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**Gas cylinders — Composite
construction — Periodic inspection
and testing**

*Bouteilles à gaz — Construction composite — 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).

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).

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

For an explanation on 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 WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](http://standards.iteh.ai)

The committee responsible for this document is ISO/TC 58, *Gas cylinders*, Subcommittee SC 4, *Operational requirements for gas cylinders*.

This second edition cancels and replaces the first edition (ISO 11623:2002), which has been technically revised with the following changes:

- up-to-date terminology particularly for the various types of composite cylinders;
- up-to-date normative references for steel and aluminium-alloy liner materials;
- list defects according to severity with an additional set of acceptance/rejection criteria;
- replacement of the procedure regarding obstructed cylinder valve (former Annex A) with a reference to ISO 25760;
- addition of a new, normative Annex B for the internal inspection of translucent composite cylinders;
- information regarding intervals between periodic inspection and testing based on cylinder type, formerly listed in Tables 1 through 4, moved into new, informative Annex C;
- update of some photographs to provide sharper examples of damage.

This corrected version of ISO 11623:2015 incorporated the following correction.

In 12.5, paragraph 1, the word 'followed' has been replaced with 'preceded'.

Introduction

The principal aim of periodic inspection and testing is that at the completion of the test, the cylinders can be reintroduced into service for a further period of time. It is not possible to identify all considerations for periodic inspection and testing of composite cylinders in this International Standard. In such cases or where there is doubt, questions regarding specific cylinders should be directed to the manufacturer or owner.

This International Standard is intended to be used under a variety of national regulatory regimes, but has been written so that it is suitable for the application of the UN Model Regulations (see Reference [1]). Attention is drawn to requirements in the relevant national regulations of the country (countries) where the cylinders are intended to be used that might override the requirements given in this International Standard. Where there is any conflict between this International Standard and any applicable regulation, the regulation always takes precedence.

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Gas cylinders — Composite construction — Periodic inspection and testing

1 Scope

This International Standard specifies the requirements for periodic inspection and testing and to verify the integrity for further service of hoop-wrapped and fully-wrapped composite transportable gas cylinders, with aluminium-alloy, steel or non-metallic liners or of linerless construction (Types 2, 3, 4, and 5), intended for compressed, liquefied or dissolved gases under pressure, of water capacity from 0,5 l up to 450 l.

This International Standard is written to address the periodic inspection and testing of composite cylinders constructed to ISO 11119-1, ISO 11119-2, and ISO 11119-3 standards and can be applied to other composite cylinders designed to comparable standards when authorized by the competent authority.

As far as practicable, this International Standard also can be applied to cylinders of less than 0,5 l water capacity.

2 Normative references

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

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

ISO 6406, *Gas cylinders — Seamless steel gas cylinders — Periodic inspection and testing*

ISO 7225, *Gas cylinders — Precautionary labels*

ISO 10461, *Gas cylinders — Seamless aluminium-alloy gas cylinders — Periodic inspection and testing*

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 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 following terms and definitions apply.

3.1

composite overwrap

fibres (3.3) and *matrix* (3.14) taken together as a combined unit

3.2

exterior coating

layer of material applied to the cylinder as a protective coating not intended to be removed or for cosmetic purposes

EXAMPLE Gel coat and paint.

Note 1 to entry: Not all composite cylinders will have a special exterior coating.

3.3

fibre

load-carrying part of the *composite overwrap* (3.1)

EXAMPLE Glass, aramid or carbon.

3.4

fully-wrapped composite cylinder without liner

cylinder manufactured only from continuous *fibre* (3.3) strands in a *matrix* (3.14) wrapped in both circumferential and longitudinal directions

Note 1 to entry: Also known as Type 5.

3.5

fully-wrapped composite cylinder with liner

steel, aluminium-alloy or non-metallic *liner* (3.10) wrapped with continuous *fibre* (3.3) strands in a *matrix* (3.14) both circumferentially and longitudinally

Note 1 to entry: Also known as either Type 3 (metallic liner) or Type 4 (non-load sharing liner).

3.6

hoop-wrapped composite cylinder

seamless steel or aluminium-alloy *liner* (3.10) wrapped with continuous *fibre* (3.3) strands or steel wire [embedded in a *matrix* (3.14)] around only the cylindrical body of the liner, leaving the metal in the neck and base regions exposed

Note 1 to entry: Also known as Type 2.

3.7

translucent composite cylinder

cylinder that permits the passage of light

3.8

identification label

label containing the permanent markings required by the relevant design specification

3.9

design life

maximum life (in number of years) to which a composite cylinder or tube is designed and approved in accordance with the applicable standard

3.10

liner

inner portion of the composite cylinder designed both to contain the gas and transmit the gas pressure to the *composite overwrap* (3.1)

3.11

non-metallic liner

liner (3.10) made from thermoplastic, thermosetting, or elastomeric material

3.12

protective sleeve

transparent or non-transparent cover fitted to the outside surface of the cylinder

3.13 repair

minor refurbishment to return the cylinder to its acceptable condition

EXAMPLE Adding resin.

3.14 matrix

material used to bind and hold the *fibres* (3.3) in place

Note 1 to entry: The matrix is sometimes called resin.

3.15 rejected cylinder

cylinder not fit for service or which needs to be set aside for further evaluation or testing in its present condition

3.16 Level 1 damage

DEPRECATED: Level 1 condition

minor damage that can occur during normal use

3.17 Level 2 damage

DEPRECATED: Level 2 condition

damage that is more severe than *Level 1* (3.16) and, where *repair* (3.13) is authorized and where the cylinder can be returned to service, or based upon the recommendations of the manufacturer to be classified as Level 1 or *Level 3* (3.18)

3.18 Level 3 damage

DEPRECATED: Level 3 condition <https://standards.iteh.ai/catalog/standards/sist/5e09675e-b245-486e-8de7->

damage that requires a cylinder to be condemned, i.e. rendered unfit for continued service

3.19 bulge

visible swelling of the wall

3.20 crack

split or separation in the material, typically appearing as a line on the surface

3.21 crease

off-colour linear or non-linear feature formed as a result of previous localized over-stressing

3.22 protective attachment

component connected to the cylinder that prevents or resists damage to the composite cylinder

EXAMPLE Casing.

Note 1 to entry: Some protective attachments are designed to be removed at the time of periodic inspection and testing.

4 Due dates for periodic inspection and testing

A cylinder shall be due for periodic inspection and testing on its first receipt by a filler after the expiry of the due date.

NOTE There is no general requirement for the user to return a gas cylinder before the contents have been used even though the test interval has lapsed.

When the design life has expired, the cylinder shall not be refilled and shall be removed from service when presented for the next filling (see [Clause 13](#)).

In some jurisdictions, it is the responsibility of the owner or user to submit cylinders used for emergency purposes for periodic inspection and testing within the specified interval.

5 Procedures for periodic inspection and testing

5.1 List of procedures

The inspection, testing and repair of composite cylinders shall be carried out only by persons competent in the subject to ensure that the cylinders are fit for continued safe use. Care shall be taken to ensure that during the retest procedure, cylinders are handled carefully, particularly with respect to loading in and out of metal pallets, and ensuring cylinders are not dropped to cause any damage.

Each cylinder shall be submitted to periodic inspection and testing. The following procedures form the requirements for this periodic inspection and testing and are explained more fully in this International Standard:

- Identification of cylinder and preparation for periodic inspection and testing (see [Clause 6](#));
- External visual inspection (see [Clause 7](#)); [ISO 11623:2015](https://standards.iteh.ai/catalog/standards/sist/5e09675e-b245-486e-8de7-40fc5559d061/iso-11623-2015)
- Safe removal of valve (see [8.1](#)); [40fc5559d061/iso-11623-2015](https://standards.iteh.ai/catalog/standards/sist/5e09675e-b245-486e-8de7-40fc5559d061/iso-11623-2015)
- Internal inspection and cleaning (see [8.2](#));
- Pressure test (see [Clause 9](#));
- Leak test (see [Clause 10](#));
- Inspection of valve (see [Clause 11](#));
- Final operations (see [Clause 12](#)); and
- Rejection and rendering cylinders unserviceable (see [Clause 13](#)).

The external and internal visual examination (see [Clauses 7](#) and [8](#)) shall be carried out prior to the pressure test (see [Clause 9](#)). It is recommended that the other tests are performed in the sequence listed above; however, when a valve is removed, ISO 25760 shall be observed.

Cylinders that fail inspection or testing shall be rejected (see [Clause 13](#)). When a cylinder passes the above-listed procedures but the condition of the cylinder remains in doubt, additional testing shall be performed to confirm its suitability for continued service or the cylinder shall be rendered unserviceable. Depending on the reason for the rejection, cylinders may be recovered and/or repaired (see [7.4](#)).

5.2 Heat exposure

When cylinders are refurbished during periodic inspection, it might be necessary to expose them to heat, for example, during initial cleaning, or as part of a stoving operation when painting or powder coating the cylinder. This heat exposure can affect the mechanical properties of the liners and/or the finished composite cylinder.

It is therefore essential that information on precise heat-effect temperatures from the cylinder manufacturer be available; in the absence of this information, cylinders shall not be exposed to a temperature exceeding 70 °C during refurbishment. If the cylinder's allowable temperature is greater than 70 °C, then that temperature and the maximum exposure time at that temperature shall be indicated on the cylinder by the manufacturer. Otherwise, the inspector shall obtain documentation indicating the cylinder's suitability for higher temperatures.

6 Identification of cylinder and preparation for periodic inspection and testing

Before any work is carried out, the relevant cylinder markings (e.g. see ISO 13769) and the gas contents (e.g. see ISO 7225) shall be identified. First, the marking shall be checked to ensure that the cylinder in question is within its design life. When composite cylinders have been designed and manufactured for a limited design life, this is indicated on the cylinder marking.

The cylinder shall be depressurized and emptied in a safe, controlled manner before proceeding. Prior to valve removal, the user shall follow procedures described in ISO 25760. In particular, a positive check shall be made to ensure that the cylinder is empty of gas. Provided the requirements as stated in ISO 25760 have been complied with, the cylinder shall be depressurized safely and the valve removed.

Cylinders with unknown gas contents shall be emptied as if the gas is dangerous (i.e. toxic, flammable or oxidizing). When the valve is non-functional, cylinders shall be emptied safely as described in ISO 25760.

7 External visual inspection

7.1 Preparation

7.1.1 The composite material including any exterior coating applied for protection shall never be removed for the visual inspection.

Permanent attachments of the composite cylinder shall not be removed prior to inspection, provided that these attachments are part of the original design and the manufacturer can produce documentation necessary to identify which defects have no adverse effect on the cylinder's integrity.

Markings specific to permanent attachments on the cylinder shall indicate if the attachments must remain in place at the time of the periodic inspection and testing. If such markings are not present, the cylinder manufacturer shall be consulted to establish whether the permanent attachments need to be removed.

7.1.2 When a transparent protective sleeve is used, it may be left in place as long as the composite wrapping can be inspected effectively without its removal.

When a non-transparent protective sleeve is used that is not part of the cylinder design, it shall be removed and only refitted after this inspection and the pressure test.

7.1.3 Each cylinder shall be cleaned and have all loose foreign matter removed from its external surface by a suitable method (e.g. washing, light brushing, controlled water jet cleaning, plastic bead blasting).

Grit and shot blasting are not suitable. Chemical cleaning agents, paint strippers, and solvents shall not be used unless it has been established that they would not have an adverse effect on the cylinder or its materials.

Care shall be taken not to remove any evidence of in-service damage (e.g. heat and fire damage), which could affect the outcome of this inspection (see [Table 1](#)).

Composite cylinders differ from their metal counterparts in that a competent person may repair them when only limited damage has taken place (see 7.4). These limits are defined in Table 1; following this repair, cylinders shall be subjected to a pressure test before being returned to service.

7.2 Inspection procedures

The acceptance/rejection criteria given in Table 1 shall be followed as a minimum. The inspection body shall contact the cylinder manufacturer to establish whether there are less stringent rejection criteria for the particular cylinder design. In case of doubt, the inspection body shall make reference to the design drawing of the cylinder. Hoop-wrapped cylinders as well as those with exposed external metal surfaces, especially at the interface with the composite overwrap, shall be inspected in accordance with the applicable clauses of the relevant standard (i.e. ISO 6406 for steel cylinders and ISO 10461 for aluminium-alloy cylinders).

The external surface shall be inspected for damage to the composite overwrap. There are three levels of damage that shall be considered (see 7.3.3); of these, only two can be repaired (see Table 1).

7.3 Damage

7.3.1 General

Damage to the composite overwrap can appear in many forms, and examples of these are described in 7.3.3 to 7.3.4. The acceptance/rejection criteria are specified in Table 1, which refers to defined damage levels and the types of damage. Care shall be taken to establish the total extent of damage from impact (see 7.3.4.3) and delamination (see 7.3.4.4) as surface appearance might not indicate the full extent of the damage.

Annex A specifies additional damage criteria for steel wire wound, aluminium-alloy cylinders.

Whenever cylinder damage is discovered, the likely cause of the damage shall be investigated.

When damage is caused by installation (e.g. trailer or bundle), severity or conditions of service, or by improper cylinder use, the inspector should advise the cylinder owner of the need to take corrective action to prevent or reduce further cylinder damage, or to prevent damage to a replacement cylinder. Such actions should be developed with the manufacturer of the cylinder and the original installer.

7.3.2 Identification label

If the label is illegible, the manufacturer of the cylinder shall be contacted.

The manufacturer may only affix a supplementary identification label to the cylinder if, as a minimum, the original label's serial number is still clearly legible.

7.3.3 Damage levels

7.3.3.1 General

In the absence of acceptance criteria based upon testing, all Level 2 damage shall be identified as Level 3 damage. The surface of the cylinder shall be inspected for evidence of damage. Damage shall be evaluated in accordance with Table 1.

7.3.3.2 Level 1 damage

Cylinders with no external visual damage or minor damage are categorized as Level 1 damage and are acceptable, hence no repair is required. Such damage normally has no adverse effects on the safety of the cylinder and its continued use. Scratched paint or nicks that have no appreciable depth in metal, or similar damage in the composite cylinder paint or resin where there are no visible frayed fibres, are considered to be of this level of damage.