



**International  
Standard**

**ISO 23802**

**Gas cylinders — Seamless tubes,  
composite tubes and large tubes  
permanently mounted in a frame —  
Periodic inspection and testing**

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**Sample Document**

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ISO copyright office  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://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 document 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)).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at [www.iso.org/patents](http://www.iso.org/patents). ISO shall not be held responsible for identifying any or all such patent rights.

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 for gas cylinders*.

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 is primarily intended for periodic inspection of assemblies with a frame, permanently mounted tubes and composite large tubes, and related equipment for transport of compressed gas.

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# Gas cylinders — Seamless tubes, composite tubes and large tubes permanently mounted in a frame — Periodic inspection and testing

## 1 Scope

This document specifies requirements and gives recommendations for the periodic inspection and testing of permanently mounted tubes of:

- composite with seamless metallic liners;
- composite with non-load-sharing liners;
- seamless steel;

in battery vehicles and multiple element gas containers (MEGCs) including frames and associated equipment (these components are also inspected);

and large tubes of:

- composite with seamless metallic liners;
- composite with non-load-sharing liners;

in modules including frames and associated equipment (these components are also inspected).

## 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 — Vocabulary*

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

ISO 15996, *Gas cylinders — Residual pressure valves — Specification and type testing of cylinder valves incorporating residual pressure devices*

ISO 18119, *Gas cylinders — Seamless steel and seamless aluminium-alloy gas cylinders and tubes — Periodic inspection and testing*

ISO/TS 19016, *Gas cylinders — Cylinders and tubes of composite construction — Modal acoustic emission (MAE) testing for periodic inspection and testing*

ISO 22434, *Gas cylinders — Inspection and maintenance of valves*

ISO 23876, *Gas cylinders — Cylinders and tubes of composite construction — Acoustic emission examination (AT) for periodic inspection and testing*

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.

ISO and IEC maintain terminology 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/>

#### 3.1 element

permanently mounted seamless steel and composite tubes or large tubes

#### 3.2 large tube

element of a module of composite construction, having a water capacity of more than 3 000 litres up to and including 15 000 litres

#### 3.3 equipment

valves, pipes, connectors, instruments, manifold, grounding system, fire protection systems, vent pipes and other components in the module and which enable the module to be used for transport of gas

#### 3.4 valve

component intended for control of the gas flow to, within and from the module

Note 1 to entry: This includes shutdown valves, closure valve, instrument valves, check valves, safety valves.

#### 3.5 manifold

pipework system for connecting valves or fittings for receptacles or large tubes in an assembly to a main valve(s) or the main connection(s)

#### 3.6 assembler

company that installs the elements and the equipment in a frame

Note 1 to entry: The assembler may be considered a manufacturer in some standards and regulations.

#### 3.7 frame

structural and non-structural members of either a bundle, a multiple element gas container (MEGC) or equivalent assembly which combine all other components together, while providing protection for the assembly's elements, valves and manifold, and which enable the assembly to be transported

#### 3.8 panel

cladding used to protect elements from UV radiation and foreign material, and as indicator of external impacts

#### 3.9 module

assembly of frame, elements, and related equipment

Note 1 to entry: In case of a MEGC, the module is the complete MEGC.

#### 3.10 permanently mounted

requiring tools for installation and removal

## 4 Preparation for periodic inspection and tests

### 4.1 General

Periodic inspection and test shall include an external examination of the frame, elements and equipment.

If identification of the elements, i.e. part number and serial number, is not possible while in the frame, either the frame shall be disassembled, or the element shall be disassembled from the frame as required to identify the elements.

The inspection, repair and testing of the module shall be carried out only by competent persons in a suitable facility. Care shall be taken to ensure safety during the inspection procedure.

Applicable regulations for assessing conformity with this document can exist in the countries of use. Tests and examinations performed to demonstrate conformity shall be conducted using instruments calibrated before being put into service and thereafter according to an established programme.

If any element or the manifold is removed from the frame during the retest procedure or related operations, a completely new assembly check shall be performed and documented in accordance with any type approval of the module, the design code and mounting instructions used for the original assembly.

Disassembling is an option for elements or equipment where visual external inspection of elements or equipment has pointed out impacts or other damage on the elements but may not be necessary to fully disassemble if some of the elements or equipment are not involved in the impact or other damage.

Risk handling of elements shall be considered linked to their size and weight.

Upon receipt of the module for inspection, the gas content and pressure within the module shall be identified and recorded.

The inspector should obtain inspection information and service documents from the original assembler and report(s) of any prior inspection(s) of the module from the owner of the module.

Before any work is carried out, the relevant element data (part numbers and serial numbers) and ownership shall be identified, and the original module approval made available to the inspection body.

These data shall be in accordance with the label on the module.

### 4.2 Safety precautions/depressurization of manifold and individual elements

The module shall be electrically connected or grounded before removing gas or inspecting the module.

Elements and equipment shall be depressurized to atmospheric pressure in a safe, controlled manner before carrying out any inspection or test work on an individual element if the element is to be internally inspected. Pressurized elements are allowed as required for non-destructive examination (NDE) inspection methods.

Particular attention shall be given to modules containing flammable, oxidizing, corrosive or toxic gases to eliminate risks at the initial inspection stage, e.g. by purging the element, tubing and associated fittings and components as required, prior to disconnecting equipment or removal of elements from the module. Purging shall be accomplished through introduction of an inert gas into the system so that risk of combustion, corrosion, or toxicity is removed.

A positive check shall be performed prior to the removal of pressure-retaining devices to ensure these devices are isolated from all pressure sources. This check shall be performed as described in ISO 25760.

Residual pressure valves and non-return valves shall be safely overridden to ensure that the elements are fully depressurized in accordance with the requirements of ISO 15996, when required.

When valves are found to be inoperative or blocked, the elements affected shall be depressurized in accordance with documented procedures. In the case of elements disassembled from module and not equipped with valves, the tube fittings shall be checked to determine whether the gas is able to pass freely from the tube.

Additional information for the depressurisation of the module may be available in the manufacturer's operating and inspection manual. In case of composite type 4 tubes and large tubes, vacuum shall not be formed at any time, unless otherwise explicitly allowed. The manufacturer may specify a value for residual pressure in the elements during inspection if the elements are not dismantled. Procedures for safe handling, depressurization, as applicable for the module shall be available at the authorized inspection site.

### 4.3 Inspection of module

Modules should be inspected in accordance with [Clause 5](#) unless all requirements in [Clause 6](#) are fulfilled.

Modules with large tubes should preferably be inspected without disassembling in accordance with [Clause 6](#).

NOTE inspection in accordance with [Clause 5](#) is a common practice for tubes of water capacity up to 3 000 L

#### 4.3.1 Inspection of frame

Whenever the frame is intended to be reused, it shall be inspected for any signs of corrosion, contamination, deformation or fracture. If defects are found, they shall be repaired, or the frame rendered unserviceable.

All frame members and their joints including welds shall be visually inspected for deformation, cracks and corrosion. If doubt exists regarding the integrity of the frame, the coating shall be removed, and the frame inspected using an appropriate method, e.g., dye penetrant. A non-destructive examination method, e.g. X-ray, ultrasonic, dye penetrant, shall be carried out following any structural repair to the frame to verify the integrity of the weld. The coating shall be repaired after any inspection or repair where the coating is removed or altered.

ISO 17638, ISO 23278 or another applicable International Standard may be used to confirm the presence of cracks.

There shall be sufficient access to all frame panels and covers so they can be removed in order to properly carry out the inspection.

Module lifting devices shall be inspected for defects or cracks. If defects or cracks are found, the lifting device shall be repaired or rendered unserviceable, and a crack detection report shall be written. A non-destructive examination method, e.g., X-ray, ultrasonic, dye penetrant, shall be carried out following any structural repairs to the lifting devices to verify the integrity of the weld.

If the frame or the lifting devices, or both, require repair, the repair shall conform to the original specification, or be approved by the owner and a competent person or by the manufacturer.

All fasteners shall be in place and the torque checked in accordance with the manufacturer's instruction. Lost and broken fasteners shall be replaced in conjunction with inspection of associated brackets.

Structural members and panels that have been deformed or impacted can be replaced with new members and panels meeting the original design and specification requirements.

Weld crack longer than 1 % of the weld length shall be blunted to prevent further growth. Crack longer than 5 % of the weld length shall be repaired.

Any repair procedure shall be approved by the owner and the manufacturer and by the authority having jurisdiction if required. If the manufacturer no longer exists, then a competent person, knowledgeable of the MEGC or module components, shall approve the repair.

#### 4.3.2 Inspection of fixation of elements

##### 4.3.2.1 General

Confirm fasteners are in-place and properly torqued.

#### 4.3.2.2 Inspection of saddles

Saddles, if used, shall be checked for deformation, cracks, aging, corrosion or other signs of degradation. Isolation pads, if used, shall be checked for significant wear in at least 3 accessible saddles selected by the inspector and be replaced if needed. If significant wear is identified, the MEGC shall be disassembled in accordance with [Clause 5](#).

#### 4.3.2.3 Inspection of neck mounts

Neck mounts, if used, shall be inspected for deformation, cracks, and corrosion. Confirm there is no evidence of significant wear on the mounting. If significant wear is identified, the neck mounting elements shall be replaced by parts meeting the module specifications.

### 4.4 Inspection of fire protection system (if equipped)

Confirm the specified fire protection systems, vent pipes and caps are installed and conform to their specifications.

The inspection shall include a detailed visual examination of all components that encompass the fire protection system as well as a leak test of the pressurized components. Perform the following and any other items, in accordance with instructions given by the manufacturer.

- Inspect the trigger lines and components for indications of damage.
- check piping and connections for leaks.

NOTE Methods can include liquid leak detector or combustible gas detectors.

- Repair leaks as necessary.
- Check the vent lines for debris and water and ensure vent pipes are not plugged.
- Check vent caps are in place on all vents if caps are required in the design specification.

All vent pipes connected to a pressure relief device (e.g. a TPRD), which are normally unpressurized, shall be checked for proper mounting, properly assembled so as to avoid leaks, and that the accessories and fittings are in accordance with the design standard used.

## 5 Inspection of a module when disassembling

### 5.1 Preparation for inspection

The following procedures, when applicable, form the requirements for such inspections and tests.

- a) identification of the module, including elements, valves, manifold and frame, and preparation for inspections and tests;
- b) depressurization of manifold and individual elements;
- c) disassembly of the module including de-valving in accordance with [4.2](#) and the safe removal of tube fittings;

NOTE The removal of the valves is not always necessary when elements are examined by a non-destructive test method.

Inspection and testing shall be performed in accordance with [5.2](#) to [5.5](#).

## 5.2 Inspection of elements

### 5.2.1 Tubes

Type I tubes shall be inspected and tested in accordance with ISO 18119. This can include the use of ultrasonic testing (UT) as a non-destructive test (NDT) method. Alternatively, ISO 16148 (acoustic emission testing) may be used.

Type II, III and IV tubes shall be inspected and tested in accordance with ISO 11623. The following non-destructive test methods may be used:

- acoustic emission test (AT) in accordance with ISO 23876;
- modal acoustic emission (MAE) in accordance with ISO TS 19016.

NDT methods need the acceptance of the authorized body

### 5.2.2 Large tubes

Large tubes shall be inspected and tested in accordance with [Annex A](#). The following non-destructive test methods may be used when approved or recognized,

- acoustic emission test (AT) in accordance with ISO 23876;
- modal acoustic emission (MAE) in accordance with ISO TS 19016.

ISO 11623 and ISO 18119 are applicable for tubes up to 3 000 l. For large tubes a specific external visual inspection shall be based on instructions from the manufacturer; ISO 11623 or ISO 18119 may offer additional guidance as applicable.

## 5.3 Inspection of equipment

### 5.3.1 General

Equipment shall be safely removed from the frame. Any available recommendations from original manufacturer shall be considered to perform such operation.

If any part of the existing frame, manifold or valves are intended to be reused, the relevant equipment shall be inspected and evaluated to be in accordance with the original specification.

The examination shall ensure that:

- a) the piping, valves, and gaskets are inspected for corroded areas, defects, and other conditions, including leakage of gaskets and connections, that might render the module unsafe for filling, discharge or transport;
- b) missing or loose bolts or nuts on any flanged connection or blank flange are replaced or tightened;
- c) all emergency devices and safety valves are free from corrosion, distortion and any damage or defect that could prevent their normal operation;
- d) spindle operated shut off valves shall be operated between full open to closed position;
- e) ball valves shall be operated from full open to closed position and to verify that valve handle and stop pins are correct positioned;
- f) remote closure devices and self-closing stop valves shall be operated to demonstrate proper operation;
- g) required marks on the equipment are legible and in accordance with the applicable requirements; and
- h) the framework, the supports and the arrangements for lifting the module are in satisfactory condition.