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Periodic inspection and testing of seamless steel gas cylinders

Contrôle et essais périodiques des bouteilles à gaz en acier sans soudure

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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 6406 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 and G of this International Standard are for information only.

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Introduction

Experience in the inspection and testing of cylinders is an important factor in the determination of 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 within the permissible limits for continued safe use.

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Periodic inspection and testing of seamless steel gas cylinders

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 applies to seamless steel transportable gas cylinders intended for compressed, liquefied or dissolved gases under pressure (excluding acetylene), of water capacity from 0,5 litres up to and including 150 litres. It also applies, as far as practicable, to cylinders of less than 0,5 litres water capacity.

Future International Standards will cover similar requirements for welded-steel cylinders, seamless aluminium-alloy cylinders and cylinders intended to convey dissolved acetylene, and the inspections 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 4705:1983, *Refillable seamless steel gas cylinders.*

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 the cylinder and preparation for the inspection and test;

b) external visual inspection;

c) internal visual inspection;

d) verification of the cylinder mass;

e) inspection of the cylinder threads;

f) hydraulic test;

g) inspection of the valve;

h) 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.

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

6 External visual inspection

6.1 The cylinder shall be first inspected for

a) fire damage,

b) burns caused by arc welding or gas welding, and

c) unauthorized additions or modifications.

6.2 The cylinder shall have all plastic coating, loose paint, corrosion products, tar, oil or other foreign matter, as well as any labels or transfers, removed from its external surface by a suitable method.

6.3 The markings shall be checked to ensure their compliance with ISO 4705.

6.4 The cylinder shall then be inspected for

a) dents, cuts, gouges, bulges, cracks or laminations,

b) corrosion, particularly at its base, and

c) other defects, such as unauthorized stamp markings.

6.5 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 of the defects similar to those listed in 6.4 a) and b). Any internal lining or coating which may obstruct a thorough internal visual inspection shall be removed. Any cylinder showing presence of foreign matter or signs of more than minor surface corrosion shall be cleaned internally by using shot blasting, water-jet abrasive cleaning, flailing, steam-jet cleaning, hot-water-jet cleaning, controlled heating in a furnace to a cylinder temperature not exceeding 350 °C, rumbling, chemical cleaning or other suitable methods. Care shall be taken to avoid damage to the cylinder. After cleaning, 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, e.g. ultrasonic techniques or other non-destructive tests, may be applied.

9 Verification of the cylinder mass

The cylinder shall be weighed to determine the difference between the actual mass and the original mass stamped on the cylinder or otherwise obtained. A cylinder showing a loss of mass of more than 3 % shall be subjected to an additional examination to determine its suitability for further service. A cylinder having a difference in mass greater than 5 % of the original mass shall be rejected unless sufficient wall thickness can be clearly established.

10 Inspection of the cylinder threads

10.1 The internal neck thread of the cylinder shall be examined to ensure that it is of full form, clean and free from burrs and other imperfections.

Where necessary , and where the design of the neck permits, taper threads may be retapped to ensure that there is the required number of effective threads for the safe fitting of the valve.

10.2 When a neck ring exists, examinations for secureness and correct thread shall be carried out. If it is found that any damage has been caused to the cylinder when replacing the neck ring, or if the neck ring has been attached by welding, brazing or soldering, the cylinder shall be removed from further service.

11 Hydraulic test

Each cylinder shall be submitted to a hydraulic pressure test. This may be a proof pressure test or a volumetric expansion test.

11.1 Proof pressure test

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

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.

A typical test method is given in annex D.

11.2 Volumetric expansion test

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

The permanent volumetric expansion of the cylinder, expressed as a percentage of the total expansion at the test pressure, shall not exceed 10 %.

If the permanent volumetric expansion exceeds 10 % of the total expansion at test pressure, the cylinder shall be rejected. However, where it can be clearly established that apparent excessive permanent volumetric expansion of a cylinder is the result of a fault in the test equipment, the cylinder may be retested.

A typical test method is given in annex E.

12 Inspection of the valve

If the cylinder is to be re-introduced into service, each valve shall be inspected and maintained so that it will perform satisfactorily and close without leakage.

A typical test procedure is given in annex F.

13 Final operations

13.1 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.

13.2 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.

13.3 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.

13.4 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 eventual loss in mass of the cylinder with the attached parts and the eventual 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 1 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.

13.5 Painting and identification

When necessary, each cylinder shall be repainted.

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.

13.6 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 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.

14 Rejection and destruction of unserviceable cylinders

A rejected cylinder shall not under any circumstances be reissued into service. It shall be destroyed either by the testing station, after agreement with the owner, or by the owner.

The markings on the cylinder shall be obliterated.

The following destruction methods may be used:

a) crushing of the cylinder by mechanical means;

b) burning of an irregular hole in the shoulder equivalent in area to approximately 10 % of the area of the shoulder or, in the case of thin-walled cylinders, piercing of the cylinder in at least three places;

c) irregular cutting of the neck.

Annex A
(informative)

Intervals between periodic inspections and tests

Some recommended intervals between periodic inspections and tests are shown in table A1.

Table A.1 — Periodicity of inspections and tests

Contents of the cylinder		Periodicity of inspections and hydraulic tests (years)
Permanent gases	Oxygen, argon, nitrogen, helium, xenon, krypton, neon and mixtures of these gases	10
	Hydrogen, compressed air	5
	Boron trifluoride	3
	Carbon monoxide, methane, natural gas	
	Fluorine	
Non-corrosive low-pressure-liquefiable gases	Chloropentafluoroethane, chlorotrifluoroethylene, butane, dimethyl ether, propane, cyclopropane, propylene, dichlorotetrafluoroethane, octofluorocyclobutane	10
	Ammonia, butadiene, ethylene oxide, monomethylamine, trimethylamine, difluoroethane, hexafluoroethane, monobromomethane, monochloroethane, monochloroethylene, monochloromethane, monofluoroethylene, trifluoroethane	5
Corrosive low-pressure-liquefiable gases	Boron trichloride, carbonyl chloride, chlorine, chlorine trifluoride, nitrogen dioxide, nitrosyl chloride, sulfur dioxide	2
Non-corrosive high-pressure-liquefiable gases	Ethylene, chlorotrifluoroethane, chlorodifluoromethane, chlorodifluoroethane, dichlorodifluoromethane, difluoroethylene, dichlorofluoromethane	10
	Sulfur hexafluoride, trifluoromethane, ethane	5
	Carbon dioxide, nitrogen monoxide	
Corrosive high-pressure-liquefiable gases	Hydrogen chloride, hydrogen sulfide	2

Annex B
(informative)

Procedure to be adopted when it is suspected that a cylinder valve is obstructed

B.1 If there is any doubt when the valve of a gas cylinder is opened that gas is not being released and the cylinder may still contain residual gas under pressure, a check or checks shall be made to establish that the free passage through the valve is not obstructed.

The method adopted shall be a recognized procedure such as the following or one that provides equivalent safeguards:

a) Introduce gas at a pressure of 5 bar and check its discharge.

b) Use the device shown in figure B.1 to pump inert gas into the cylinder by hand.

c) For cylinders of liquefiable gases, check that the total mass of the cylinder is the same as the tare stamped on the cylinder. If there is a positive difference, the cylinder may contain either liquefied gas under pressure or non-pressure contaminants.

B.2 When it is established that there is no obstruction to gas flow in the cylinder valve, the valve may be removed.

B.3 When a cylinder is found to have an obstructed gas passage in the valve or a damaged/inoperable valve, the cylinder shall be set aside for special attention as follows:

a) Saw or drill the valve body until junction is made with the gas passage between the valve body stem and valve spindle seat.

b) Loosen or pierce the safety device in a controlled manner.

These methods are applicable to cylinders of non-toxic, non-flammable gas. Appropriate safety precautions shall be taken to ensure that no hazard results from the uncontrolled discharge of any residual gas.

Where the contents are toxic or flammable, the preferred method is to unscrew partially the valve within a glanded cap, secured and jointed to the cylinder and vented to a safe discharge. The principle requirements of a suitable device are illustrated in figure B.2.

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

Dimensions in millimetres

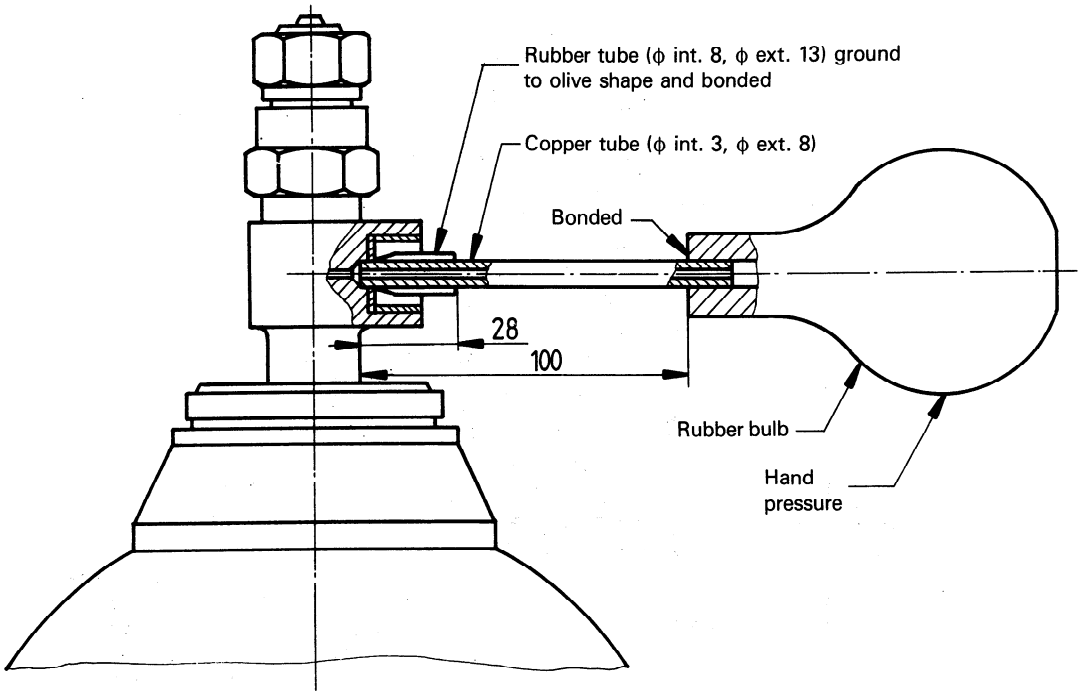

Figure B.1 — Device for detecting an obstructed cylinder valve