
**Gas cylinders — Seamless, welded
and composite cylinders for
compressed and liquefied gases
(excluding acetylene) — Inspection at
time of filling**

Bouteilles à gaz — Bouteilles à gaz comprimés et liquéfiés (à l'exception de l'acétylène) sans soudure, soudées et composites — Contrôle au moment du remplissage

ISO 24431:2016

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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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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 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 the following URL: www.iso.org/iso/foreword.html.

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 24431:2006), which has been technically revised with the following changes.

- This edition has been restructured and includes additional provisions for the inspection before, during and after filling of composite cylinders (Types 2 to 5 inclusive).

Introduction

This International Standard covers requirements that reflect current practice and experience.

Each transportable gas cylinder is inspected at the time of filling in order to establish that

- it has no defects which render it unsafe for filling or continued use,
- it can be identified and complies with the relevant requirements with regard to marking (e.g. within test period, labelling, colour coding and completeness of its accessories), and
- its valve functions satisfactorily.

The cylinder filling inspection is carried out exclusively by persons who have the appropriate training and competencies, so as to ensure that each cylinder is safe for continued use.

Guidance and requirements provided in this International Standard allow fillers to determine when cylinders should be rejected for filling. This International Standard is intended to be used as a basis for developing specific operating procedures for a filling operation.

CAUTION — Some of the tests specified in this International Standard involve the use of processes which could lead to a hazardous situation.

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.^[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.

In International Standards, weight is equivalent to a force, expressed in Newtons. However, in common parlance (as used in terms defined in this International Standard), the word “weight” continues to be used to mean “mass”, although this practice is deprecated (see ISO 80000-4).

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Gas cylinders — Seamless, welded and composite cylinders for compressed and liquefied gases (excluding acetylene) — Inspection at time of filling

1 Scope

This International Standard specifies the inspection requirements at the time of filling, and applies to seamless or welded transportable gas cylinders made of steel or aluminium-alloy (Type 1), and for composite transportable gas cylinders (Types 2 to 5 inclusive) for liquefied or compressed gases of a water capacity up to 150 l. It may be applicable to cylinders and tubes with a water capacity between 150 l and 450 l, provided they are inspected and filled as individual cylinders and tubes.

This International Standard does not apply to acetylene cylinders, bundles of cylinders, tubes, multiple-element gas container (MEGCs) or battery vehicles.

This International Standard may also be applicable to LPG. For specific LPG applications, refer to ISO 10691.

For cylinders manifolded in bundles, refer to ISO 11755.

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

ISO 7225, *Gas cylinders — Precautionary labels*

ISO 10460, *Gas cylinders — Welded carbon-steel gas cylinders — Periodic inspection and testing*

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

ISO 11623, *Gas cylinders — Composite construction — Periodic inspection and testing*

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

compressed gas

gas which when packaged under pressure for transport is entirely gaseous at $-50\text{ }^{\circ}\text{C}$

Note 1 to entry: This category includes all gases with a critical temperature less than or equal to $-50\text{ }^{\circ}\text{C}$.

3.2

covering

protective or non-protective, transparent or non-transparent, device or attachment that can interfere with an external visual inspection

3.3

cylinder marking

permanent and durable information on the cylinder required by the relevant design standard and/or ISO 13769 and the regulations in the country(ies) of use

3.4

empty weight

mass of the cylinder including all permanent attachments (e.g. neckring, footring), but excluding the mass of valve, valve cap or valve guard and any coating

Note 1 to entry: See Introduction for terminology regarding weight and mass.

3.5

examination

process having the object of determining a condition by judgement

Note 1 to entry: The examination results in a pass or fail or further measurement, testing or gauging.

[SOURCE: ISO 10286:2015]

3.6

fibre

continuous filament of glass, aramid, carbon or other material

3.7

filler

person (or persons) responsible for *inspection* (3.10) prior to, during and immediately after filling, who has received an appropriate level of training for the work involved

3.8

filling pressure

pressure to which a cylinder is filled at the time of filling

Note 1 to entry: Filling pressure varies according to the gas temperature in the cylinder, which is dependent on the charging parameters and ambient conditions. It is normally higher than the *working pressure* (3.27) (because of the heat of compression) and always less than the test pressure.

3.9

filling ratio

ratio of the mass of gas to the mass of water at 15 °C that would fill completely a cylinder fitted ready for use

Note 1 to entry: Synonyms are filling factor and filling degree, often expressed in kg/l or similar.

[SOURCE: ISO 10286:2015]

3.10

inspection

evaluation of conformity by observation and judgment accompanied as appropriate by measurement, *examination* (3.5), testing or gauging

[SOURCE: ISO 10286:2015]

3.11

liner

inner portion of the composite cylinder comprising a metallic or non-metallic vessel, whose purpose is to both contain the gas and transmit the gas pressure to the composite overwrap

3.12**liquefied gas**

gas which, when packaged under pressure, is partially liquid at temperatures above $-50\text{ }^{\circ}\text{C}$

Note 1 to entry: A distinction is made between

- high pressure liquefied gas, a gas with a critical temperature between $-50\text{ }^{\circ}\text{C}$ and $+65\text{ }^{\circ}\text{C}$, and
- low pressure liquefied gas, a gas with a critical temperature above $+65\text{ }^{\circ}\text{C}$.

3.13**maximum permissible filling weight****maximum permissible filling mass**

maximum mass of gas in kg which is allowed in a filled cylinder

Note 1 to entry: This term applies to *liquefied gas* (3.12).

3.14**pallet**

device for handling several cylinders at the same time

3.15**pressure relief device**

device that protects the cylinder against overpressurization

Note 1 to entry: This is a collective term that includes a bursting disk, fusible plug or pressure relief valve.

3.16**protective attachments**

component (or components) connected to the cylinder that prevents or resists damage to the cylinder and/or valve

Note 1 to entry: Some protective attachments are designed to be removed at the time of requalification or prefill inspection (3.10).

3.17**service life**

number of years a cylinder is permitted to be in service

Note 1 to entry: Usually applied to composite designs, and when required, the service life is marked in accordance with an applicable standard or regulation (e.g. "FINAL 2019/10" in ISO 13769).

3.18**sleeve**

thin *covering* (3.2) fitted to the outside surface of the cylinder such as by stretching or heat shrinking

Note 1 to entry: Some sleeves are designed to be removed at the time of prefill inspection (3.10).

3.19**rejected cylinder**

cylinder not fit for filling in its present condition

3.20**tare**

weight of the cylinder when empty, including accessories fitted and coatings as presented for filling

3.21**total weight****total mass**

tare (3.20) of the cylinder plus the *maximum permissible filling weight* (3.13)

3.22

Type 1 cylinder

all metal cylinder

3.23

Type 2 cylinder

hoop wrapped cylinder with a load sharing metal *liner* (3.11) and composite reinforcement only on the cylindrical (sidewall) part

3.24

Type 3 cylinder

fully wrapped cylinder with a load sharing metal *liner* (3.11) and composite reinforcement on both the cylindrical part and dome ends

3.25

Type 4 cylinder

fully wrapped cylinder with a non-load sharing *liner* (3.11) and composite reinforcement on both the cylindrical portion and the dome ends

[SOURCE: ISO 11119-3:2013]

3.26

Type 5 cylinder

fully wrapped cylinder without a *liner* (3.11) and with composite reinforcement on both the cylindrical portion and dome ends

[SOURCE: ISO 11119-3:2013]

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3.27

working pressure

settled pressure of a *compressed gas* (3.1) at a reference temperature of 15 °C in a full gas cylinder

Note 1 to entry: In North America, service pressure is often used to indicate a similar condition, usually at 21,1 °C (70 °F).

Note 2 to entry: In East Asia, service pressure is often used to indicate a similar condition.

3.28

verification

confirmation, by *examination* (3.5) of objective evidence, that specified requirements have been fulfilled

[SOURCE: ISO 10286:2015]

4 Identification of cylinder owner

Some country's regulations and filling organizations require verification of ownership of the cylinder before filling and forbid to fill cylinders that are not owned by the filling organization except if the owner has authorized filling.

The filler may request technical information from the cylinder owner to verify that the cylinder is safe to fill.

In all cases, if the owner cannot be identified, or if the owner or owner's representative does not authorize the filling of the cylinder, the cylinder shall not be accepted for filling.

5 Filling inspection

5.1 General

Each cylinder shall be inspected by the filler before, during and immediately after filling, as indicated in this Clause.

5.2 Verification of serviceable condition of individual cylinders before filling

5.2.1 General criteria

The filler shall establish that

- a) the information required for filling (e.g. next requalification date, filling pressure, gas identification) is present on the cylinder,
- b) the cylinder and/or valve are not on a prohibited fill list,
- c) the cylinder has not exceeded its due date for periodic inspection and testing,
- d) the cylinder has not exceeded its service life (if applicable),
- e) the cylinder and valve (such as valve outlet, material of construction and specification) are compatible with the intended gas content and the condition (pressure or weight as applicable) to which the cylinder is to be filled,
- f) the cylinder is permitted for filling in the country of the filling station,
- g) the cylinder has not been subject to unauthorized modifications, and
- h) the intended gas contents correspond to any identification label and shoulder or body colour on the cylinder through verification of the cylinder's markings and the colour coding (e.g. by reference to ISO 7225 and ISO 32) or by questioning the owner of the cylinder.

NOTE Not all countries require standardized colours.

Cylinders not meeting these criteria shall be rejected for filling and handled in accordance with [Clause 6](#).

5.2.2 Exterior condition

5.2.2.1 General requirements

Before an individual cylinder can be filled, the filler shall establish that

- a) the cylinder does not show any signs of having undergone any unauthorized modifications, such as but not limited to, welding of attachments to the cylinder or additional stamp markings,
- b) the external surface of the cylinder is clean and free of foreign material (i.e. such that the cylinder can be assessed for physical damage that would prevent it from being filled safely). Possible variations to this are those cylinders fitted with a covering or protective attachment, in which case, the requirements of [5.2.6](#) shall first be considered, and
- c) the cylinder is free from abnormalities as described in ISO 6406, ISO 10460, ISO 10461 or ISO 11623. Typical abnormalities include, but are not limited to
 - arc burns,
 - bulging,
 - cracks,