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## Gas cylinders — Welded aluminium- alloy, carbon and stainless steel gas cylinders — Periodic inspection and testing

*Bouteilles à gaz — Bouteilles à gaz soudées en alliage d'aluminium,  
carbone et acier inoxydable — 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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see: [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

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

This third edition cancels and replaces the second edition (ISO 10460:2005), which has been technically revised.

The main changes compared to the previous edition are as follows:

- inclusion of text to evaluate welded aluminium-alloy and welded stainless steel cylinders;
- removal of conformity assessment requirements;
- deletion of text on blocked valves as this edition now references a specific standard.

This corrected version of ISO 10460:2018 incorporates the following correction:

- In Table C.1, in the fourth column of the “Stamping” row, the “c” at the end of “Render unserviceablec” has been changed to superscript to lead to a footnote at the bottom of the table.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

This document contains requirements that reflect current practice and experience.

This document provides information and procedures for the periodic inspection and testing of welded cylinders and the condition of the test equipment. The principal aim of periodic inspection and testing is that at the satisfactory completion of the inspection the cylinders may be reintroduced into service for a further period of time.

This document has been written so that it is suitable to be referenced in the UN *Model Regulations*<sup>[1]</sup>.

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# Gas cylinders — Welded aluminium-alloy, carbon and stainless steel gas cylinders — Periodic inspection and testing

**CAUTION — Some of the tests and procedures specified in this document involve the use of processes which could lead to a hazardous situation.**

## 1 Scope

This document specifies the requirements for the periodic inspection and testing of welded aluminium-alloy, carbon and stainless steel gas cylinders of water capacity from 0,5 l to 150 l intended for compressed and liquefied gas service under pressure and to verify the integrity of such gas cylinders for further service.

It also applies, as far as is practical, to cylinders of less than 0,5 l water capacity and greater than 150 l up to 450 l.

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

It is primarily intended for use with cylinders containing industrial gases other than liquefied petroleum gas (LPG). This document may also be applicable to LPG. Requirements for LPG applications are also provided in ISO 10464.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 10286, *Gas cylinders — Terminology*

ISO 11114-1, *Gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 1: Metallic materials*

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

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

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

ISO 13769, *Gas cylinders — Stamp marking*

ISO 22434, *Transportable gas cylinders — Inspection and maintenance of cylinder valves*

ISO 25760, *Gas cylinders — Operational procedures for the safe removal of valves from gas cylinders*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 10286 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at <https://www.iso.org/obp>

— IEC Electropedia: available at <https://www.electropedia.org/>

## 4 Intervals between periodic inspection and testing

A cylinder shall be due for periodic inspection and testing on its first receipt by a filler following the expiry of the established interval, e.g., in accordance with national or international regulations or, in the absence of such regulations, in accordance with the UN *Model Regulations* (packaging instruction P200)<sup>[1]</sup>. The inspection and test expiry date is based on the last test date stamped on the cylinder.

Annex A provides typical periodic inspection intervals. [Annex B](#) provides one example of an existing system to indicate the next periodic inspection date. Other systems are in use.

Provided there is no evidence that the cylinder has been subjected to abusive and/or abnormal conditions (e.g. being involved in an accident, being exposed to excessive heat or other severe conditions) that would render the cylinder unsafe, there is no requirement for the user to return the cylinder for inspection and test before the contents have been used even though the periodic inspection and testing interval has lapsed. However, it is recommended that the user be advised by the supplier to return the cylinder to the supplier once it is empty or if the cylinder is no longer needed by the user.

Shorter periodic inspection intervals than those shown in [Annex A](#) may be considered for applications where the cylinder could be exposed to severe conditions (e.g. marine service).

## 5 Periodic inspection and testing procedures

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### 5.1 General

This document requires that well-trained and competent inspectors, who consult the cylinder's manufacturer if there are any doubts about aspects of the standard, undertake the work as described in this document so that the cylinder manufacturer's current recommendations are taken into account.

Tests and examinations performed to demonstrate compliance with this document shall be conducted using instruments calibrated before being put into service and thereafter according to an established programme.

All cylinders shall undergo periodic inspection and testing. The procedures outlined in [5.2](#) and [5.3](#) shall be performed first and in the order presented. The tests and procedures outlined in [5.4](#), [5.5](#), [5.6](#), [5.7](#), [5.8](#) and [5.9](#) shall be performed after [5.2](#) and [5.3](#) and in any order. However, the order of the tests and procedures presented in this document is recommended.

Some procedures outlined in the following subclauses (e.g. [5.2](#), [5.3.2](#)) are for preparations prior to but not part of periodic inspection.

Cylinders that fail a periodic inspection shall be rejected (the requirements set out in [5.10](#) and [Annex C](#) describe the actions to be taken if a cylinder is rejected).

If the condition of a cylinder that has passed the tests described in [5.2](#), [5.3](#), [5.4](#), [5.5](#), [5.6](#) and [5.8](#) remains in doubt, additional tests shall be performed to confirm its suitability for continued service or the cylinder shall be rendered unserviceable in accordance with [5.10](#).

Depending on the reason for rejection, some cylinders may be returned to service. The requirements for returning a rejected cylinder to service are provided in [5.7](#) and [Annex C](#).

The mechanical properties of cylinders meeting the requirements of this document can be affected by heat. Therefore, the maximum temperature for any operation shall be limited to prevent any adverse effects on the performance of the cylinder when it is returned to service.

Before any work can be carried out, the relevant cylinder data (e.g. the requirements in ISO 13769), its contents and its ownership shall be identified and the owner shall authorize the retest. 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 the cylinder contents are identified as hydrogen or any other embrittling gas, only those cylinders manufactured or qualified for hydrogen service shall be used (see ISO 11114-1). It shall be confirmed that the cylinder is compatible for hydrogen service (e.g. cylinders marked in accordance with ISO 13769 are stamped H). Cylinders that have been used in hydrogen service but not stamped H shall be removed from this service and their suitability for continued use shall be evaluated in accordance with ISO 11621.

## 5.2 Depressurization and devalving procedures

### 5.2.1 Depressurization

Before performing any tests, cylinders shall be depressurized and emptied in a safe, controlled manner (e.g. using a safe and environmentally friendly venting system). Particular attention shall be given to cylinders containing flammable, oxidizing or toxic gases.

Cylinders that have contained a toxic or flammable gas shall be made safe (e.g. by purging with a suitable gas) before carrying out any further operations or inspections.

Refrigerant gases (e.g. chlorofluorocarbons) shall not be released to the atmosphere.

### 5.2.2 Devalving

**WARNING** — The uncontrolled removal of a valve from a cylinder can lead to serious injury, death or property damage. (standards.iteh.ai)

A positive check shall be performed before removing any pressure-retaining accessories (e.g. the cylinder valve or a flange) to ensure that the cylinder does not contain any gas under pressure. A gas retention check shall be performed in accordance with ISO 25760.

Cylinders with inoperative or blocked valves shall be handled in accordance with ISO 25760.

After the requirements described in [5.2.1](#) and [5.2.2](#) have been met, the cylinder valve can be removed.

## 5.3 External visual inspection

### 5.3.1 General

An initial external visual inspection shall be performed on all cylinders before the removal of any paint or coatings to detect whether the cylinders have been subjected to abusive and/or abnormal conditions (e.g. being involved in an accident, being exposed to excessive heat or other severe conditions) that would render them unsafe. If a cylinder appears to be damaged, the damage shall be assessed in accordance with [Annex C](#).

### 5.3.2 Preparation

Each cylinder shall be clean and have all loose coatings (e.g. corrosion products, tar, oil or other foreign matter) removed from its external surface (e.g. by brushing, shot-blasting [under closely controlled conditions], water jet abrasive cleaning or chemical cleaning). The presence of any corrosion products on external or internal surfaces of the cylinder should be noted prior to cleaning.

Externally mounted carrying handles or shrouds that interfere with a complete external visual inspection shall be removed before this inspection is carried out.

The method used to clean the cylinder shall be a validated, controlled process and care shall be taken at all times to avoid damage to the cylinder or the removal of excess amounts of cylinder wall. When

selecting the shot-blasting medium and the process parameters to be used, consider the following to ensure that as far as practicable only the surface coating or contamination is removed from the cylinder:

- medium hardness and shape;
- medium delivery pressure and volume flow rate;
- angle of impingement of the medium onto the surface of the cylinder;
- the temperature of the process itself, including monitoring the temperature of the cylinder surface to maintain it within acceptable limits when a heat source is used.

A cylinder coating (e.g. fused nylon, polyethylene) that is either damaged or prevents a complete external visual inspection shall be removed. If the coating is removed by the application of heat, in no case shall the temperature of the cylinder exceed:

- a) 300 °C for carbon and stainless steel cylinders;
- b) 80 °C for aluminium-alloy cylinders manufactured from non-heat-treated alloys (e.g. AA5283). For temperatures between 70 °C and 80 °C, the exposure time shall be limited to 30 min. If the heat exposure time exceeds 30 min at temperatures greater than or equal to 70 °C, or if at any time the temperature exceeds 80 °C, then agreement shall be obtained from the manufacturer regarding further use of the cylinder;
- c) 175 °C for aluminium-alloy cylinders manufactured from AA 6XXX heat-treated alloys (e.g. AA 6061). Only testing facilities that can control heat input and record time and temperature may heat cylinders. The total cumulative time at temperatures between 110 °C and 175 °C shall be limited to the time recommended by the cylinder manufacturer.

### 5.3.3 Procedure

The external surface of each cylinder, including welds and areas adjacent to them, shall be inspected for:

- a) dents, cuts, gouges, bulges, cracks, laminations or excessive base wear;
- b) heat damage, torch or electric-arc burns (as described in [Table C.1](#));
- c) corrosion (as defined in [Table C.2](#));
- d) other imperfections, e.g. illegible, incorrect or unauthorized stamp markings or unauthorized additions or modifications (as described in [Table C.1](#));
- e) the integrity of all permanent attachments (as described in [C.2](#));
- f) if relevant, base damage (as described in [Table C.1](#)).

When inspecting the cylinder for corrosion or other deposits (e.g. mud in the footring), special attention shall be given to areas where deposits/fluids could be trapped. These areas include but are not limited to the entire base area, the junction between the body and the footring and the junction between the cylinder body and shroud.

### 5.3.4 Inspection result

Cylinders that pass the external visual inspection shall undergo an internal visual inspection as described in [5.4](#).

If there is concern regarding the cylinder's wall thickness after the external visual inspection, the wall thickness may be measured provided the manufacturer's wall thickness requirements are known. When the manufacturer's wall thickness requirements are either not known or are not met, the cylinder shall be rendered unserviceable or set aside pending further investigation.

Rejection criteria are described in [Annex C](#). Cylinders no longer suitable for service shall be rendered unserviceable in accordance with [5.10](#).

## 5.4 Internal visual inspection

### 5.4.1 General

Each cylinder shall be internally inspected using adequate illumination so as to be able to identify any imperfections that are present.

Precautions shall be taken to ensure that the method of illumination used presents no risk to the tester while the inspection is being carried out. For cylinders that have been used in flammable gas service, particular attention shall be paid to selecting the method of illumination used to minimize the risk of igniting any residual gas.

### 5.4.2 Preparation

Any cylinder internal liner or coating that prevents a complete internal visual inspection shall be removed.

### 5.4.3 Cleaning

Cylinders with foreign matter or more than light surface discolouration or staining shall be cleaned internally under closely controlled conditions (e.g. by dry medium blasting, water jet abrasive cleaning, flailing, steam jet, hot water jet, rumbling or chemical cleaning). The cleaning method chosen shall take into account the cylinder material and 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.

The presence of any corrosion products on external or internal surfaces of the cylinder should be noted prior to cleaning. <https://standards.iteh.ai/catalog/standards/sist/433ec0b0-a8e6-4114-bc26-e415119208ea/iso-10460-2018>

If internal cleaning is required, the cylinder shall be visually re-inspected after the cleaning operation has been completed.

Caution shall be taken when applying dry medium blasting on certain welded cylinders (e.g. with joggle joint welds). Beads/pellets can get trapped in the seams during the blasting process, which is difficult to observe during visual inspection. These particles can be released from the seams during use of the cylinder and contaminate the gas.

### 5.4.4 Inspection result

Cylinders that pass the internal visual inspection shall be inspected and treated as described in [5.5](#), [5.6](#), [5.7](#), [5.8](#) and [5.9](#).

If there is concern regarding the cylinder's wall thickness after the internal visual inspection, the wall thickness may be measured provided the manufacturer's wall thickness requirements are known. When the manufacturer's wall thickness requirements are either not known or are not met, the cylinder shall be rendered unserviceable or set aside pending further investigation.

Rejection criteria are described in [Annex C](#). Cylinders no longer suitable for service shall be rendered unserviceable in accordance with [5.10](#).

## 5.5 Cylinder neck inspection

### 5.5.1 Cylinder-to-valve threads

#### 5.5.1.1 All cylinders

When the valve(s) is removed from the cylinder, the cylinder-to-valve threads shall be examined to ensure that they are

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

The threads of cylinders in gas services other than toxic or corrosive service may be verified using appropriate gauges in cases of doubt. For cylinders in toxic or corrosive service, see [5.5.1.2](#) for additional requirements.

Cylinder neck threads that are dirty or exhibit burrs may be rectified. Cylinders with neck threads that are damaged, cracked or exhibit other defects shall be rectified only by an approved process or the cylinders shall be rendered unserviceable in accordance with [5.10](#).

#### 5.5.1.2 Cylinders used in toxic or corrosive service

**WARNING** — Leakage of toxic or corrosive products has the potential to become a serious incident.

[Annex D](#) provides examples of gases that are known to be corrosive to welded steel cylinders.

In addition to the requirements shown in [5.5.1.1](#), the neck threads of cylinders used in toxic or corrosive service shall be examined using an appropriate thread gauge or gauges. For examples on the use of thread gauges, see ISO 11363-2.

If a cylinder's neck threads are examined using a gauge and do not meet the gauging requirements of the valve intended to be used, the cylinder shall be rendered unserviceable in accordance with [5.10](#).

### 5.5.2 Other neck surfaces

Other surfaces of the cylinder neck shall be examined to ensure they are free of cracks or other imperfections. The requirements in [Annex C](#) shall be used to evaluate cylinder imperfections.

Any coating that prevents a complete visual inspection of the cylinder neck shall be removed.

[Figure 1](#) provides an example of a cracked cylinder neck.