BS EN 16728:2016

BSI Standards Publication

LPG equipment and accessories — Transportable refillable LPG cylinders other than traditional welded and brazed steel cylinders — Periodic inspection

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National foreword

This British Standard is the UK implementation of EN 16728:2016. Together with BS EN 1440:2016, it supersedes BS EN 1440:2008+A1:2012, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PVE/19, LPG containers and their associated fittings.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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English Version

LPG equipment and accessories - Transportable refillable LPG cylinders other than traditional welded and brazed steel cylinders - Periodic inspection

Équipements pour GPL et leurs accessoires - Bouteilles transportables et rechargeables pour GPL autres que celles en acier soudé et brasé - Contrôle périodique

Flüssiggas-Geräte und Ausrüstungsteile - Ortsbewegliche, wiederbefüllbare Flaschen für Flüssiggas (LPG), ausgenommen geschweißte und hartgelötete Stahlflaschen - Wiederkehrende Inspektion

This European Standard was approved by CEN on 2 January 2016.

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European foreword

This document (EN 16728:2016) has been prepared by Technical Committee CEN/TC 286 “Liquefied petroleum gas equipment and accessories”, the secretariat of which is held by NSAI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2016, and conflicting national standards shall be withdrawn at the latest by September 2016.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document in conjunction with EN 1440:2016 supersedes EN 1440:2008+A1:2012 and deals with the periodic inspection requirements for transportable refillable LPG cylinders that are not covered by EN 1440.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

This European Standard has been submitted for reference into the RID [1] and the technical annexes of the ADR [2].

NOTE These regulations take precedence over any clause of this standard. It is emphasized that RID/ADR are being revised regularly at intervals of two years which may lead to temporary non- compliances with the clauses of this standard.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

The primary objective of the periodic inspection of transportable refillable liquefied petroleum gas (LPG) cylinders is that, on the completion of the tests, the cylinders may be re-introduced into service for a further period of time.

The new designs of LPG cylinders have led to the development of alternative methods of inspection.

This European Standard has been prepared to reflect the current methodology for periodic inspection of LPG cylinders, and is based on extensive operating experience.

This European Standard calls for the use of substances and procedures that can be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

Protection of the environment is a key political issue in Europe and elsewhere, for CEN/TC 286 this is covered in CEN/TS 16765 [3], and this Technical Specification should be read in conjunction with this standard.

It has been assumed in the drafting of this European Standard that the execution of its provisions is entrusted to appropriately qualified and experienced people.

Where judgements are called for, it has been assumed that they are made by competent persons who have been specifically trained for the tasks.

1 Scope

This European Standard specifies procedures for periodic inspection and testing, for transportable refillable LPG cylinders with a water capacity from 0,5 l up to and including 150 l.

This European Standard is applicable to the following:

— welded steel LPG cylinders manufactured to an alternative design and construction, see EN 14140 or equivalent standard;

— welded aluminium LPG cylinders, see EN 13110 or equivalent standard;

— composite LPG cylinders, see EN 14427 or equivalent standard;

— over-moulded cylinders designed and manufactured according to EN 1442 or EN 14140, see Annex F.

NOTE The requirements of RID/ADR take precedence over those of this standard in the case of cylinders complying with that regulation, including pi marked cylinders.

This European Standard does not apply to cylinders permanently installed in vehicles.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 837-1:1996, *Pressure gauges — Part 1: Bourdon tube pressure gauges — Dimensions, metrology, requirements and testing*

EN 837-3:1996, *Pressure gauges — Part 3: Diaphragm and capsule pressure gauges — Dimensions, metrology, requirements and testing*

EN 1442, *LPG equipment and accessories — Transportable refillable welded steel cylinders for LPG — Design and construction*

EN 10028-7, *Flat products made of steels for pressure purposes — Part 7: Stainless steels*

EN 12816, *LPG equipment and accessories — Transportable refillable LPG cylinders — Disposal*

EN 13110, *LPG equipment and accessories — Transportable refillable welded aluminium cylinders for liquefied petroleum gas (LPG) — Design and construction*

EN 14140:2014, *LPG equipment and accessories — Transportable refillable welded steel cylinders for LPG — Alternative design and construction*

EN 14427:2014, *LPG equipment and accessories — Transportable refillable fully wrapped composite cylinders for LPG — Design and construction*

EN 14894, *LPG equipment and accessories — Cylinder and drum marking*

EN 14912, *LPG equipment and accessories — Inspection and maintenance of LPG cylinder valves at time of periodic inspection of cylinders*

EN ISO 4628-3:2003, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 3: Assessment of degree of rusting (ISO 4628-3:2003)*

EN ISO 14245, *Gas cylinders — Specifications and testing of LPG cylinder valves — Self-closing (ISO 14245)*

EN ISO 15995, *Gas cylinders — Specifications and testing of LPG cylinder valves — Manually operated (ISO 15995)*

ISO 2859-1:1999, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 16269-6:2014, *Statistical interpretation of data — Part 6: Determination of statistical tolerance intervals*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
competent authority
authority or authorities or any other body or bodies designated as such in each State and in each specific case in accordance with domestic law

3.2
competent person
person which by combination of appropriate qualification, training, experience, and resources, is able to make objective judgments on the subject

3.3
inspection body
independent inspection and testing body approved by the competent authority

3.4
liquefied petroleum gas
LPG
low pressure gas composed of one or more light hydrocarbons which are assigned to UN 1011, UN 1075, UN 1965, UN 1969 or UN 1978 only and which consists mainly of propane, propene, butane, butane isomers, butene with traces of other hydrocarbon gases

3.5
over-moulded cylinder
OMC
coated steel or stainless steel cylinder with a non removable over-moulded protective case in polyurethane or material which provides equivalent protection.

3.6
over-moulded cylinders inspection lot
production of cylinders from a single over-moulding company, using inner cylinders manufactured by one manufacturer, within one calendar year

3.7
periodic inspection
activities carried out at defined intervals, such as examining, measuring, testing or gauging the characteristics of a pressure vessel and comparing these with specified requirements

3.8
protective casing
layer of protective material which gives mechanical protection which, either cannot be removed without destroying it or is only removable with special tools or is bonded to the cylinder wall

Note 1 to entry: This definition can be applied to cylinders with over-moulded layers or with separate casings.

3.9
tare mass
sum of the mass of the empty cylinder, the mass of the valve including a dip tube where fitted, and the mass of all other parts that are permanently attached to the cylinder when it is being filled, e.g. fixed valve guard

4 Requirements for periodic inspection

4.1 General

The interval between periodic inspections shall be dependent on the content of a written scheme.

Periodic inspections/tests shall be carried out by a competent person under the control of an inspection body based on a written scheme and in accordance with the procedures specified in Table 1.

NOTE 1 A written scheme describes work procedures, criteria, responsibilities and other minimum requirements.

NOTE 2 With the agreement of the competent authority an alternative to the proof pressure test of cylinders is acoustic emission testing, ultrasonic examination or a combination of both. EN ISO 16148 [4] can be used as a guide for acoustic emission testing procedures.

NOTE 3 Tests can be performed in any order as determined by the written scheme.

4.2 Steel and aluminium cylinders

The maximum interval between periodic inspections for welded steel cylinders in conformance with EN 14140 or an equivalent standard and, welded aluminium LPG cylinders in conformance with EN 13110, or equivalent standard, shall be 10 years.

However for welded LPG steel cylinders in conformance with EN 14140 manufactured before the 1st January 2015, this maximum interval can be extended to 15 years, provided the conditions of Annex D are fully met and approval from the relevant competent authority(ies) has been given.

4.3 Over-moulded cylinders

For over-moulded cylinders the interval is determined in accordance with Table 1.

4.4 Composite cylinders

For composite cylinders, the determination of the interval between periodic inspections shall depend on the content of a written scheme that shall be approved by a competent authority, or body designated by this authority, which issued the type approval.

Annex E provides guidance on the requirements for 10-year periodic inspection interval for composite cylinders.

4.5 Rejected cylinders

Rejected cylinders shall be segregated and be either reconditioned, re-tested or rendered unserviceable.

The decision to render a cylinder unserviceable may be taken at any stage during the periodic inspection procedure. With agreement by the owner, a cylinder shall be rendered unserviceable in accordance with EN 12816 such that it cannot be re-issued into service as a pressure vessel.

NOTE In some countries, render unserviceable means scrapping.

Table 1 — Requirements for periodic inspection

Cylinder types	Maximum periodic inspection interval	Procedures
Welded steel cylinders in conformance with EN 14140, or equivalent standard.	10 years	— External visual inspection as described in 5.2 and Annex A; — Proof pressure test (hydraulic proof pressure test or, with the agreement of the competent authority, a pneumatic proof test and leak test) as described in 5.3; — Internal condition check as described in 5.4.1 and Annex A; — Inspection of threads as described in 5.5; — Inspection of valves as described in 5.6.
Welded steel cylinders in conformance with EN 14140 or equivalent standard – manufactured before 1st January 2015.	— 10 years; or — 15 years with the agreement of the competent authority and under the conditions of Annex D.	
Welded aluminium cylinders.	10 years	— External visual inspection as described in 5.2 and Annex B; — Proof pressure tests (hydraulic proof pressure test or, with the agreement of the competent authority, a pneumatic proof test and leak test) as described in 5.3; — Internal condition check as described in 5.4.1; — Inspection of threads as described in 5.5; — Inspection of valves as described in 5.6.
Composite cylinders	As determined by the competent authority. Guidance for 10 year periodic inspection interval described in Annex E.	— External visual inspection as described in 5.2 and Annex C; — Proof pressure test (hydraulic proof pressure test or, with the agreement of the competent authority, a pneumatic proof test and leak test) as described in 5.3; — Internal condition check as described in 5.4.2; — Inspection of threads as described in 5.5; — Inspection of valves as described in 5.6.
Over-moulded cylinders	Annex F provides specific additional inspection requirements with destructive tests with an interval of maximum 3 years after putting in service and thereafter every 5 years.	— External visual inspection as described in F.2.2; — Burst Tests as described in F.2.3; — Internal condition check as described in 5.4; — Inspection of threads as described in 5.5 — Inspection of valves as described in 5.6.

5 Inspections and tests

5.1 General

Relevant cylinder data shall be identified before any inspections or tests are carried out.

Cylinders which cannot be safely emptied of gas shall be set aside for special handling.

Cylinders with inoperative or blocked valves shall be set aside for safe valve removal.

Before preparing for inspection, manufacturer's guidelines shall be taken into account to avoid any damage to the cylinders.

Any chemical solutions and/or cleaning methods used shall be selected to ensure that they do not adversely affect the cylinder material.

5.2 External visual inspection

5.2.1 Preparation for external visual inspection

a) If necessary, the cylinder shall be cleaned and have all loose coatings or labels, corrosion products, tar, oil or other foreign matter removed from its external surface.

b) Care shall be taken to avoid damaging the cylinder.

c) When cylinders are treated by a process that might remove cylinder material, the inspection body shall decide whether a thickness test is required, e.g. ultrasonic thickness check.

NOTE Cleaning methods include wire brushing, shot blasting (in accordance with EN ISO 8501-1 [5] and the EN ISO 8504 [6] series), water jet cleaning, chemical cleaning or other suitable methods, that do not adversely affect any part of the cylinders.

5.2.2 Inspection procedure

5.2.2.1 Welded steel and welded aluminium LPG cylinders:

Cylinders shall be inspected for:

a) dents, cuts, gouges, bulges, cracks, laminations or punctures, while applying the criteria for rejection in Annex A and Annex B, as appropriate;

b) corrosion while applying the criteria for rejection in A.2 and Table B.2 as appropriate, giving special attention to areas where water can be trapped;

Example at the base of the cylinder;

the junction between the cylindrical shell and the foot-ring;

the junction between the cylindrical shell and the valve guard or shroud;

the cylindrical shell and the valve guard or shroud; and

hidden corrosion e.g. under handles, applying the criteria for rejection given in Annex A and Annex B as appropriate.

c) other defects (e.g. depressed bung or fire damage), while applying the criteria for rejection given in Annex A and Annex B as appropriate;

d) integrity of all permanent attachments including protective casing where relevant; and

e) integrity of all mandatory permanent markings.

5.2.2.2 Composite cylinders:

Cylinders shall be inspected for:

a) cuts, gouges, bulges, cracks or de-laminations, while applying the criteria for acceptance/rejection in Annex C;

b) other defects e.g. depressed bung or fire damage, while applying the criteria for acceptance/rejection in Annex C;

c) integrity of all permanent attachments including protective casing; and

d) integrity of the mandatory permanent marking.

5.2.3 Rejection criteria

Details of defects and rejection limits are described in:

— Annex A for specific requirements for welded steel LPG cylinders manufactured in accordance with EN 14140 or equivalent standard;

— Annex B for specific requirements for welded aluminium LPG cylinders; and

— Annex C for specific requirements for composite LPG cylinders.

5.3 Proof pressure test

5.3.1 General

The test shall consist of one of the proof pressure tests, as described in 5.3.2 and 5.3.3. The pneumatic proof pressure test and leak test require the agreement of a competent authority.

Pressure gauges that are used to read the cylinder test pressure shall be in accordance with EN 837-1:1996 and EN 837-3:1996, accuracy class 1,6 or better. They shall be calibrated or checked for accuracy against a master gauge at regular intervals and not less frequently than once every six months. The master gauge shall be re-calibrated in accordance with national requirements.

All joints within the system shall be leak tight.

The test equipment shall not restrict the expansion of the cylinder.

5.3.2 Hydraulic proof pressure test

5.3.2.1 General

A non-corrosive liquid, that is compatible with the material of construction of the cylinder, shall be used as the test medium.

5.3.2.2 Preparation of cylinders

a) Cylinders shall be depressurized in a safe and controlled manner before proceeding.

b) The external surface of the cylinder shall be in such condition that any leak can be detected. If the cleaning method involves the wetting of the outside surface or if the outside surface is wet due to outdoor storage conditions, the outside surface shall be completely dried before commencing the test procedure.

5.3.2.3 Test equipment

The design and installation of the equipment and the cylinders connected to it shall ensure that no air is trapped in the system.

A device shall be fitted to the test equipment to ensure that no cylinder is subjected to pressure in excess of its test pressure by more than the tolerance given in 5.3.2.4.

5.3.2.4 Procedure

a) Where appropriate, cylinders shall be positioned so that the welds are visible during the test.

b) The test pressure shall be at least the test pressure marked on the cylinder.

c) The pressure shall be gradually increased in the cylinder until the test pressure is reached.

d) The test pressure shall not be exceeded by more than 20 % or 6 bar, whichever is the least. More than one cylinder can be tested at a time provided they all have a test pressure within the tolerance specified. If the cylinder is tested at a higher pressure than that marked, the owner of the cylinder shall calculate the maximum pressure not to be exceeded to ensure that the general membrane stress in the cylinder wall does not exceed 95 % of the guaranteed minimum yield strength of the material used in the finished cylinder.

e) The test pressure shall be held for the time necessary to inspect the cylinder and examine it for any leak and/or other defects, but no less than 15 s.

f) If there is leakage in the pressure system, it shall be corrected and the cylinders re-tested.

g) Cylinders that do not leak or show any permanent visible distortion after the pressure has been released shall be deemed to have passed this test. Cylinders, showing visible defects, shall be examined by a competent person.

h) Cylinders that fail this test shall be rejected.

i) Records of rejected cylinders shall be maintained.

5.3.3 Pneumatic proof test and leak test

5.3.3.1 Preparation of cylinders

a) Where a cylinder has to be depressurized, it shall be carried out in a safe and controlled manner before proceeding.

b) Repainting before the pneumatic test shall be limited to a primer coat. The finishing coat shall be applied after the test in order not to mask potential leaks.

5.3.3.2 Procedure

5.3.3.2.1 Proof test

a) Cylinders shall be tested in a safe enclosure to protect against rupture under pneumatic pressure. Adequate safety procedures and measures, e.g. hearing protection, shall be adopted to protect personnel in charge of the test.

b) The pressure of the test for a RID/ADR cylinder shall be at least the test pressure marked on the cylinder.

c) Where a separate pressure relief valve is fitted, an adequate margin of safety shall be maintained between the pneumatic proof test pressure and the pressure setting of the pressure relief valve. Where necessary, the pressure relief valve shall be removed and the port plugged for testing.

d) After the cylinder has been placed in a safe enclosure, it shall be charged with the pneumatic test medium (e.g. air, nitrogen) to the test pressure and held at that pressure for at least 5 s. The gas to be used for testing shall be non-flammable to avoid any internal explosion risk. The cylinder shall pass the proof test if it does not burst. The cylinder shall then be isolated from the pressure source.

NOTE Care needs to be taken to avoid corrosion if full water immersion is used.

5.3.3.2.2 Leak test

a) The pressure shall be reduced to not less than 6 bar. The pressure drop shall be monitored in a safe and controlled manner.

b) The reduced pressure shall be held for as long as it is necessary to inspect the cylinder and check for any leaks.

c) Cylinders that do not leak or show any visible permanent distortion after the pressure has been released shall pass this test.

NOTE Care needs to be taken to avoid corrosion if full water immersion is used.

d) Cylinders that fail this test shall be rejected.

e) Records of rejected cylinders shall be maintained.

5.4 Check of the internal condition of the cylinder

5.4.1 Welded aluminium and steel cylinders of alternative design and construction

5.4.1.1 General

The check shall consist of one of the following tests, see 5.4.1.2 and 5.4.1.3.

5.4.1.2 Internal visual inspection

5.4.1.2.1 Preparation of cylinders

a) Cylinders shall be depressurized in a safe and controlled manner before proceeding.

b) Valves shall be removed from cylinders.

c) Where necessary, residual liquid and possible foreign matter shall be removed from the inside of the cylinder.

5.4.1.2.2 Procedure

a) Cylinders shall be inspected internally for any sign of corrosion or other defects that can affect their integrity, using a safe inspection lighting system with appropriate internal illumination (e.g. an endoscope).

b) Cylinders showing signs of internal corrosion, except those having only a film layer of surface rust, shall be removed for further detailed evaluation in accordance with Table A.2.

c) If cleaning is required, care shall be taken to avoid damaging the cylinder walls. Cylinders shall be re-inspected after cleaning.

5.4.1.3 Check of the minimum wall thickness

The wall thickness shall be measured e.g. by ultrasonic method, according to the procedure agreed with the competent authority, in a sufficient number of places, in order to guarantee the minimum wall thickness of the entire cylinder. The measurements shall be compared to the required calculated minimum wall thickness. If one of the measurements is lower than the required calculated minimum wall thickness, the cylinder shall be rejected.

The required calculated minimum wall thickness shall be provided by the owner of the cylinder.

5.4.2 Check of the internal condition of composite cylinders

5.4.2.1 General

An internal visual inspection shall be performed on cylinders to detect internal defects or the presence of foreign matter.

For translucent/transparent composite cylinders, the internal visual inspection can be made from outside without depressurizing the cylinder or removing the valve, provided that the internal defects, as defined by the manufacturer, can be identified from the outside.

5.4.2.2 Preparation of cylinders

a) Cylinders shall be depressurized in a safe and controlled manner before proceeding.

b) Care shall be taken when clamping composite cylinders in order to avoid damage.

5.4.2.3 Procedure

a) Cylinders shall be inspected internally for any sign of corrosion or other defects that could affect its integrity, using a safe inspection lighting system with appropriate internal illumination (e.g. an endoscope).

b) Cylinders showing signs of internal corrosion (e.g. general corrosion, local corrosion, chain pitting or line corrosion, crevice corrosion), except those having only superficial surface rust, shall be removed for further detailed evaluation.

c) Cylinders showing signs of internal defects, e.g. cracks, damaged liner or chemical attack, shall be scrapped.

d) If cleaning is required, care shall be taken to avoid damaging the cylinder walls. Cylinders shall be re-inspected after cleaning.

5.5 Inspection of cylinder threads

5.5.1 General

When the valve (and any other fitting) is removed during periodic inspection, the cylinder threads shall be inspected in accordance with 5.5.2, 5.5.3 and 5.5.4.

5.5.2 Internal threads

The internal threads of the cylinder shall be visually inspected and cleaned of any foreign matter. The leak-tightness of the valve onto the cylinder shall be checked after valving.

NOTE The leak-tightness test can be performed at the test station or at the filling station.

5.5.3 External threads

External neck threads, which are required for operational reasons, shall be examined for integrity and for thread damage.

5.5.4 Damaged threads

Where necessary and where the design permits, damaged threads shall be repaired by a competent person or the cylinder shall be rendered unserviceable in accordance with EN 12816.

5.6 Inspection of valves

Valves shall be inspected, repaired, refurbished or scrapped in accordance with EN 14912 or equivalent standard referred to in the RID/ADR.

6 Final operations

6.1 General

After hydraulic testing, effective precautions shall be taken to prevent internal corrosion and/or contamination.

6.2 Valving

If the valve is removed for inspection or refurbishment, a new, inspected or refurbished valve, suitable for the intended use, shall be fitted to the cylinder using a sealing material/system and the optimum torque necessary to ensure a seal between the valve and the cylinder.

The torque applied shall be consistent with both the cylinder and valve manufacturers' recommendations. The torque applied shall be checked at regular intervals using an appropriate and calibrated torque wrench. Records of such measurements shall be maintained according to Clause 8.

New valves shall be in conformance with EN ISO 14245 or EN ISO 15995.

The leak-tightness of the valve (or any other fitting) onto the cylinder shall be checked after valving.

NOTE This can be performed at the test station or at the filling station.

6.3 Tare mass

The tare mass or indication of tare mass of the cylinder shall be re-established if any modification or re-valving has been made that affects the tare mass of the cylinder.

The scale used to confirm or determine the tare mass shall be calibrated according to national regulations. The scale shall be checked at regular intervals using an appropriate and calibrated set of weights to ensure its compliance.

Records of such measurements shall be maintained according to Clause 8.

If the new tare indication is different from the old tare indication, steps shall be taken to ensure that the former tare is unreadable.

6.4 Marking

After successful completion of the periodic inspection, each cylinder shall be legibly and durably marked in accordance with EN 14894.

NOTE 1 For over-moulded cylinders, see Annex F.

NOTE 2 RID/ADR regulations on marking take precedence over this clause.

6.5 Purging

Air shall be removed from the cylinder, e.g. by displacement with LPG.

NOTE This can be performed at the test station or at the filling station.

7 Repair of cylinders

Majors and minor repairs of cylinders shall only be carried out with the agreement of the cylinder manufacturer and according to a written scheme approved by a notified body.

The repairs shall only be carried out by a competent person. All identification marks of the repaired cylinders shall be maintained (e.g. by transferring or otherwise).

8 Records

The organisation operating the periodic inspection station shall maintain records of the quality system, inspection reports, test data, calibration data and reports concerning the qualifications or approvals of the competent persons.

Inspection reports and test data for cylinders shall be held and maintained by the organisation operating the periodic inspection station for at least the retest period plus an additional 2 years.

NOTE An inspection report or test data can cover one or more cylinders.

Annex A
(normative)

Specific requirements for external visual inspection for welded steel LPG cylinders in accordance with EN 14140 or equivalent standard

A.1 General

Where applicable, the protective casing shall be removed prior to inspection.

The owner of the cylinder (or their authorized representative) shall provide a written scheme to the periodic inspection station, which contains acceptance/rejection criteria for the physical and material defects and heat damage to the cylinder.

The procedure for establishing the acceptance/rejection criteria is described in A.2.

These criteria shall be at least those established by the manufacturer, taking into account the design conditions of the cylinder, e.g. wall thickness, material, protective casing.

The procedure and the records of the test results shall be witnessed and assessed by a competent authority.

The descriptions of defects for carbon steel cylinders are shown in Table A.1, Table A.2 and Table A.3. The descriptions of defects for stainless steel cylinders are shown in Table A.4, Table A.5 and Table A.6.

A.2 Procedure for establishing rejection criteria carbon steel cylinders

The rejection criteria for the defects described in Table A.1, Table A.2 and Table A.3 shall be established in accordance with the following procedure for each design of cylinder as defined in EN 14140:

— for each defect, four cylinders with the same defect shall be tested. The size of this defect shall be recorded. If the defects of the cylinders are different sizes, the size of the smaller defect shall be recorded;

— two cylinders shall be submitted to the burst test as described in EN 14140 and two cylinders shall be submitted to the fatigue test as described in EN 14140;

— if the cylinders pass the tests, the defect shall be deemed acceptable. The rejection limit may then be defined by the size of that defect;

— when all rejection criteria have been established for a design of cylinder as defined in EN 14140, and Table A.1, Table A.2 and Table A.3 shall be completed by the owner/manufacturer of the cylinder.

Table A.1 — Carbon steel cylinders - Physical defects in the cylinder wall

Defects	Description	Rejection limit
Bulge	Visible swelling of the cylinder.	All
Dent	A depression in the cylinder that has neither penetrated nor removed metal, and its width at any point is greater than 2 % of the external cylinder diameter.	See A.2 [a]
Cut or gouge	A sharp impression where metal has been removed or redistributed.	See A.2
Intersecting cut or gouge	The point of intersection of two or more cuts or gouges.	All
Dent containing cut or gouge	A depression in the cylinder within which there is a cut or gouge.	When the size of the dent or cut or gouge exceeds the dimensions for rejection as an individual defect.
Crack	A split or rift in the cylinder shell.	All
Lamination	Layering of the material within the cylinder wall appearing as a discontinuity, crack, lap or bulge at the surface.	All
[a] Appearance (e.g. sharp dent) and location (e.g. on shoulder of the cylinder) also play a part in the evaluation of dent severity.		

Table A.2 — Carbon steel cylinders - Corrosion on the cylinder wall

Defects	Description	Rejection limit
Isolated corrosion pits	A pitting of metal occurring in isolated areas at a concentration not greater than 1 pit per 500 mm^2 of surface area.	See A.2
Area corrosion	Reduction in wall thickness over an area not exceeding 20 % of the cylinder surface.	See A.2
General corrosion	A reduction in wall thickness over an area exceeding 20 % of the cylinder surface.	See A.2
Chain pitting, or line or channel corrosion	A series of pits or corroded cavities of limited width along the length or around the cylinder circumference.	See A.2
Crevice corrosion	Crevice corrosion occurs in the area of the intersection of the foot ring or shroud with the cylinder.	See A.2

Table A.3 — Carbon steel cylinders - Other defects

Defects	Description	Rejection limit
Depressed bung	Damage to the bung which has altered the profile of the cylinder.	All or a limited level of depression/alignment deviation as agreed with the competent authority.
Arc or torch burns	— burning of the cylinder base metal; — a hardened heat affected zone; — the addition of extraneous weld metal; — or the removal of metal by scarfing or cratering.	All
Fire damage [a]	Excessive general or localized heating of a cylinder usually indicated by: — charring or burning of paint; — fire damage of the metal; — distortion of the cylinder; — melting of metallic valve parts; — melting of any plastic components, e.g. date ring, plug or cap.	All
Damage of handle, if fitted.	Excessively deformed handle.	Where there is a risk of an injury, e.g. finger cut.
Damaged foot-ring, if fitted.	Not firmly attached foot-ring.	All
	Badly deformed foot-ring.	Unstable or unbalanced cylinder.
Damaged shroud if fitted	Loose or badly deformed shroud.	Preventing proper operation or protection of valve.
Damage of protective casing, if fitted.	Broken casing exceeding the limits defined by the manufacturer.	Minor damage that does not affect the protecting function of the casing is acceptable. If it cannot be established that the cylinder is unaffected, the cylinder shall be put aside for further investigation. Casings that do not meet the manufacturer's requirements shall not be refitted.
[a] If paint is only superficially charred, a cylinder may be accepted by a competent person.		

A.3 Rejection criteria for stainless steel cylinders

Rejection criteria for defects on stainless steel cylinders are described in Table A.4, Table A.5 and Table A.6.

These tables apply to cylinders manufactured from stainless steel in accordance with EN 10028-7.

If required, the cylinder shall be cleaned and have all loose coatings or labels, corrosion products, tar, oil or other foreign matter removed from its external surface.

Table A.4 — Stainless steel cylinders – Physical defects in the cylinder wall

Defects	Description	Rejection limit
Bulge	Visible swelling of the cylinder.	All
Dent	A depression in the cylinder that has neither penetrated nor removed metal, and its width, at any point, is greater than 4 % of the external cylinder diameter.	When the depth of the dent exceeds one third of its width at any point. Consideration of the appearance and location also plays a part in the evaluation of dents. [a]
Cut or gouge	A sharp impression where metal has been removed or re-distributed.	Where the original calculated wall thickness is known: — depth of cut or gouge is such that the undamaged (remaining) wall is less than the minimum calculated wall thickness. Where the original calculated wall thickness is not known: — All.
Intersecting cut or gouge	The point of intersection of two or more cuts or gouges.	All
Dent containing cut or gouge	A depression in the cylinder within which there is a cut or gouge.	When the size of the dent or cut or gouge exceeds the dimensions for rejection as an individual defect.
Crack	A split or rift in the cylinder shell.	All
Lamination	Layering of the material within the cylinder wall appearing as a discontinuity, crack, lap or bulge at the surface.	All
[a] Appearance (e.g. sharp dent) and location (e.g. on shoulder of the cylinder) also play a part in the evaluation of dent severity.		

Table A.5 — Stainless steel cylinders – Corrosion on the cylinder wall

Defects	Description	Rejection limit
Isolated corrosion pits	A pitting of metal occurring in isolated areas.	All
Area corrosion and general corrosion	Reduction in the wall thickness over an area exceeding 5 % of the cylinder surface.	All
Crevice corrosion	Crevice corrosion occurs in the area of the intersection of the foot ring or shroud with the cylinder.	When the depth of penetration exceeds 0,2 mm or when the depth of corrosion cannot be measured.

Table A.6 — Stainless steel cylinders – Other defects

Defects	Description	Rejection limit
Depressed bung	Damage to the bung which has altered the profile of the cylinder.	— A limited level of depression/alignment deviation, as agreed by the competent authority, or — All.
Arc or torch burns	— burning of the cylinder base metal; — a hardened heat affected zone; — the addition of extraneous weld metal; or — the removal of metal by scarfing or cratering.	All
Fire damage	Excessive general or localized heating of a cylinder usually indicated by: — fire damage to the metal; — distortion of the cylinder; — melting of metallic valve parts; — melting of any plastic components e.g. data ring, plug or cap.	All
Damage of handle	Excessively deformed of the handle.	If there is a risk of an injury e.g. finger cut.
Damaged foot-ring	Not firmly attached foot-ring.	All
	Badly deformed foot-ring.	Unstable or unbalanced cylinder.
Damaged shroud	Loose or badly deformed shroud.	Preventing proper operation or protection of valve.

Annex B
(normative)

Specific requirements for external visual inspection of welded aluminium LPG cylinders

Rejection limits for physical, material and other defects on the cylinder wall are given in Table B.1, Table B.2 and Table B.3.

Table B.1 — Physical defects in the cylinder wall

Defect	Description	Rejection limit
Bulge	Visible swelling of the cylinder	All
Dent	A depression in the cylinder that has neither penetrated nor removed metal, when its width at any point is greater than 2 % of the external cylinder diameter.	When the depth of the dent exceeds 25 % of its width at any point. [a]
Cut or gouge	A sharp impression where metal has been removed or redistributed.	Where the original calculated wall thickness is known: — depth of cut or gouge is such that the undamaged (remaining) wall is less than the minimum calculated wall thickness. Where the original calculated wall thickness is not known: — all.
Dent containing cut or gouge	A depression in the cylinder within which there is a cut or gouge.	When the size of the dent or cut or gouge exceeds the dimensions for rejection as an individual defect
Crack	A split or rift in the cylinder shell.	All
Lamination	Layering of the material within the cylinder wall appearing as a discontinuity, crack, lap or bulge at the surface.	All

[a] Appearance (e.g. sharp dent) and location (e.g. on shoulder of the cylinder) also play a part in the evaluation of dent severity.

Table B.2 — External corrosion

Type of corrosion	Description	Rejection limit
General corrosion	A reduction in wall thickness over an area exceeding 20 % of the cylinder surface.	— Original surface of the metal is no longer recognizable; or — Depth of penetration exceeds 10 % of the original thickness of wall; or — The wall thickness is less than the minimum design wall thickness.
Area corrosion	Reduction in wall thickness over an area not exceeding 20 % of the cylinder surface.	— Depth of penetration exceeds 20 % of the original thickness of the cylinder wall; or — The wall thickness is less than the minimum design wall thickness.
Chain pitting or line or channel corrosion	A series of pits or corroded cavities of limited width along the length or around the cylinder circumference.	— A total length of corrosion in any direction exceeds the diameter of the cylinder; or — Depth exceeds 10 % of the original wall thickness; or — Wall thickness is less than the minimum design wall thickness.
Isolated corrosion pits	Corrosion forming isolated craters, without significant alignment.	— If the diameter of a pit is greater than 5 mm, refer to the "area corrosion" row. — If the diameter of a pit is less than 5 mm, the latter shall be assessed as carefully as possible in order to check that the remaining thickness of the wall or base is not less than the minimum design wall thickness.

Table B.3 — Other defects

Defect	Description	Rejection limit
Depressed bung	Damage to the bung which has altered the profile of the cylinder.	All, except a limited level of depression/alignment deviation, as agreed by the competent authority.
Arc or torch burns	— Burning of the cylinder base metal; — A hardened heat affected zone; — The addition of extraneous weld metal; or — The removal of metal by scarfing or cratering.	All
Fire damage [a]	Excessive general or localized heating of a cylinder usually indicated by: — charring or burning of paint; — fire damage of the metal; — distortion of the cylinder; — melting of metallic valve parts; — melting of any plastic components, e.g. date ring, plug or cap.	All
Damaged foot-ring	Not firmly attached foot-ring.	All
	Badly deformed foot-ring.	Unstable or unbalanced cylinder.
Damaged shroud	Loose or badly deformed shroud.	Prevents proper operation or protection of valve.
[a] If paint is only superficially charred, a cylinder may be accepted by a competent person.		

Annex C
(normative)

Specific requirements for visual inspection of composite LPG cylinders

C.1 Establishment of rejection criteria

C.1.1 General

The owner of the cylinder (or their authorized representative) shall provide a written scheme to the periodic inspection station, which contains rejection criteria for the physical and material defects and the heat damage to the cylinder/protective casing.

The procedure for establishing the acceptance/rejection criteria is described in C.1.2.

These criteria shall be at least those established by the manufacturer, taking into account the design conditions of the cylinder e.g. nature of the casing if any, nature and type of the fibre and of the resin system.

The procedure and the records of the test results shall be witnessed and assessed by a competent authority.

NOTE RID/ADR requires that these criteria are acceptable to the competent authority.

The descriptions for defects on cylinders are shown in Table C.1 and Table C.2.

C.1.2 Procedure

The rejection criteria for the defects described in Table C.1 and Table C.2 shall be established in accordance with the following procedure for each design of cylinder as defined in EN 14427.

— For each defect, four cylinders with the same defect shall be tested. The size of this defect shall be recorded. If the defects of the cylinders are different sizes, the size of the smaller defect shall be recorded.

— Two cylinders shall be submitted to the burst test as described in EN 14427 and two cylinders shall be submitted to the pressure cycle test as described in EN 14427.

— If the cylinders pass the tests, the defect is acceptable. The rejection limit shall then be defined by the size of that defect.

— When all rejection criteria have been established for a design of cylinder as defined in EN 14427, Table C.1 and Table C.2 shall be completed by the owner/manufacturer of the cylinder.

C.2 Examples of rejection criteria

C.2.1 Cylinders without a metallic liner

The rejection criteria given in Table C.1 are an example of the criteria applicable to cylinders without a metallic liner.

NOTE References to percentages will be replaced in absolute values (in mm) for particular cylinder design.

Table C.1 — Cylinders without a metallic liner - Rejection criteria for external visual inspection

Defect	Description	Rejection limit
Abrasion damage or damage from cuts	Abrasion damage caused by wearing, grinding or rubbing material away by friction, see Figure C.1. Cuts or gouges caused by contact with sharp objects in such a way as to cut into the composite, reducing its thickness at that point, see Figure C.2.	— Depth exceeds 10 % of composite overwrap thickness; or — Total length of cut(s) exceeds 50 % of the diameter of the cylinder; or — Damaged area maximum diameter [a] exceeds 50 % of the diameter of the cylinder. Cuts that do not sever a fibre are not included in the above.
Chemical damage	Chemical attack appearing as the dissolution of the resin matrix surrounding the fibres, where the cylinder surface is sticky. If the casing is not drainable, chemical attack might appear inside the casing.	Chemical attack resulting in damage to the resin matrix surrounding the fibres.
Damage of protective casing	Broken casing exceeding the limits defined by the manufacturer. The casing shall be removed and the cylinder inspected. If the cylinder is not damaged, a new casing can be assembled, see Figure C.5.	A damaged cylinder shall be rejected. (Minor damage that does not affect the protecting function of the casing is acceptable. Acceptable damage can be, for example, small cracks. If it cannot be established that the cylinder is unaffected, the cylinder shall be put aside for further investigation).
Heat/fire damage of casing or cylinder	Heat or fire damage evident by discolouration, scarring or burning of the composite overwrap, casing, labels and non-metallic components of the valve.	Visible damage from heat and/or fire, see Figure C.6.
Corrosion of bung		Severe corrosion.
Delamination	Inter-laminar delamination is a separation of layers of strands, while intra-laminar delamination is separation between strands within the same layer. See Figure C.3 and Figure C.4 for examples.	All
[a] The maximum diameter of the damage area is the diameter of the smallest circle that includes the damaged area.		
NOTE Intra-laminar delamination appears as a whitish patch like a blister or air bubble beneath the surface.		

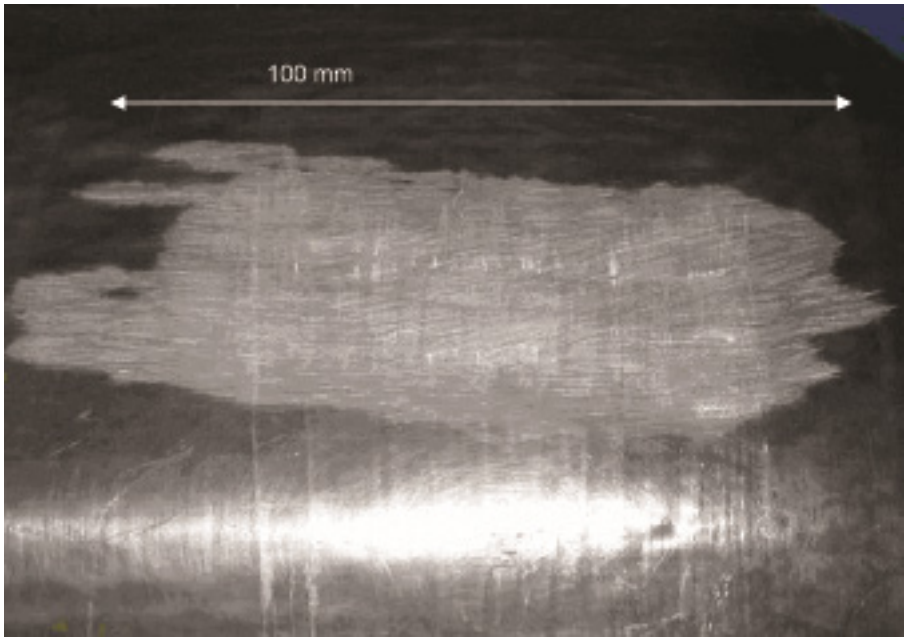


Figure C.1 — Damage from abrasion

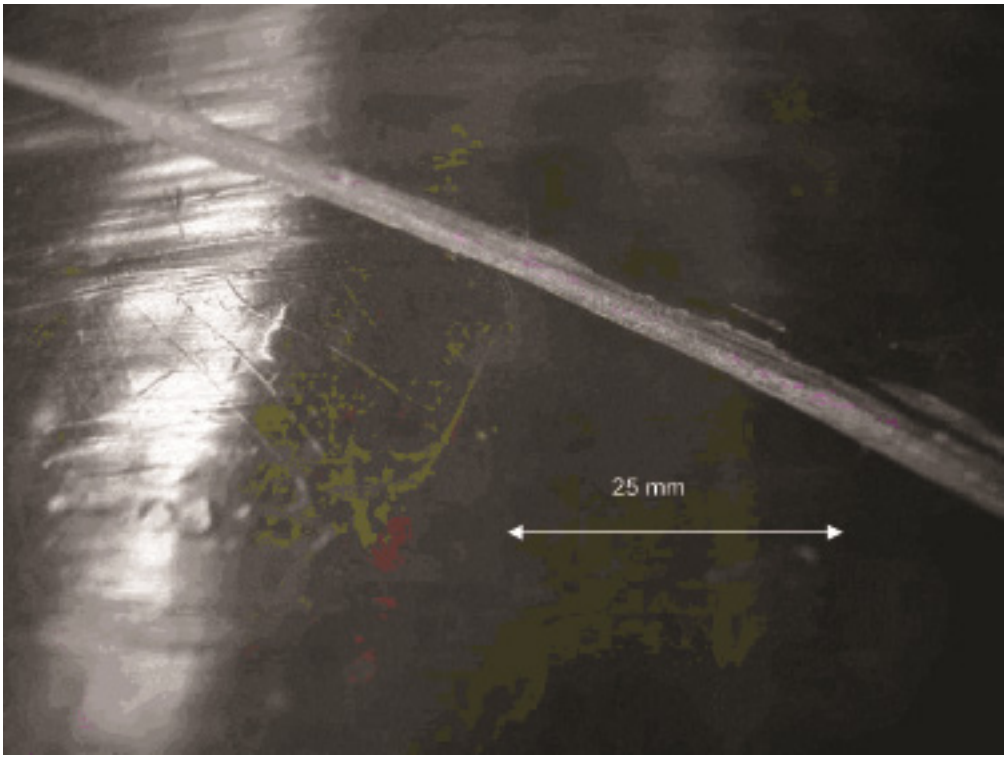


Figure C.2 — Damage from cuts

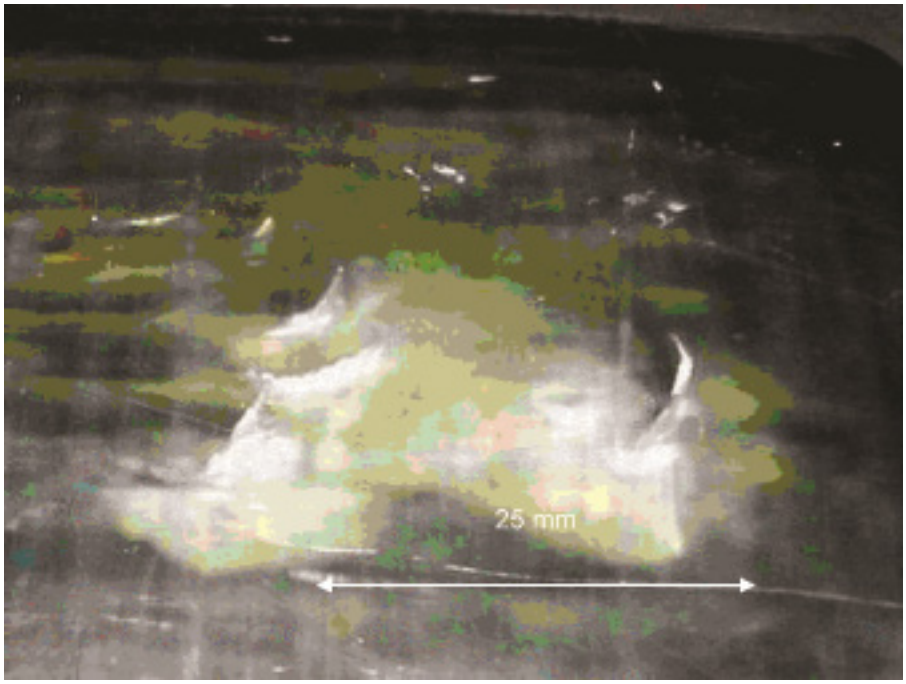


Figure C.3 — Impact damage in combination with delamination and surface defects

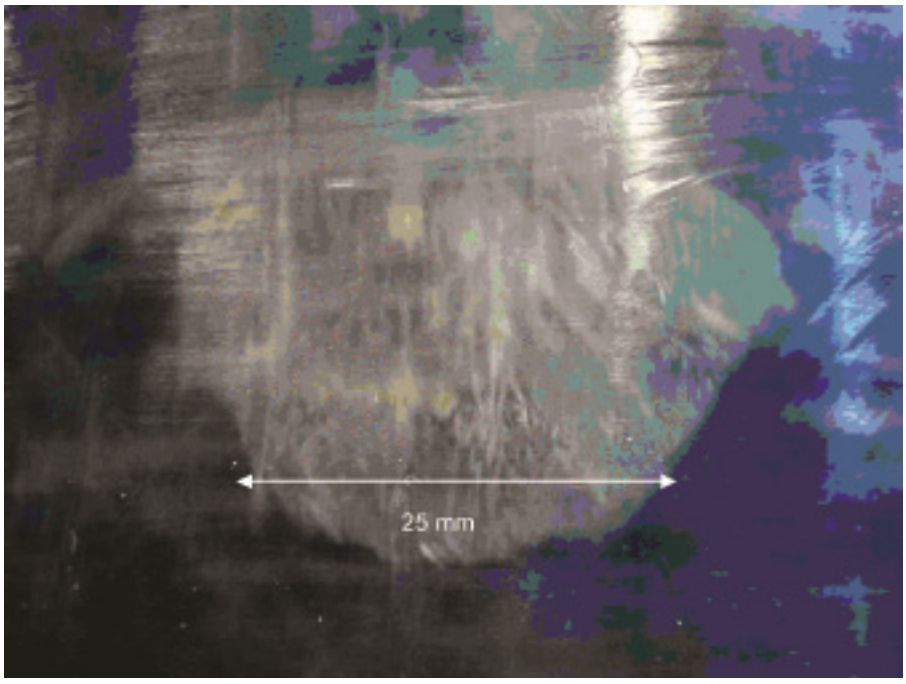


Figure C.4 — Delamination with no signs of surface damage

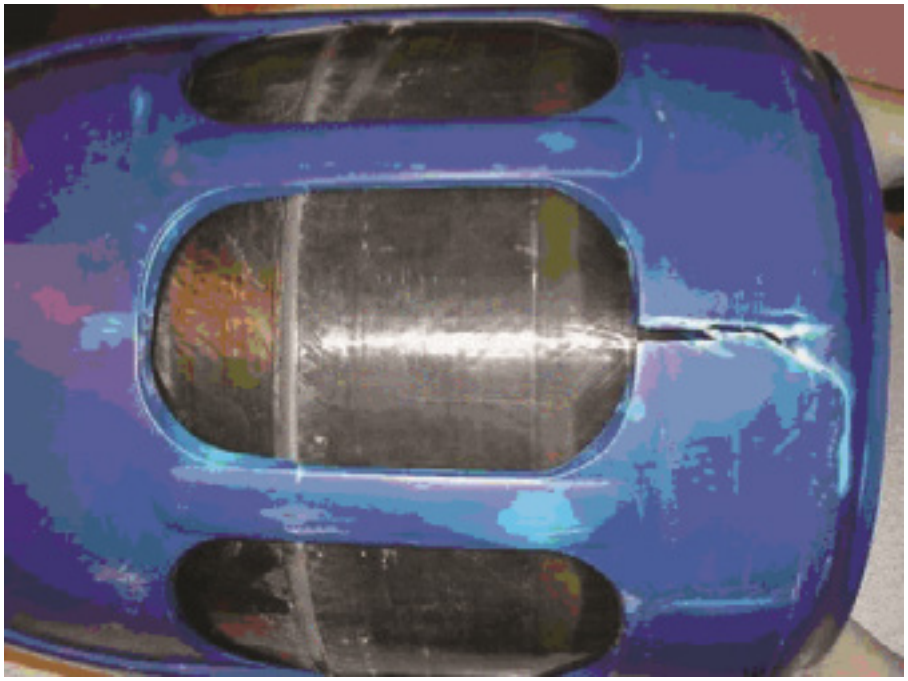


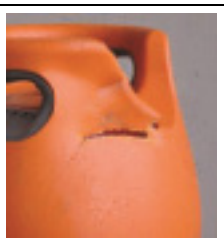
Figure C.5 — Defect protective casing: Broken casing

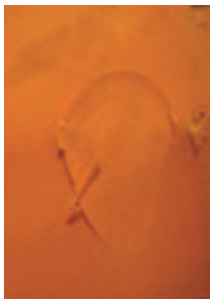
Figure C.6 — Heat and fire damage

C.2.2 Cylinders with a metallic liner

The rejection criteria given in Table C.2 are examples of the criteria applicable to cylinders with a liner of metallic material (welded or seamless), reinforced by fibres of glass, carbon or aramid (or a mixture thereof).

Table C.2 — Cylinders with a metallic liner - Rejection criteria for external visual inspection

Type of damage	**Level of damage**			
	Photo	**Level 1** **Acceptable damage**	**Level 2** **Rejection damage** (requiring additional inspections or repairs)	**Level 3** **Scrapped** (not repairable)
Abrasion damage	 **Level 1**	Minor abrasion damage to the protective jacket.	Sharp edges on the protective jacket that reduces its easy-handling. The cylinder can be repaired.	
	 **Level 2**			
Impact damage	 **Level 1**	Small cracks on the protective jacket.	Damage from impact which only affects the protective jacket can be repaired.	Cylinders in which such damage that involve deformation of the bung are not repairable.
				

	Level 2			
Structural damage				Abnormal bulges, distorted valve connections, depressions not originally designed or if, by visual examination of the inside of the cylinder, there is evidence of damage involving deformation of the liner.
Heat or fire damage	 **Level 2**		Evident by discolouration, charring or burning of the thermoplastic jacket, composite overwrap, labels or non-metallic components of the valve. Where the jacket is charred superficially, the cylinder is acceptable for repair.	Damage affecting the composite overwrap.
	 **Level 3**			
Chemical attack			Dissolution of the thermoplastic jacket. Where the jacket is dissolved superficially, the cylinder is acceptable for repair.	Cylinders in which the dissolution reaches the composite overwrap.
Identification label			Cuts or abrasive damage of the markings. In the event that the manufacturer can accurately identify the cylinder, a supplementary	Where the cylinder cannot be identified.

			identification marking shall be engraved on the cylinder.	
Bulges				Visible swelling of the cylinder
Cuts or Gouges	  		Sharp impressions caused by sharp objects in such a way as to cut the jacket. If such an impression is only present on the protective jacket, the cylinder can be repaired.	Damage in the composite overwrap.

Annex D
(informative)

Conditions for 15-year periodic inspection interval of welded steel cylinders manufactured before 1st January 2015

D.1 General

For a cylinder to qualify for a 15-year inspection interval, all of the following specific requirements shall apply:

a) There shall be at least 15 years operating experience related to the cylinder type.

b) Cylinder shall be filled in accordance with the criteria contained in EN 1439 [7] or equivalent standard as approved by a competent authority with particular emphasis on:

— cylinder identification (e.g. design code, tare mass, mark of the competent authority), see EN 14894;

— external cylinder condition, see 5.1;

— cylinders are designed, manufactured and tested to EN 14140, or equivalent;

— for carbon steel cylinders, there is a system of external protection against corrosion which is being maintained.

c) LPG quality shall comply with the limitations on corrosive contaminants specified in ISO 9162 [8].

d) Cylinders shall be under the control of a competent gas organisation responsible for their distribution, filling and maintenance. The concept of control of cylinders is detailed in D.2.

e) Other conditions to be met are listed in D.3.

D.2 Concept of control

a) Cylinders shall be owned by, and under the responsibility of, a competent gas organisation for checking, filling and maintenance and that loans or hires them to distribution undertakings, consumers or other users under the conditions used in D.3; or

b) Cylinders are not owned by, but their distribution, filling and maintenance are under the responsibility of a competent gas organisation; and

c) The responsible competent gas organisation may contract the filling, maintenance and/or testing to other competent organisations, ensuring that the cylinders are filled, maintained and tested only as contracted in accordance with the procedures of that competent gas organisation.

D.3 Conditions

The following conditions shall be fulfilled:

a) The responsible competent gas organisation shall ensure that the cylinders are returned for filling, maintenance and/or testing to the responsible competent gas organisation or an authorized

contractor, or shall be exchanged for a full cylinder at a retail outlet serviced by the responsible competent gas organisation or an authorized contractor.

b) The responsible competent gas organisation or their contractor shall have established appropriate filling, maintenance and test facilities under their control.

c) The responsible competent gas organisation shall have a policy of taking all necessary measures to ensure that their cylinders are filled, maintained and tested only at the facilities stated in b).

NOTE 1 15-year periodic inspection interval is allowed under conditions of ADR 2009 P200 v which takes precedence over any clause of this annex.

NOTE 2 The application of this annex is subject to the agreement by the relevant competent authority.

Annex E
(informative)

Guidance on conditions for 10-year periodic inspection interval of composite cylinders

For a cylinder to qualify for a 10 year inspection interval, the following requirements shall apply:

a) Cylinders are designed, manufactured and tested to EN 14427:2014, or equivalent standard approved by a competent authority.

b) Each type of cylinder as defined in EN 14427:2014, A.2.1 shall undergo and pass the following tests:

— 100 cylinders older than 5 years shall be picked at random;

— 80 of these cylinders shall be subjected to and pass a burst test in accordance with test number 5 in EN 14427:2014;

— 20 of these cylinders shall be subjected to and pass a fatigue test in accordance with test number 6 in EN 14427:2014.

NOTE Sampling size and relevant tests above are provided as an example.

c) Cylinders shall be filled in accordance with the criteria contained in EN 1439 or equivalent standard approved by a competent authority with particular emphasis on:

— cylinder identification (e.g. design code, tare mass, mark of the competent authority), see EN 14894;

— external cylinder condition, see 5.2.2.2 and 5.2.3.

d) The LPG quality shall comply with the limitations on corrosive contaminants specified in ISO 9162.

e) Cylinders shall be under the control of a competent gas organisation responsible for their distribution, filling and maintenance. The concept of control of cylinders is detailed in D.2.

f) The responsible competent gas organisation shall ensure that the cylinders are returned for filling, maintenance and/or testing to the responsible competent gas organisation or an authorized contractor, or they shall be exchanged for a full cylinder at a retail outlet serviced by the responsible competent gas organisation or an authorized contractor.

g) The responsible competent gas organisation or their contractor shall have established appropriate filling, maintenance and test facilities that are under their control.

h) The responsible competent gas organisation shall have a policy of taking all necessary measures to ensure that their cylinders are filled, maintained and tested only at the facilities stated in g).

i) Agreement from the competent authority or body designated by the competent authority.

Annex F
(normative)

Specific Periodic inspection procedure for over-moulded cylinders (OMC)

F.1General

F.1.1 Introduction

This annex is applicable to over-moulded cylinders designed and manufactured in accordance with EN 1442 or EN 14140.

An example of an over-moulded cylinder is given in Figure G.1.

This specific procedure is applicable to OMC's that meet the requirements of F.1.2 and F.1.3.

F.1.2 Valve

Over-moulded cylinders shall be equipped with self-closing valves.

F.1.3 Marking and records

Each cylinder shall be fitted with an individual resilient electronic identification device linked to an electronic database as defined in EN 1442 and EN 14140.

This electronic database shall ensure:

— automatic sampling of cylinders, to perform tests and/or manage the periodic inspection test date;

— recording of relevant data of periodic inspection in the database (date and place of periodic inspection);

— marking which indicates the successful completion of the periodic inspection;

— that in the case of an issue with a cylinder or with a whole annual production, automatic withdrawal of defective cylinder at filling plant, before filling.

Additional database recording requirements are listed in EN 1442 and EN 14140.

F.2Periodic inspection

F.2.1 General

The inspections described in 5.2 and 5.3 shall be replaced by F.2.2 and F.2.3 respectively, here after.

The inspections described in 5.4, 5.5 and 5.6 shall be fulfilled for each OMC.

Sampling shall be random.

NOTE The return of cylinders from customers occurs in a random manner and this sampling is considered random.

F.2.2 External visual inspection

F.2.2.1 General

Each over-moulded cylinder shall be submitted to a visual external inspection that can be done either at the filling station or at the periodic inspection facility by a competent person and according to Table F.1.

Table F.1 — Defects of over-moulded cylinders and rejection criteria before filling

Defect on	Description	Rejection limit
Casing	Visible material gouge, cut or crack.	Depth > 4 mm Length > 10 mm
Casing	Visible depression	All
Casing	Visible swelling	All
Foot-rings and handles	Visible material gouge, cut or crack.	Depth > 20 mm Length > 50 mm Missing feet
Handles	Broken handles	For each handle if more than one crack. Parts of handle missing.
Electronic tag	Illegible tag	All
Over-moulded cylinder	Fire damage Excessive general or localized heating of a cylinder usually indicated by: — surface charring or burning; — distortion of the cylinder; — melting of metallic valve parts; — melting of any plastic components, e.g. plug or cap.	All
Bung	Damage to the bung, which has altered the profile of the cylinder.	All, except a limited level of depression/alignment deviation, as agreed by the competent authority.
Valves	Broken valves	All

If during this inspection, the outer surface of an over-moulded cylinder is not free from the defects described in Table F.1, the over-moulded cylinder shall be removed from service.

Prior to any possible reuse of the inner receptacle for over-moulding, the former over-moulding case shall be removed and a hydraulic test shall be carried out.

F.2.2.2 Sampling

F.2.2.2.1 General

In addition to the external visual inspection the following tests, shall be done on a sampling basis.

F.2.2.2.2 Peeling and corrosion test

Each cylinder of the sample shall be tested (see Table F.3). Tests shall be done in conformance with EN ISO 4628-3:2003. The minimum peeling and corrosion criteria are Grade Ri2.

F.2.2.2.3 Adhesion tests of the polyurethane material

Each cylinder of the sample shall be tested (see Table F.2). 5 adhesion tests shall be carried out per cylinder. The minimum adhesion value is set to 0,5 N/mm^2.

If the result does not comply with this criterion for at least one test, a second sample of the same size shall be taken. If at least one cylinder of the second sample does not comply with the minimum value of the adhesion criteria, tests shall be re-done taking smaller fractions of the annual production, to define either a period of production with a manufacturing defect or a single isolated defect.

The adhesion test procedure is described in EN 14140:2014, 7.3.7.3.2.

NOTE Table F.2 gives the correspondence between the numbers of cylinders of the annual production divided by one thousand and the sample size according to ISO 2859-1:1999.

F.2.2.3 Test frequency

The additional tests described in F.2.2.2.2 and F.2.2.2.3 shall be carried out after 3 years of service, and every 5 years thereafter.

Table F.2 — Sampling size for adhesion test

Annual Production of OMC	**Related range from** ISO 2859-1	**Sampling size according to** ISO 2859-1
< 9 000	2 to 8	2
Between 9 000 and 16 000	9 to 15	2
Between 16 000 and 25 000	16 to 25	3
Between 25 000 and 51 000	26 to 50	5
Between 51 000 and 91 000	51 to 90	5
Between 91 000 and 150 000	91 to 150	8

F.2.3 Burst test

Burst tests, in accordance with EN 1442 or EN 14140, shall be carried out on one sample per annual production. The minimum size of the sample shall be in accordance with Table F.3, but not less than 20 cylinders. For each of the two sets of results (burst pressure and volumetric expansion), the right unilateral statistical tolerance interval shall be calculated for a confidence level of 95 % and a fraction of population equal to 99 %. The calculation is made in accordance with ISO 16269-6:2014 assuming, for each of the OMC inspection lots, the normal distribution of the population and considering that the variance is unknown (see the size of sample and criteria in Table F.3).

The additional test described above shall be carried out after 3 years of service, and every 5 years thereafter.

F.2.4 Rejection criteria and annual production sampling

A summary of the rejection criteria and the sampling levels are given in Table F.3.

Table F.3 — Sampling and criteria

Test interval **(years)**	**Test type**	**Standard**	**Rejection criteria**	**Batch sampling level**	**Test results**
After 3 years in service	Burst test	EN 1442 and EN 14140:2014	— Burst pressure (*) < 70 bar in propane service;or — 50 bar in butane service	$3\sqrt[3]{Q}$ or $Q/200$ whichever is lower, and with a minimum of 20 per batch (Q)	If any test fails, repeat tests replacing Q with monthly production q of representative sub-batches
			Volumetric expansion (*) < 15 or 9 % (**)		
	Peeling and corrosion	EN ISO 4628-3:2003	Max corrosion grade: Ri2.	Q/1 000	
	Adhesion of Polyurethane	ISO 2859-1	Adhesion value > 0,5 N/mm²	See ISO 2859-1 applied to Q/1000	
Every 5 years thereafter	Burst test	EN 1442 and EN 14140:2014	— Burst pressure (*) < 70 bar in propane service; or — 50 bar in butane service	— $6\sqrt[3]{Q}$ or $Q/100$ whichever is lower; and — with a minimum of 40 per batch (Q)	If any test fails, repeat tests replacing Q with monthly production q of representative sub-batches.
			Volumetric expansion (*) < 13, 12 or 9 % (**)		
	Peeling and corrosion	EN ISO 4628-3:2003	Max corrosion grade: Ri2	Q/1 000	
	Adhesion of Polyurethane	ISO 2859-1	Adhesion value > 0,5 N/mm²	See ISO 2859-1 applied to Q/1000	
Q Represents an over-moulded cylinders inspection lot. q Represents a continuous over-moulded cylinder sub-batch.					

(*) For each of the two groups of figures (burst pressure and volumetric expansion), the "right" unilateral statistical tolerance interval shall be calculated for a confidence level of 95 % and a fraction of population equal to 99 %. The calculation is made in accordance with ISO 16269-6 admitting, for each of the OMC inspection lots, the normality of the population and considering that the variance is unknown.

The tolerance interval with coverage *p* at confidence level *1 – α* has lower limit x_L defined by this formula:

$$x_L = x - k_3(n; p; 1-\alpha) \times s \quad \text{(F.1)}$$

with

x sample mean;

s sample standard deviation;

k_3 tabulated factor function of *n, p* and *1-α*;

NOTE This value can be read from ISO 16269-6:2014, Table D.4.

p proportion of the population selected for the tolerance interval (99 %);

1- α confidence level (95 %);

n sample size.

(**)

— For the cylinders manufactured according to Directive 84/527/EEC [9], the volumetric expansion cannot be lower than:

a) 15 % for the tests done 3 years after manufacturing;

b) 13 % for the tests done 8 years after manufacturing;

c) 12 % for the tests done every 5 years thereafter ;

— for the cylinders manufactured according to Directive 1999/36/EC [10] or Directive 2010/35/EU [11] and according to EN 1442, the volumetric expansion cannot be lower than 9 %;

— for the cylinders manufactured according to Directive 1999/36/EC [10] or Directive 2010/35/EU [11] according to EN 14140, it is necessary to have at least 8 years of experience related to the cylinder type to determine the criteria for the volumetric expansion.

If the burst tests or peeling tests fail, the tests shall be re-done considering smaller fractions of annual production, to define either a period of production with a manufacturing defect or a single isolated defect. The production period with a defect shall be withdrawn immediately after identification using the electronic device, but before filling.

F.2.5 Periodic inspection tests reports and records

Periodic inspection reports shall be made available to the competent authority upon request. At the end of the tests, the database should be updated for the cylinders of the related annual production.

When the cylinders return to a filling plant, the cylinders from the relevant annual production are:

— marked provided the successful completion of the valve control or the valve replacement; or

— withdrawn, if part of a batch with a proven manufacturing defect.

Test results shall be maintained by the owner for 30 years and made available to the competent authority upon request.

F.3Lifetime

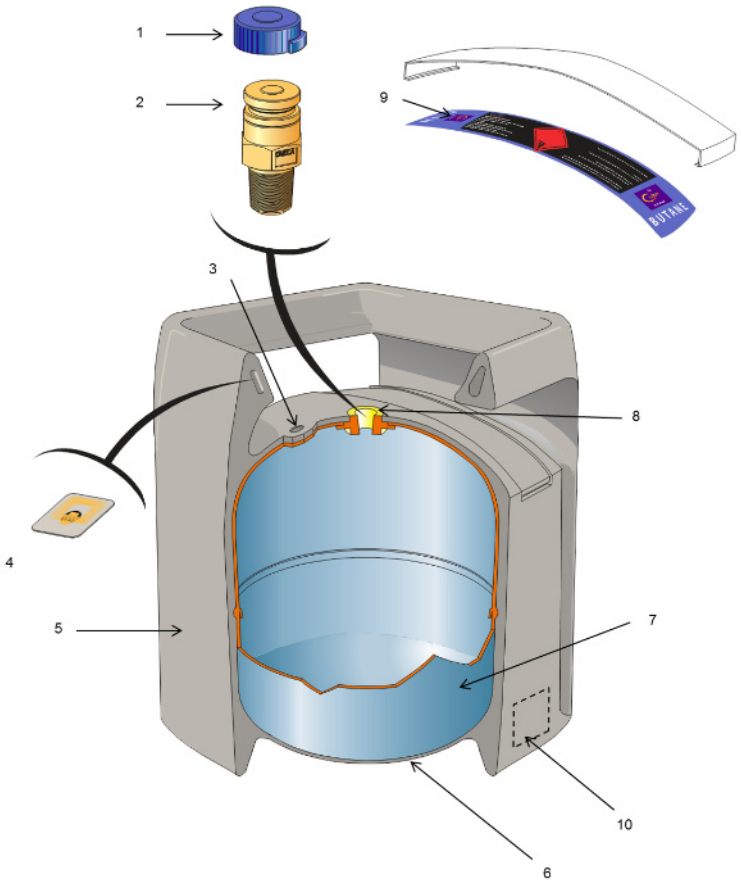
The design lifetime of the over-moulded cylinder is currently set to 30 years.

NOTE 1 However, this lifetime can be extended every 5 years, as long as the tests undertaken at the periodic inspection demonstrate that the polyurethane adhesion to the inner receptacle has retained its properties.

NOTE 2 The electronic device linked to the database enables a production of cylinders to be withdrawn when it has reached its lifetime.

Annex G
(informative)

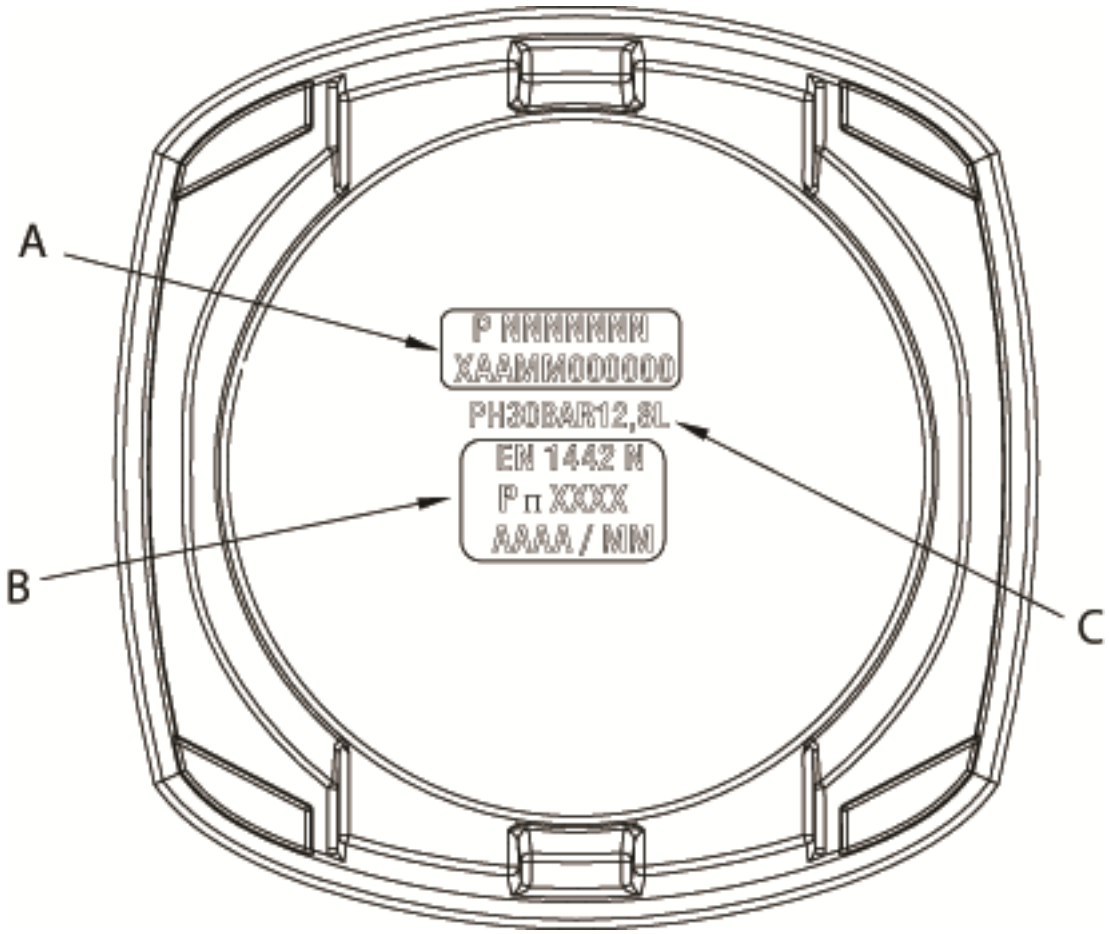
Example of an Over-Moulded Cylinder



Key

1 cylinder valve cap
2 cylinder valve
3 tare weight indication
4 electronic identification tag
5 over-moulded case
6 certification, operational and manufacturing marks
7 coated steel inner pressure receptacle
8 cylinder number
9 identification marks and transport label
10 possible location for marks after Periodic Inspection – full width

Figure G.1 — Example of an over-moulded cylinder



Key

A manufacturing marks

B certification marks

C operational marks

Figure G.2 — Markings on the over-moulded case

Bibliography

[1] Regulations concerning the International Carriage of Dangerous Goods by Rail (RID), appearing as Appendix C to the Convention concerning International Carriage by Rail (COTIF), Vilnius, 3 June 1999, as amended

[2] European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR), Geneva, 30 September 1957, as amended

[3] CEN/TS 16765 *LPG equipment and accessories — Environmental considerations for CEN/TC 286 standards*

[4] EN ISO 16148, *Gas cylinders — Refillable seamless steel gas cylinders — Acoustic emission testing (AT) for periodic inspection (ISO 16148)*

[5] EN ISO 8501-1, *Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness — Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings (ISO 8501-1)*

[6] EN ISO 8504 (all parts), *Preparation of steel substrates before application of paints and related products — Surface preparation methods*

[7] EN 1439, *LPG equipment and accessories — Procedure for checking LPG cylinders before, during and after filling*

[8] ISO 9162, *Petroleum products — Fuels (class F) — Liquefied petroleum gases — Specifications*

[9] Council Directive 84/527/EEC of 17 September 1984 on the approximation of the laws of the Member States relating to welded unalloyed steel gas cylinders

[10] Directive 1999/36/EC of 29 April 1999 on transportable pressure equipment

[11] Directive 2010/35/EU of 16 June 2010 on transportable pressure equipment

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