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Gas cylinders — Refillable welded steel cylinders for liquefied petroleum gas (LPG) — Periodic inspection and testing

Bouteilles à gaz — Bouteilles rechargeables soudées en acier pour gaz de pétrole liquéfié (GPL) — Contrôles et essais périodiques

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 10464 was prepared by Technical Committee ISO/TC 58, *Gas cylinders*, Subcommittee SC 4, *Operational requirements for gas cylinders*.

Introduction

The primary objective of the periodic inspection of transportable refillable welded steel liquefied petroleum gas (LPG) cylinders is that, at the completion of the test, the cylinders can be reintroduced into service for a further period of time.

The original periodic inspection and test procedures for transportable refillable welded steel LPG cylinders were based on those for gas cylinders or other pressure vessels, including those used for high-pressure industrial gases. These early methods relied on a periodic hydraulic proof pressure test being carried out at intervals as frequently as two years (pre-1940). With increasing experience and confidence so gained, together with improved cylinder manufacturing quality, it has been possible to allow the extension of the intervals between periodic tests to 15 years.

Periodic inspection is normally carried out at a test station operating under the supervision of a competent body.

This International Standard has been prepared to reflect the current state of the art for the periodic inspection of LPG cylinders and is based on the operating experience of millions of cylinders in service over many years.

Gas cylinders — Refillable welded steel cylinders for liquefied petroleum gas (LPG) — Periodic inspection and testing

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

1 Scope

This International Standard specifies the intervals and inspection and testing procedures for the periodic inspection of refillable welded steel dedicated LPG cylinders of water capacity from 0,5 l up to and including 150 l.

It applies to cylinders protected by a system to prevent external corrosion and designed and manufactured in accordance with ISO 4706, ISO 22991 or an equivalent design and construction standard. This International Standard may also apply to other refillable welded steel cylinder designs for LPG with the approval of the national authority. Cylinders for the on-board storage of LPG as a fuel for vehicles are excluded from this standard, except cylinders used for fork-lift truck applications.

2 Normative references

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

ISO 4706, *Refillable welded steel gas cylinders*

ISO 8501-1:1988, *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 8504-2, *Preparation of steel substrates before application of paints and related products — Surface preparation methods — Part 2: Abrasive blast-cleaning*

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

ISO 10691, *Gas cylinders — Refillable welded steel cylinders for liquified petroleum gas (LPG) — Procedures for checking before, during and after filling*

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

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

ISO 22991, *Gas cylinders — Transportable refillable welded steel cylinders for liquefied petroleum gas (LPG) — Design and construction*

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

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

3 Terms and definitions

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

3.1
competent body
person or corporate body, defined by the national or relevant authority, which by combination of appropriate qualification, training, experience and resources is able to make objective judgments on a subject

3.2
competent person
person who by a combination of training, experience and supervision is able to make objective judgments on a subject

3.3
liquefied petroleum gas
LPG
a mixture of predominantly butane or propane with traces of other hydrocarbon gases classified in accordance with UN number 1965, hydrocarbon gas mixture, liquefied, or NOS or UN number 1075, petroleum gases, liquefied

NOTE In some countries, UN number 1011 and UN number 1978 may also be used to designate LPG.

3.4
periodic inspection
activities carried out at defined intervals including but not limited to examining, measuring, testing or gauging the characteristics of a cylinder and comparing these with specified requirements as defined in the cylinder design standard and marking to attest conformity with the standard

3.5
periodic inspection test station
place where cylinders are tested and periodically inspected

3.6
tare mass
sum of the empty mass, 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. the fixed valve guard

4 Intervals between periodic inspections

The determination of the interval between periodic inspections shall be dependent on the content of a written scheme that shall be approved by a competent body as complying with the conditions outlined in Annex A.

The interval between periodic inspections shall be 15 years provided the conditions of Annex A are fully met. A shorter time interval not exceeding 10 years shall apply if any of the conditions specified in Annex A are not met.

5 Procedures for periodic inspection

5.1 General

The determination of the periodic inspection procedures shall be dependent on the content of a written scheme approved by a competent body.

5.2 Test procedures

In all cases, periodic inspection procedures shall consist of an external visual inspection as given in 5.3. Additionally, where required by national regulations, one of the following test procedures shall be performed:

a) hydraulic proof pressure test (see 5.4.2);

b) internal visual inspection (see 5.4.3) provided that cylinders have an adequate wall thickness and the design burst pressure is known or the actual burst pressure is proven equal to or exceeding:

   1) 35 bar for cylinders designed for dedicated butane service,

   2) 70 bar for cylinders designed for propane service;

c) pneumatic proof test and leak test (see 5.4.4);

d) pneumatic leak test for LPG cylinders of water capacity 6,5 l or less (see 5.4.5) where the actual burst pressure is equal to or exceeds:

   1) 35 bar for cylinders designed for dedicated butane service,

   2) 70 bar for cylinders designed for propane service;

e) volumetric expansion test (see 5.4.6) where authorized by the national or other relevant authority.

5.3 External visual inspection

5.3.1 Preparation for external visual inspection (see also Annex B)

Where the cylinder surface has loose coatings, corrosion products, tar, oil or other foreign matter, these shall be removed by steel wire brushing, shot blasting in accordance with ISO 8504-2, water jet abrasive cleaning, chemical cleaning or other suitable methods.

Care shall be taken to avoid damaging the cylinder.

Cylinders treated by a process that may remove cylinder material shall be checked by a suitable means, e.g. a thickness check.

5.3.2 Inspection procedure

The entire surface of the cylinder shall be inspected by a competent person for:

a) dents, cuts, gouges, bulges, cracks, laminations or punctures, applying the guidelines for rejection in Table 1;

b) corrosion, giving special attention to areas where water can be trapped, at the base of the cylinder, the junction between the body and the foot ring, the junction between the body and the valve guard or shroud, and in particular hidden corrosion (e.g. behind the data plate), applying the criteria for rejection given in Table 2;

c) other defects (e.g. depressed bung or fire damage), applying the criteria for rejection given in Table 3;

d) the integrity of all permanent attachments.

Any cylinder rejected by the competent person shall be segregated for reconditioning, for further testing or to be rendered unserviceable (see Clause 8).

NOTE In some countries, to render unserviceable means to scrap.

5.3.3 Visible defects

Rejection criteria for physical and material defects on the cylinder shell are contained in Tables 1, 2 and 3. Under exceptional conditions and with the approval of a competent person, the wall thickness may be less than the minimum design value, in which case the cylinder shall pass the pressure test specified in 5.4.2.

Table 1 — Physical defects in the cylinder wall

Defect	Description	Rejection limit
Bulge	Visible swelling of the cylinder	Rejection in all cases
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	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: where 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: rejection in all cases
Intersecting cut or gouge	The point of intersection of two or more cuts or gouges	Rejection in all cases
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	Rejection in all cases
Lamination	Layering of the material within the cylinder wall appearing as a discontinuity, crack, lap or bulge at the surface	Rejection in all cases

[a] Consideration of appearance and location also plays a part in the evaluation of dents.

Table 2 — Corrosion on the cylinder wall

Defect	Description	Rejection limit
Isolated corrosion pits	Pitting of metal occurring in isolated areas at a concentration not greater than 1 pit per 500 mm^2 of surface area	When the depth of discrete pits exceeds 0,6 mm (a greater depth can be accepted provided the depth of corrosion does not reduce the wall thickness below the minimum calculated wall thickness)
Area corrosion	Reduction in wall thickness over an area not exceeding 20 % of the cylinder surface, including the ends (top and bottom)	When the depth of penetration of any pit exceeds 0,4 mm (a greater depth can be accepted provided the depth of corrosion does not reduce the wall thickness below the minimum calculated wall thickness)
General corrosion	A reduction in wall thickness over an area exceeding 20 % of the cylinder surface	When the depth of penetration of any pit exceeds 0,2 mm (a greater depth can be accepted provided the depth of corrosion does not reduce the wall thickness below the minimum calculated 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 corrosion circumference	1) When the total length of corrosion in any direction exceeds 50 % of the circumference of the cylinder 2) When the depth of penetration exceeds 0,4 mm (a greater depth can be accepted provided the depth of corrosion does not reduce the wall thickness below the minimum calculated wall thickness) 3) When the depth of corrosion cannot be measured
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 0,4 mm or when the depth of corrosion cannot be measured

Table 3 — Other defects

Defect	Description	Rejection limit
Depressed bung	Damage to the bung which has altered the profile of the cylinder	Rejection in all cases, or a limited level of depression/alignment deviation may be accepted as agreed with the competent body
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	Rejection in all cases
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	Rejection in all cases
[a] If paint is only superficially charred, a cylinder may be accepted by a competent person.		

5.4 Additional test procedures

5.4.1 Preparation of cylinders

The cylinders shall be emptied of any liquid and depressurized in a safe and controlled manner before proceeding.

Cylinders with inoperative or blocked valves shall be brought to a place for safe valve removal (see Annex C). Valves shall be removed from cylinders for inspection and maintenance.

NOTE The external surface of the cylinder may have been subject to cleaning (see 5.3.1).

5.4.2 Hydraulic proof pressure test

5.4.2.1 General

A liquid shall be used as the test medium, e.g. water or kerosene.

5.4.2.2 Preparation of cylinders

If the cylinder was cleaned (see 5.3.1) and the cleaning method involved wetting the outside surface, the outside surface shall be completely dried before commencing the test procedure.

5.4.2.3 Test equipment

All rigid pipework, flexible tubing, valves, fittings and other components forming the pressure system of the test equipment shall be designed to withstand a pressure of 1,5 times the maximum test pressure of any cylinders to be tested. Flexible tubing shall have characteristics that prevent kinking.

Pressure gauges that are used to read the cylinder test pressure shall be in accordance with EN 837-1 and EN 837-3 (class 1.6 or better). They shall be calibrated or checked for accuracy against a master gauge at regular intervals and in any case not less frequently than once a month. The master gauge shall be recalibrated in accordance with national requirements. The design and installation of the equipment and the cylinders connected to it shall ensure that no air is trapped in the system.

All joints within the system shall be leak tight.

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 5.4.2.4 d).

5.4.2.4 Procedure

a) The pressure of the test shall be established from the test pressure marking on the cylinder.

NOTE More than one cylinder may be tested at a time provided they all have the same test pressure.

b) Before applying pressure, the external surface of the cylinder shall be in such condition that any leak can be detected. The cylinder shall be positioned so the welds are visible during the test.

c) The pressure shall be increased gradually in the cylinder until the test pressure is reached. Then the cylinder shall be isolated from the pumping system.

d) The test pressure shall not be exceeded by more than 10 % or 2 bar, whichever is the lesser.

e) The test pressure shall be held for at least 30 s to carry out the test.

f) If there is a leakage in the pressure system, it shall be corrected and the cylinders retested.

g) Cylinders that do not leak or show any visible permanent distortion shall be deemed to have satisfied the requirements of the hydraulic test.

h) Any cylinders that fail shall be rejected. Rejected cylinders having a pinhole leak at the weld may be repaired, however. Cylinders that leak through pinholes at the weld should be rendered unserviceable or examined by a competent person to determine whether they can be repaired by welding. Any welding or repairing should be carried out in accordance with a written procedure approved by a competent body.

All repaired cylinders shall as a minimum be subjected to the procedures from a) to h) above. All repaired cylinders which fail a second time shall be rendered unserviceable.

5.4.3 Internal visual inspection procedure

After removing any residual liquid and depressurizing the cylinder, it shall be inspected internally for any sign of corrosion or other defects that may affect its integrity. A safe inspection lighting system (e.g. explosion-proof) with appropriate internal illumination shall be used.

A cylinder requiring internal mechanical cleaning shall be degassed and the loose scale or other foreign matter removed. 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 2.

If mechanical cleaning is required, care shall be taken to avoid damaging the cylinder walls. Cylinders shall be reinspected after cleaning.

5.4.4 Pneumatic proof test and leak test

5.4.4.1 General

Cylinders shall be tested in a safe enclosure to protect against rupture under pneumatic pressure.

Repainting before the test should preferably be limited to a primer coat. The finishing coat should be applied after the test in order not to mask potential leaks.

NOTE 1 Consideration should be given to the need for repainting before commencing the test if full water immersion will be used.

NOTE 2 The external surface of the cylinder may have been subject to cleaning (see 5.3.1).

5.4.4.2 Procedure

a) The pneumatic proof test pressure for the cylinder shall be established before starting the test. The pneumatic proof test pressure shall be the same as for an equivalent hydraulic test (see 5.4.2.4 d).

   Cylinders shall be charged with the pneumatic test medium to the test pressure, isolated from the pressure source and then held at that pressure for 5 s to 7 s to carry out the test.

   Where a 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. If necessary, the pressure relief valve shall be removed and the port plugged for testing.

b) The pressure may then be reduced to that required for the leakage check. The reduced pressure shall not be less than the pressure developed at the reference temperature as given in the design standard. If the pressure relief valve has been removed, it shall be reinstalled before leak testing.

c) The leakage check shall be for the entire cylinder and shall be by full water immersion or an equivalent method.

d) Any cylinder that fails the test shall be reconditioned or rendered unserviceable.

All reconditioned cylinders shall as a minimum be resubjected to the procedures from a) to d) of this subclause.

5.4.5 Pneumatic leak test

5.4.5.1 General

Repainting before the test should preferably be limited to a primer coat. The finishing coat should be applied after the test in order not to mask potential leaks.

NOTE 1 Consideration should be given to the need for repainting before commencing the pneumatic test if full water immersion will be used.

NOTE 2 The external surface of the cylinder may have been subject to cleaning (see 5.3.1).

5.4.5.2 Procedure

a) The cylinder shall be filled either with a pneumatic test medium (e.g. natural gas, air, nitrogen) or with a small quantity of LPG in such a way that the internal pressure developed in the cylinder at the time it is checked for leakage shall be:

   1) 7^{+2}_{0} bar for cylinders designed for dedicated butane service;

   2) 18^{+2}_{0} bar for cylinders designed for propane service.

   Propane vapour may also be used as the test medium, in which case the test pressure shall be limited to 5 bar.

   Then the cylinder shall be isolated from the pressure source.

b) The gas tightness check shall be capable of detecting any leak from any part of the cylinder or its equipment.

c) The test shall consist of full immersion of the cylinder in water or an equivalent system.

d) Any cylinder that fails the test shall be reconditioned or rendered unserviceable.

All reconditioned cylinders shall as a minimum be resubjected to the procedures from a) to d) of this subclause.

5.4.6 Volumetric expansion test

5.4.6.1 General

The cylinder shall be placed in a water jacket equipped to measure expansion and may be pressurized by water, kerosene or another suitable liquid.

5.4.6.2 Preparation of cylinders

a) The cylinders shall be emptied of any liquid and depressurized in a safe and controlled manner before proceeding.

b) Cylinders with inoperative or blocked valves shall be brought to a place for safe valve removal (see Annex C).

c) Valves shall be removed from cylinders for internal inspection.

NOTE The external surface of the cylinder may have been subject to cleaning (see 5.3.1).

5.4.6.3 Test equipment

All rigid pipework, flexible tubing, valves, fittings, and other components forming the pressure system of the test equipment shall be designed to withstand a pressure of 1,5 times the maximum test pressure of any cylinders to be tested. Flexible tubing shall have characteristics that prevent kinking.

Pressure gauges that are used to read the cylinder test pressure shall be in accordance with EN 837-1 and EN 837-3 (class 1.6 or better). They shall be calibrated or checked for accuracy against a master gauge at regular intervals and in any case not less frequently than once a month. The master gauge shall be recalibrated in accordance with national requirements. The design and installation of the equipment and the cylinders connected to it shall ensure that no air is trapped in the system.

All joints within the system shall be leak tight.

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 5.4.2.4 d).

The expansion measurement system shall be capable of an accuracy of $\pm$ 2 % or better.

5.4.6.4 Procedure

a) The pressure of the test shall be established from the test pressure marking on the cylinder.

b) The pressure shall be increased gradually in the cylinder until the test pressure is reached. Then the cylinder shall be isolated from the pumping system.

c) The test pressure shall be held for at least 30 s to carry out the test.

d) If there is a leakage in the pressure system, it shall be corrected and the cylinders retested.

e) The cylinder shall not exhibit a permanent expansion greater than 10 % of the maximum expansion.

6 Inspection of cylinder threads

6.1 General

If the valve (or any other fitting) is removed during periodic inspection, the cylinder threads shall be inspected in accordance with 6.2 to 6.4.

6.2 Internal threads

The internal threads of the cylinder shall be visually examined to ensure that they are of adequate form and are clean. They shall be checked for burrs, cracks and other thread damage.

6.3 External threads

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

6.4 Damaged threads

Where necessary and where the design permits, damaged threads may be repaired by a competent person.

7 Final operations

7.1 Drying

After hydraulic testing, effective precautions shall be taken to prevent internal corrosion.

7.2 Purging

Air should be removed from the cylinder, e.g. by evacuation or by displacement with LPG. Cylinders should not be left open without valves or plugs for any period other than that required for essential maintenance.

7.3 Tare mass

The tare mass of the cylinder shall be re-established if any modification or re-valving has been made on the cylinder (see ISO 4706 and ISO 22991).

7.4 Valving

A valve suitable for the intended use shall be fitted to the cylinder using a sealing material/system (see ISO 13341 for details) and the optimum torque necessary to ensure a seal between the valve and the cylinder. The torque applied shall take into consideration the size, form and taper of the threads, the material of the valve and the type of sealing material/system used.

Testing and specifications of valves shall be in accordance with ISO 14245 and ISO 15995.

7.5 Marking

After successful completion of the periodic inspection, each cylinder shall be legibly and durably marked with the following information:

a) The identification of the test station or inspection body which carried out the periodic inspection.

b) The date of the inspection, which shall be in line with the UN model regulations. The height of the markings shall be at least 4 mm.

7.6 Reference to next periodic inspection date

The next periodic inspection date shall be identified on the cylinder in accordance with the relevant regulations.

7.7 Identification of contents

The cylinder contents shall be identified in accordance with the relevant regulations, e.g. commercial propane.

8 Rendering cylinders unserviceable

The decision to render a cylinder unserviceable may be taken at any stage during the periodic inspection procedure. Before rendering any cylinder unserviceable, the agreement of the owner shall be obtained so that the cylinder cannot be reissued into service as a pressure vessel.

Prior to taking any of the following actions, ensure that the cylinder is empty (see 5.4.1) and degassed.

The following methods may be employed to render a cylinder unserviceable:

— by crushing the cylinder using mechanical means;

— by burning an irregular hole in the top dome equivalent in area to approximately 10 % of the area of the top dome or, in the case of a thin-welded cylinder, by piercing in at least three places;

— by irregular cutting of the neck;

— by irregular cutting of the cylinder in two or more pieces;

— by bursting (in a controlled and safe manner).

9 Records

The competent body shall maintain records including quality system, inspection reports and test data, calibration data, and reports concerning the qualifications or approvals of the competent persons.

Inspection reports and test data for cylinders shall be kept and maintained by the competent body at least until the retest date plus 2 years.

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

Where reports are issued for individual cylinders, at least the following information shall be available:

a) serial number;

b) cylinder mass or tare, where applicable;

c) test pressure, where applicable;

d) type and result of test (pass or fail);

e) retest date;

f) identification of the competent body or the test station;

g) identification of the competent person;

h) details of any major repairs made to the cylinder by the retester;

i) cylinder manufacturer;

j) manufacturing specification;

k) water capacity/size.

Annex A
(normative)

Requirements for 15-year periodic inspection interval

A.1 General

For a cylinder to qualify for a 15-year time interval, all of the following requirements shall be met:

a) The cylinder shall be filled in accordance with the criteria contained in ISO 10691 or an equivalent standard/code as approved by a competent authority.

   Key parameters that shall be checked include the following:

   — cylinder identification (e.g. design code, tare mass, mark of the competent body);

   — external cylinder condition (see 5.3);

   — whether the cylinder is within the test date.

b) The LPG quality shall comply with ISO 9162.

c) The cylinders shall be under the control of a single competent gas organization responsible for their distribution, filling and maintenance. The concept of control of cylinders shall be as stated in A.2.

d) Other conditions to be fulfilled are listed in A.3.

A.2 Concept of control

For the purposes of this International Standard, the concept of control of cylinders is as follows:

a) either the cylinders are owned by and under the responsibility for filling, maintaining and testing of a single competent gas organization that loans or hires them to distribution undertakings, consumers or other users under the conditions listed in A.3;

b) or the cylinders are not owned by a single competent gas organization, but their testing, filling, distribution and maintenance are under the responsibility of a single competent gas organization.

In either case, the competent gas organization responsible for filling, maintenance and testing may contract the filling, maintenance and/or testing to other competent organizations, but shall ensure that the cylinders are filled, maintained and tested only as contracted, in accordance with the procedures of the responsible competent gas organization.

A.3 Conditions

The following conditions shall be fulfilled:

a) The cylinders shall be returned for filling, maintenance or testing to the responsible competent gas organization or an authorized contractor, or shall be exchanged for a full cylinder at a retail outlet serviced by the responsible competent gas organization or an authorized contractor.

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

c) The responsible competent gas organization 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).

Annex B
(informative)

System of protection against external corrosion

When LPG cylinders are found to show signs of serious corrosion but there is proof that they are fit for further service, they may be given further protection against corrosion as indicated in the following guidelines:

a) **Pretreatment of the cylinders**

The cylinders should first be shot-blasted in accordance with ISO 8504-2. The shot-blasting quality should not be less than grade B Sa 21/2 as defined in ISO 8501-1.

This quality grade should be applied to the entire surface of the cylinder. Special care should be taken with the base and the foot ring areas to ensure that no traces of rust remain in hidden crevices in the cylinder since these parts are more susceptible to corrosion.

After the shot-blasting procedure, it is essential for the success of the protection against corrosion to keep the cylinders in a dry environment until the first corrosion protection layer is applied.

b) **First corrosion protection coating**

Directly after the shot-blasting process, the cylinders should be coated with the first corrosion protection layer. It is important to make sure that this coating is thoroughly applied to all hidden crevices and to the base and foot ring areas. Such coatings could include zinc-phosphate-based primers, metallic-zinc sprays, galvanization, epoxy-based coatings, etc.

The resulting coating should be examined by visual inspection, especially when it was applied by automatic equipment. If there is any doubt as to whether the first coating has been applied satisfactorily, an additional coating should be applied.

c) **Final coating**

After application of the first coating, a final paint coating can be applied, when required. Before this step, it should be ensured that the first coating is ready for the next to be applied over it.

NOTE Some protective systems are designed to be applied “wet on wet” and then stoved.

Various types of paint are available for this final coating:

— solvent-free paint (usually water-based);

— synthetic enamel with a low solvent content;

— synthetic enamel with a normal solvent content (not allowed in some countries);

— powder coating.

If the final coating requires stoving, care must be taken to ensure that the mechanical properties of the cylinder material are not affected.

d) **Cylinders which are not seriously corroded**

For cylinders that are not seriously corroded, it may be sufficient to clean them, e.g. by wire brushing, before applying a corrosion protection system as necessary [see b) and c)].

Annex C
(informative)

Procedure that may be adopted when it is suspected that a cylinder valve is obstructed/blocked

C.1 Check for obstructed/blocked valve

If there is any doubt, when the valve of a gas cylinder is opened, as to whether gas is being released or whether the cylinder may still contain residual gas under pressure, a check or checks should be made to establish that the free passage through the valve is not obstructed/blocked.

The first check is to establish that the total mass of the cylinder is the same as the tare mass indicated on the cylinder. If there is a positive difference, the cylinder may contain either LPG or contaminants.

To rectify this, inert gas should be introduced at a pressure up to 5 bar and a check made that it discharges.

C.2 Valve unobstructed/unblocked

When it has been established that there is no obstruction/blockage to gas flow in the cylinder valve, the valve may be removed.

C.3 Valve obstructed/blocked

When a cylinder is found to have an obstructed/blocked gas passage in the valve, the cylinder should be set aside for special attention.

C.4 General remarks

These procedures should be carried out only by trained personnel. When the gas, if any, has been released and the pressure within the cylinder reduced to atmospheric, and provided there is no frost or dew on the outside of the cylinder, the valve may be removed.

Bibliography

[1] ISO 9000, *Quality management systems — Fundamentals and vocabulary*

[2] ISO 9001, *Quality management systems — Requirements*

[3] ISO 13341, *Transportable gas cylinders — Fitting of valves to gas cylinders*

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