall exceed neither two-thirds of the test pressure nor 1.32 MPa (13.2 bar). Aerosol dispensers and small receptacles containing gas (gas cartridges) shall be so filled that at 50 °C the liquid phase does not exceed 95% of their capacity.
- 6.2.6.2** **Hydraulic pressure test**
- 6.2.6.2.1** The internal pressure to be applied (test pressure) shall be 1.5 times the internal pressure at 50 °C, with a minimum pressure of 1 MPa (10 bar).
- 6.2.6.2.2** The hydraulic pressure tests shall be carried out on at least five empty receptacles of each model:
- (a) until the prescribed test pressure is reached, by which time no leakage or visible permanent deformation shall have occurred; and
  - (b) until leakage or bursting occurs; the dished end, if any, shall yield first and the receptacle shall not leak or burst until a pressure 1.2 times the test pressure has been reached or passed.
- 6.2.6.3** **Tightness (leakproofness) test**
- 6.2.6.3.1** **Small receptacles containing gas (gas cartridges) and fuel cell cartridges containing liquefied flammable gas**
- 6.2.6.3.1.1** Each receptacle or fuel cell cartridge shall satisfy a tightness (leakproofness) test in a hot-water bath.
- 6.2.6.3.1.2** The temperature of the bath and the duration of the test shall be such that the internal pressure of each receptacle or fuel cell cartridge reaches at least 90% of the internal pressure that would be reached at 55 °C. However, if the contents are sensitive to heat or if the receptacles or the fuel cell cartridges are made of a plastics material which softens at this temperature, the temperature of the bath shall be from 20 °C to 30 °C. In addition, one receptacle or fuel cell cartridge out of every 2 000 shall be tested at 55 °C.
- 6.2.6.3.1.3** No leakage or permanent deformation of a receptacle or fuel cell cartridge shall occur, except that a plastics receptacle or fuel cell cartridge may be deformed through softening, provided that it does not leak.
- 6.2.6.3.2** **Aerosol dispensers**
- Each filled aerosol dispenser shall be subjected to a test performed in a hot water bath or an approved water bath alternative.

#### 6.2.6.3.2.1 Hot water bath test

6.2.6.3.2.1.1 The temperature of the water bath and the duration of the test shall be such that the internal pressure reaches that which would be reached at 55 °C (50 °C if the liquid phase does not exceed 95% of the capacity of the aerosol dispenser at 50 °C). If the contents are sensitive to heat or if the aerosol dispensers are made of plastics material which softens at this test temperature, the temperature of the bath shall be set at between 20 °C and 30 °C but, in addition, one aerosol dispenser in 2000 shall be tested at the higher temperature.

6.2.6.3.2.1.2 No leakage or permanent deformation of an aerosol dispenser may occur, except that a plastics aerosol dispenser may be deformed through softening, provided that it does not leak.

#### 6.2.6.3.2.2 Alternative methods

With the approval of the competent authority alternative methods which provide an equivalent level of safety may be used, provided that the requirements of 6.2.6.3.2.2.1, 6.2.6.3.2.2.2 and 6.2.6.3.2.2.3 are met.

#### 6.2.6.3.2.2.1 Quality system

Aerosol dispenser fillers and component manufacturers shall have a quality system. The quality system shall implement procedures to ensure that all aerosol dispensers that leak or that are deformed are rejected and not offered for carriage.

The quality system shall include:

- (a) a description of the organizational structure and responsibilities;
- (b) the relevant inspection and test, quality control, quality assurance, and process operation instructions that will be used;
- (c) quality records, such as inspection reports, test data, calibration data and certificates;
- (d) management reviews to ensure the effective operation of the quality system;
- (e) a process for control of documents and their revision;
- (f) a means for control of non-conforming aerosol dispensers;
- (g) training programmes and qualification procedures for relevant personnel; and
- (h) procedures to ensure that there is no damage to the final product.

An initial audit and periodic audits shall be conducted to the satisfaction of the competent authority. These audits shall ensure the approved system is and remains adequate and efficient. Any proposed changes to the approved system shall be notified to the competent authority in advance.

#### 6.2.6.3.2.2.2 Pressure and leak testing of aerosol dispensers before filling

Every empty aerosol dispenser shall be subjected to a pressure equal to or in excess of the maximum expected in the filled aerosol dispensers at 55 °C (50 °C if the liquid phase does not exceed 95% of the capacity of the receptacle at 50 °C). This shall be at least two-thirds of the design pressure of the aerosol dispenser. If any aerosol dispenser shows evidence of leakage at a rate equal to or greater than  $3.3 \times 10^{-2}$  mbar·l·s<sup>-1</sup> at the test pressure, distortion or other defect, it shall be rejected.

#### 6.2.6.3.2.2.3 Testing of the aerosol dispensers after filling

Prior to filling the filler shall ensure that the crimping equipment is set appropriately and the specified propellant is used.

Each filled aerosol dispenser shall be weighed and leak tested. The leak detection equipment shall be sufficiently sensitive to detect at least a leak rate of  $2.0 \times 10^{-3}$  mbar·l·s<sup>-1</sup> at 20 °C.

Any filled aerosol dispenser which shows evidence of leakage, deformation or excessive weight shall be rejected.

6.2.6.3.3 With the approval of the competent authority, aerosols and receptacles, small, containing pharmaceutical products and non flammable gases which are required to be sterile, but may be adversely affected by water bath testing, are not subject to 6.2.6.3.1 and 6.2.6.3.2 if:

- (a) They are manufactured under the authority of a national health administration and, if required by the competent authority, follow the principles of Good Manufacturing Practice (GMP) established by the World Health Organization (WHO)<sup>3</sup>; and

---

<sup>3</sup> WHO Publication: "Quality assurance of pharmaceuticals. A compendium of guidelines and related materials. Volume 2: Good manufacturing practices and inspection".

- (b) An equivalent level of safety is achieved by the manufacturer's use of alternative methods for leak detection and pressure resistance, such as helium detection and water bathing a statistical sample of at least 1 in 2000 from each production batch.

#### 6.2.6.4 Reference to standards

The requirements of this section are deemed to be met if the following standards are complied with:

- for aerosol dispensers (UN No. 1950 aerosols): Annex to Council Directive 75/324/EEC<sup>4</sup> as amended by Commission Directive 94/1/EC<sup>5</sup>;
- for UN No. 2037, small **receptacles** containing gas (gas cartridges) containing UN No. 1965, hydrocarbon gas mixture n.o.s, liquefied: EN 417:2003 Non-refillable metallic gas cartridges for liquefied petroleum gases, with or without a valve, for use with portable appliances – Construction, inspection, testing and marking.

---

<sup>4</sup> Council Directive 75/324/EEC of 20 May 1975 on the approximation of the laws of the Member States relating to aerosol dispensers, published in the Official Journal of the European Communities No. L 147 of 9 June 1975.

<sup>5</sup> Commission Directive 94/1/EC of January 1994, adapting some technicalities of Council Directive 75/324/EEC on the approximation of the laws of the relating Member States to aerosol dispensers published in the Official Journal of the European Communities No. L 23 of 28 January 1994.