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Welded carbon steel gas cylinders — Periodic inspection and testing

iTeh STANDARD PREVIEW

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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.

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.

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

Annexes A, B, C, D, E, F, G and H of this International Standard are for information only.

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Introduction

The primary object of periodic inspection and testing of gas cylinders is to ensure that at the completion of the test the cylinders may be re-introduced into service for a further period of time.

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

The inspection and testing should be carried out only by persons who are competent in the subject, to assure all concerned that the cylinders are fit within the permissible limits for continued safe use.

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Welded carbon steel gas cylinders — Periodic inspection and testing

1 Scope

This International Standard specifies the minimum requirements for periodic inspection and testing to verify the integrity of gas cylinders for further service. It does not exclude the application of additional national requirements.

It applies to welded carbon steel transportable gas cylinders intended for compressed, liquefied or dissolved gases under pressure, excluding acetylene and LPG, of water capacity from 1 litre up to and including 150 litres; it also applies, as far as practicable, to cylinders of less than 1 litre water capacity.

Additional International Standards cover similar requirements for seamless steel, seamless aluminium, acetylene and LPG cylinders and the inspection and tests to be carried out during normal filling procedures.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 32:1977, *Gas cylinders for medical use — Marking for identification of content.*

ISO 448:1981, *Gas cylinders for industrial use — Marking for identification of content.*

ISO 4706:1989, *Refillable welded steel gas cylinders.*

ISO 10297:—¹⁾, *Gas cylinder valves — Specifications and testing.*

3 List of procedures for periodic inspection and tests

Each cylinder shall be submitted to periodic inspection and testing. The following procedures form the basic requirements for such inspection and testing.

- a) identification of cylinder and preparation for the inspection and test;
- b) external visual inspection;
- c) internal visual inspection;
- d) inspection of welds;
- e) verification of the cylinder mass or tare, as appropriate;
- f) inspection of the cylinder threads;
- g) hydraulic test;
- h) repair of cylinders;
- i) inspection of the valve;
- j) final operations.

When the condition of the cylinder remains in doubt after these inspections and tests have been carried out, additional tests shall be implemented.

1) To be published.

4 Intervals between periodic inspection and tests

The interval between periodic inspection and tests is usually specified by national or international authorities. Should no such regulations apply, some recommended intervals are proposed in annex A.

5 Identification of the cylinder and preparation for the inspection and test

Before any work is carried out, the cylinder and its contents shall be identified. The cylinder shall be emptied using a safe procedure and the release of pressure shall be controlled.

If it is suspected that a cylinder valve is obstructed, a check or checks shall be made to establish whether there is free passage through the valve or not. Typical test procedures are given in annex B.

Special attention shall be given to cylinders containing toxic, irritating or flammable gases. Cylinders shall be emptied at a properly equipped testing station by an operator trained to handle such gases.

Cylinders with unknown gas contents, or those which cannot be safely emptied of gas, shall be set aside for special handling.

Provided the requirements given above have been complied with, the valve shall be removed.

6 External visual inspection

6.1 The cylinder shall have all loose coatings, corrosion products, tar, oil or other foreign matter, as well as any labels or transfers, removed from its external surface by a suitable method, e.g. by steel wire brushing, shot blasting, water-jet abrasive cleaning, chemical cleaning, etc. Care shall be taken to avoid damage to the cylinder.

6.2 The external surface of the cylinder, particularly in the region of the welds, shall then be inspected for

- a) dents, cuts, gouges, bulges, cracks, laminations or pinholes;
- b) corrosion by giving special attention to areas where water may be trapped, to the base of the cylinder, and to the junction between the body and the foot ring and/or the shroud;
- c) other defects such as illegible or unauthorized stamp markings, heat damage, electric arc or torch burns, unauthorized additions or modifications.
- d) integrity of all permanent attachments.

6.3 Typical rejection limits are given for guidance in annex C.

7 Internal visual inspection

The cylinder shall be inspected internally over its whole surface using an appropriate device (e.g. a lamp) to identify any defects similar to those listed in 6.2. Any cylinder showing presence of foreign matter or signs of more than minor surface corrosion shall be cleaned internally by shot blasting (under closely controlled conditions), water-jet abrasive cleaning, flailing, steam-jet cleaning, hot-water-jet cleaning, rumbling, chemical cleaning or other suitable method. Care shall be taken to avoid damage to the cylinder. If cleaning is required, the cylinder shall be inspected again.

Typical rejection limits are given for guidance in annex C.

8 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 may be applied, e.g. ultrasonic or radiographic techniques, or other non-destructive tests. Alternatively the cylinder shall be scrapped.

9 Verification of the cylinder mass or tare

The cylinder stamp marking shall be scrutinized to determine whether this marking indicates a mass or a tare.

NOTE 1 The cylinder mass is the mass, expressed in kilograms, of the empty cylinder with the attached parts (e.g. foot ring and neck ring) but without valve. This mark shall be prefixed by the letter M. The tare of the cylinder is the mass, expressed in kilograms, of the empty cylinder with the attached parts (e.g. foot ring and neck ring) and including the valve and permanent shroud (if fitted). This mark shall be prefixed by the letter T. The mass or tare is expressed to three significant figures, the third figure being determined by rounding up for the mass or tare, where the mass or tare is greater than 10 kg. For cylinders with a lower mass or tare, these values are expressed to two significant figures only.

EXAMPLES

Measured mass or tare:	1,064 5	10,675	106,55
Mass or tare to be expressed as:	1,1	10,7	107

The cylinder shall be weighed on a calibrated weighing device to determine the actual mass/tare. This measurement shall be compared with the original mass/tare stamped on the cylinder. A cylinder having a difference in mass/tare greater than 5 %

of the original mass/tare shall be rejected [see 14.4 a)].

10 Inspection of the cylinder threads

10.1 The internal neck threads of the cylinder and other internal threaded openings, e.g. for safety devices, shall be examined to ensure that they are of full form, clean and free from burrs, cracks and other imperfections.

10.2 External neck threads and other external threads shall be examined for integrity and for thread damage.

10.3 Where necessary, and where design permits, damaged threads may be rectified by a suitable method and checked with the appropriate gauge.

11 Hydraulic test

Each cylinder shall be submitted to a hydraulic pressure test, using a suitable fluid as the test medium. This may be a proof pressure test, or a volumetric expansion test.

The test pressure shall be established from the marking on the cylinder, directly or indirectly from the filling pressure.

11.1 Proof pressure test

This test requires that the pressure in the cylinder increases gradually until the test pressure is reached. The cylinder test pressure shall be held for a sufficiently long period to ascertain that there is no tendency for the pressure to decrease and that tightness is guaranteed.

Annex D proposes a typical method for carrying out the test. Any cylinder failing to comply with the requirements of this test shall be rejected.

11.2 Volumetric expansion test

The permanent volumetric expansion of the cylinder, expressed as a percentage of the total expansion at the test pressure, shall not exceed 10 %. If this value is exceeded the cylinder shall be rejected.

Annex E proposes a typical method for carrying out the test and gives details for determining the volumetric expansion of welded steel gas cylinders.

12 Repair of cylinders

12.1 Repair of pinholes

If, during the pressure test or external visual inspection, pinhole leaks are detected in a weld, they may, at the discretion of the inspector, be repaired by welding. No other repair to pressure-containing welds shall be undertaken.

12.2 Other repairs

Any other major repairs, including dedenting, replacement of foot rings and shrouds, may be carried out provided this repair will not impair the integrity of the cylinder. All corrosion products shall be removed prior to repair.

12.3 Requirements for repair

12.3.1 Major repairs as defined in 12.1 and 12.2 shall be performed by a competent, authorized re-conditioner. After such repairs, a stress-relief/normalizing heat treatment shall be performed. The cylinder shall finally be retested as specified in ISO 4706.

12.3.2 Minor repairs such as reforming damaged shrouds, carrying handles etc., not involving welding or hot-work on pressure-containing parts may be carried out as long as the integrity of the cylinder is not impaired.

13 Inspection of the valve

If it is to be re-introduced into service, each valve shall be inspected and maintained so that it will perform satisfactorily and close without leakage according to ISO 10297:—¹) (see clause 2).

A typical test procedure is given in annex F.

14 Final operations

14.1 Drying and cleaning

The interior of each cylinder shall be thoroughly dried.

The interior of the cylinder shall be inspected immediately after the hydraulic test to ensure that it is dry and free from contamination. Any contamination shall be removed using a suitable method.

14.2 Revalving of the cylinder

The valve shall be fitted to the cylinder using a suitable jointing medium and the optimum torque necessary to ensure a seal between the valve and the cylinder.

The torque applied shall be determined on the basis of the size, form and taper of the threads, the material of the valve and the type of jointing material used.

The torque shall be sufficient to obtain the required number of thread engagements. A torque wrench may be used to establish the torque required for proper thread engagement.

14.3 Reference to next test date

The next test date may be indicated using an appropriate method.

A code, using a disc fitted between the valve and the cylinder, which indicates the date (year) of the next periodic inspection and tests, is proposed in annex G.

14.4 Marking

After satisfactory completion of the periodic inspection and test and the revalving of the cylinder, each cylinder shall undergo the following:

- a) For liquefiable gas cylinders, the tare shall be established, taking into account the possible loss in mass of the cylinder with the attached parts and the possible difference in mass of the valve. If it differs from the marked tare significantly, the latter shall be lined out, but so that it is still readable, and the correct tare shall be marked in a permanent and legible fashion.

NOTE 2 This practice can be applied to any gas cylinder.

- b) The cylinder shall be stamped, adjacent to the previous inspection/test mark, according to national requirements or with

- the symbol of the inspection body or test station;
- the date of the test (this date may be indicated by the month and year or by the year followed by a number within a circle to denote the quarter of the year).

The markings should preferably be not less than 6 mm in height but in any case shall be not less than 3 mm in height.

When a marking collar is fitted it shall be used. When there is no space available, markings may be stamped on the shoulder if its thickness is greater than the cylinder wall thickness.

14.5 Identification of contents

The contents shall be identified in accordance with ISO 448 and ISO 32 and, where applicable, by a colour, if required by the appropriate national standard.

14.6 Records

An inspection/test record shall be retained by the testing station for not less than the period between tests. It shall record sufficient information to identify positively the cylinder and the results of the test/inspection. Where national regulations require certain information to be recorded, this shall be complied with. The test record may include the following information:

- a) the owner;
- b) serial number;
- c) the date of the previous test;
- d) the manufacturer;
- e) the manufacturing specifications;
- f) the water capacity;
- g) the cylinder mass/tare as tested, if applicable;
- h) the test pressure;
- i) the inspection/test date;
- j) the results of the inspection/test;
- k) the inspection performed;
- l) details of any modification or repair made to the cylinder.

15 Rejection and destruction of unserviceable cylinders

The decision to reject a cylinder may be taken at any stage during the inspection and test procedure. A rejected cylinder shall not under any circumstances be re-issued into service. It shall be destroyed either by the testing station, after agreement with the owner, or by the owner. In case of any disagreement, ensure that the legal implications of contemplated action are fully understood.

The markings on the cylinder shall be obliterated.

Prior to taking any of the following actions, ensure the cylinder is empty (see clause 5).

The following destruction methods may be employed:

- a) crushing the cylinder by mechanical means;
- b) burning an irregular hole in the shoulder equivalent in area to approximately 10 % of the area of the shoulder or, in the case of a thin-walled cylinder, by piercing in at least three places;
- c) irregular cutting of the neck;
- d) irregular cutting of the cylinder into two or more pieces;
- e) bursting.

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Annex A (informative)

Intervals between periodic inspection and tests

Some recommended intervals between periodic inspection and tests for welded carbon steel cylinders are shown in table A.1.

Table A.1 — Periodicity of inspections and tests

Contents of the cylinder		Periodicity of hydraulic tests and inspection (years)
Permanent gases	Air, argon, helium, krypton, neon, nitrogen, oxygen, xenon and their mixtures	5 or 10 ¹⁾
	Carbon monoxide, natural gas	5
Non-corrosive low-pressure-liquefiable gases ($T_c > +70\text{ °C}$)	Halocarbons, cyclopropane	10 ²⁾
	Ammonia, butadiene	5
Non-corrosive high-pressure-liquefiable gases ($-10\text{ °C} < T_c < +70\text{ °C}$)	Ethylene	10
	Carbon dioxide, nitrous oxide	5
Corrosive high-pressure-liquefiable gases ($-10\text{ °C} < T_c < +70\text{ °C}$)	Chlorine, hydrogen chloride, hydrogen fluoride	2

1) For air, oxygen and their mixtures, the 10-year extended retest period shall only be used if there is no free moisture under all operating conditions. Otherwise, the test period shall be 5 years.

2) For fluorocarbon-containing cylinders used for fire fighting, the retest period may be 20 years provided that they are externally inspected annually. If such a cylinder exhibits > 3 % weight loss, the cylinder shall be requalified.