
**Gas cylinders — Welded carbon-steel gas
cylinders — Periodic inspection and
testing**

*Bouteilles à gaz — Bouteilles à gaz soudées en acier au carbone —
Contrôles et essais périodiques*

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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 10460 was prepared by Technical Committee ISO/TC 58, *Gas cylinders*, Subcommittee SC 4, *Operational requirements for gas cylinders*.

This second edition cancels and replaces the first edition (ISO 10460:1993), which has been technically revised.

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Introduction

The principal aim of a periodic inspection and testing procedure is to be satisfied that at the completion of the test the cylinders can be re-introduced into service for a further period of time.

The inspection and test are to be carried out only by persons who are authorized under the relevant regulations and competent in the subject to assure all concerned that the cylinders are fit for continued safe use.

Experience of inspection and testing of cylinders that are specified in this International Standard is an important factor when determining whether a cylinder should be returned into service.

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Gas cylinders — Welded carbon-steel gas cylinders — Periodic inspection and testing

1 Scope

This International Standard deals with welded, carbon-steel, transportable gas cylinders intended for compressed and liquefied gases under pressure, of water capacity from 0,5 l to 150 l; it also applies, as far as practical, to cylinders of less than 0,5 l water capacity and greater than 150 l up to 450 l.

This International Standard specifies the requirements for periodic inspection and testing to verify the integrity of such gas cylinders for further service.

This International Standard does not apply to the periodic inspection and testing of acetylene cylinders or composite (fully wrapped or hoop-wrapped) cylinders.

This International Standard is primarily for industrial gases other than liquefied petroleum gas (LPG), but may also be applied for LPG. For specific LPG applications, see ISO 10464.

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 11621, *Gas cylinders — Procedures for change of gas service*

ISO 11114-2, *Transportable gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 2: Non-metallic materials*

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

3 Intervals between periodic inspections and tests

A cylinder shall be due for a periodic inspection and test on its first receipt by a filler after the expiry of the interval in accordance with the requirements of the United Nations *Recommendations on the Transport of Dangerous Goods, Model Regulations* or as specified by national or international authorities (see examples in Annex A).

Provided the cylinder has been subjected to normal conditions of use and has not been subjected to abusive and abnormal conditions rendering the cylinder unsafe, there is no general requirement for the user to return a gas cylinder before the contents have been used even though the periodic inspection and test interval may have lapsed.

It is the responsibility of the owner or user to submit the cylinder for a periodic inspection and test within the interval specified by national or international authorities, or as specified in the relevant cylinder design standard if this is shorter.

4 List of procedures for periodic inspections and tests

Each cylinder shall be submitted to periodic inspections and tests. The following procedures, where applicable, form the requirements for such inspections and tests and are explained more fully in later clauses:

- a) identification of cylinder and preparation for inspections and tests (Clause 5);
- b) depressurization and de-valving procedures (Clause 6);
- c) external visual inspection (Clause 7);
- d) internal visual inspection (Clause 8);
- e) supplementary tests (Clause 9);
- f) inspection of cylinder neck (Clause 10);
- g) pressure test (Clause 11);
- h) repair of cylinders (Clause 12);
- i) inspection of valve and other accessories (Clause 13);
- j) final operations (Clause 14);
- k) rejection and rendering cylinders unserviceable (Clause 15).

It is recommended that the previously listed tests be performed in the suggested sequence. In particular the internal visual inspection (Clause 8) should be carried out before the pressure test (Clause 11).

Cylinders that fail an inspection or tests shall be rejected (see Clause 15). Where a cylinder passes the above procedures, but when the condition of the cylinder remains in doubt, additional tests shall be performed to confirm its suitability for continued service or the cylinder shall be rendered unserviceable.

Depending on the reason for the rejection, some cylinders may be recovered (see Clause 8, 10.3 and Annex C).

The inspections and tests shall be carried out only by persons who are competent in the subject and authorized under relevant regulations.

Mechanical properties of steel cylinders can be affected by heat. Therefore, the maximum temperature for any operation shall be limited according to the manufacturer's recommendations.

5 Identification of cylinder and preparation for inspections and tests

Before any work is carried out, the relevant cylinder data (e.g. see ISO 13769) and its contents and ownership shall be identified. Cylinders with incorrect or illegible markings, unknown gas contents or those that cannot be safely emptied of gas shall be set aside for special handling.

If contents are identified as hydrogen or other embrittling gases, only those cylinders manufactured or qualified as hydrogen cylinders shall be used for that service. It shall be checked that the cylinder is compatible for hydrogen service, i.e. with respect to the maximum tensile strength and internal surface condition. For example, cylinders according to ISO 13769 are stamped "H". All other cylinders shall be withdrawn from hydrogen service and their suitability checked for their new intended service.

6 Depressurization and de-valving procedures

The cylinders shall be depressurized and emptied in a safe, controlled manner before proceeding. Particular attention shall be given to cylinders containing flammable, oxidizing or toxic gases to eliminate risks at the internal inspection stage.

Before removing any pressure-retaining accessory (valve, flange, etc.), a positive check shall be performed to ensure that the cylinder does not contain any gas under pressure. This can be performed as described in Annex D using a device such as shown in Figure D.1.

Cylinders with inoperative or blocked valves shall be treated as outlined in Annex D.

Provided the requirements previously stated have been complied with, the cylinder shall be depressurized safely and the valve shall be removed.

7 External visual inspection

7.1 Preparation for external visual inspection

When necessary, each cylinder shall be cleaned and have all loose coatings, corrosion products, tar, oil or other foreign matter removed from its external surface by a suitable method, e.g. brushing, shot-blasting (under closely controlled conditions), water jet abrasive cleaning, chemical cleaning or other suitable methods. The method used to clean the cylinder shall be a validated, controlled process. Care shall be taken at all times to avoid damaging the cylinder or removing excess amounts of cylinder wall (see Annex C).

If fused nylon, polyethylene or a similar coating has been applied and the coating is seen to be damaged or prevents a proper inspection, then the coating shall be stripped. If the coating has been removed by the application of heat, in no case shall the temperature of the cylinder have exceeded 300 °C.

7.2 Inspection procedure

The external surface of each cylinder shall then be inspected for

- a) dents, cuts, gouges, bulges, cracks, laminations or excessive base wear;
- b) heat damage, torch or electric-arc burns (as specified in Table C.1);
- c) corrosion (as defined in Table C.2);
- d) other defects such as illegible, incorrect or unauthorized stamp markings, or unauthorized additions or modifications;
- e) integrity of all permanent attachments (see C.2); and
- f) vertical stability, if relevant (see Table C.1).

When inspecting for corrosion [see c)], special attention shall be given to areas where water could be trapped. These include the entire base area, the junction between the body and the foot-ring and the junction between body and the shroud.

For rejection criteria, see Annex C. Cylinders no longer suitable for future service shall be rendered unserviceable (see Clause 15).

8 Internal visual inspection

Each cylinder shall be inspected internally using adequate illumination to identify any defects similar to those listed in 7.2 a) and 7.2 c). Precautions shall be taken to ensure that the method of illumination presents no risks to the tester while performing the operation. Any internal liner or coating that may obstruct optimum internal visual inspection shall be removed. Any cylinder showing presence of foreign matter or signs of more than light surface corrosion shall be cleaned internally under closely controlled conditions by shot-blasting, water jet abrasive cleaning, flailing, steam jet, hot water jet, rumbling, chemical cleaning or other suitable method. The method used to clean the cylinder shall be a validated, controlled process. Care shall be taken at all times to avoid damaging the cylinder or removing excess amounts of cylinder wall (see Annex C). If cleaning is required, the cylinder shall be reinspected after the cleaning operation.

9 Supplementary tests

Where there is doubt concerning the type and/or severity of a defect found on visual inspection, additional tests or methods of examination shall be applied, e.g. ultrasonic techniques, check weighing or other non-destructive tests.

10 Inspection of cylinder neck

10.1 Cylinder to valve threads

When the valve is removed, the cylinder to valve threads shall be examined to identify the type of thread (e.g. 25E) and to ensure that they are

- clean and of full form,
- free of damage,
- free of burrs,
- free of cracks, and
- free of other imperfections.

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10.2 Other neck surfaces

Other surfaces of the neck shall also be examined to ensure they are free of cracks or other defects (see Annex C).

10.3 Damaged internal neck threads

Where necessary and where the manufacturer or the competent design authority confirms that the design of the neck permits, threads may be re-tapped or the thread type changed to provide the appropriate number of effective threads. After re-tapping or changing the thread form, the threads shall be checked with the appropriate thread gauge, e.g. ISO 11191 for 25E threads.

10.4 Neck ring and collar attachment

When a neck ring/collar is attached, an examination shall be carried out to ensure it is secure and to inspect for thread damage. A neck ring shall only be changed using an approved procedure. If it is found that any significant damage to cylinder material has occurred by replacement of the neck ring/collar, the cylinder shall be rendered unserviceable (see Clause 15).

11 Pressure test

11.1 General

Each cylinder shall be subjected to a hydraulic or pneumatic pressure test.

WARNING — Appropriate measures shall be taken to ensure safe operation and to contain any energy that could be released. It should be noted that pneumatic pressure tests require more precautions than hydraulic pressure tests since, regardless of the size of the container, any error in carrying out this test is highly likely to lead to a rupture under gas pressure. Therefore, these tests shall be carried out only after ensuring that the safety measures satisfy the safety requirements.

Each cylinder subjected to a hydraulic pressure test shall use a suitable fluid, normally water, as the test medium. The test pressure shall be established from the stamping on the cylinder.

This test requires that the pressure in the cylinder be increased gradually until the test pressure is reached. The cylinder test pressure shall be held for at least 30 s with the cylinder isolated from the pressure source, during which time there shall be no decrease in the recorded pressure or any evidence of leakage. Adequate safety precautions shall be taken during the test.

The following proposes a typical method for carrying out the test. Any cylinder failing to comply with the requirements of a hydraulic proof pressure test shall be rendered unserviceable.

11.2 Test equipment

11.2.1 All rigid pipe work, flexible tubing, valves, fittings and components forming the pressure system of the test equipment shall be designed to withstand a pressure at least 1.5 times the maximum test pressure of any cylinder that could be tested.

11.2.2 Pressure gauges shall be to Industrial Class 1 ($\pm 1\%$ deviation from the end value) with a scale appropriate to the test pressure (e.g. EN 837-1 or EN 837-3). They shall be checked for accuracy against a calibrated master gauge at regular intervals and in any case not less than once a month. The master gauge shall be calibrated in accordance with national requirements. The pressure gauge shall be chosen so that the test pressure is between approximately one-third and two-thirds of the value capable of being measured on the pressure gauge.

11.2.3 The design and installation of the equipment, the connection of the cylinders and the operating procedures shall be such as to avoid trapping air in the system when a liquid medium is used.

11.2.4 All joints within the system shall be leak tight.

11.2.5 A suitable system control device shall be fitted to the test equipment to ensure that no cylinder is subjected to a pressure in excess of its test pressure by more than the tolerances specified in 11.3.3.

11.3 Test criteria

11.3.1 More than one cylinder may be tested at a time provided that they all have the same test pressure. If individual test points are not used, then in case of leakage all cylinders being tested shall be individually re-tested.

11.3.2 Before applying pressure, the external surface of the cylinder shall be dry.

11.3.3 The pressure applied shall not be below the test pressure and shall not exceed the test pressure by 3 % or 10 bar, whichever is lower.

11.3.4 On attaining the test pressure, the cylinder shall be isolated from the pump and the pressure held for a minimum period of 30 s.

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