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Gas cylinders — Cylinder bundles — Periodic inspection and testing

Bouteilles à gaz — Cadres de bouteilles — Contrôles et essais périodiques

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Foreword

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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 World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: 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*.

Introduction

The principal aim of a periodic inspection and testing procedure is that, at the completion of the test, the cylinder bundles may be reintroduced into service for a further period of time.

Periodic inspection and testing of cylinder bundles is carried out in conjunction with the retest period of the cylinders within the bundle in order to comply with national and regional transport regulations.

If there are any doubts, inspectors should consult the bundle/cylinder's manufacturer so that the manufacturer's current recommendations are taken into account.

This document 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[10].

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

Gas cylinders — Cylinder bundles — Periodic inspection and testing

CAUTION — Some of the tests 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 cylinder bundles containing compressed, liquefied and dissolved gas.

NOTE Additional requirements for acetylene cylinder bundles are provided in Annex A.

This document also establishes general principles for the maintenance of cylinder bundles.

This document is not applicable to acetylene bundles with solvent-free acetylene cylinders.

This document excludes the requirements for cylinder bundles when they are a part of a battery vehicle. For some specific applications, e.g. offshore, additional requirements can apply.

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

ISO 10462, *Gas cylinders — Acetylene cylinders — Periodic inspection and maintenance*

ISO 10961, *Gas cylinders — Cylinder bundles — Design, manufacture, testing and inspection*

ISO 11372, *Gas cylinders — Acetylene cylinders — Filling conditions and filling inspection*

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

ISO 14113, *Gas welding equipment — Rubber and plastics hose and hose assemblies for use with industrial gases up to 450 bar (45 MPa)*

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

ISO 18119[1)], *Gas cylinders — Seamless steel and seamless aluminium-alloy gas cylinders and tubes — Periodic inspection and testing*

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*

1) To be published.

3 Terms and definitions

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

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

— IEC Electropedia: available at http://www.electropedia.org/

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

3.1
compressed gas
gas, which, when packaged under pressure for transport, is entirely gaseous at −50 °C

Note 1 to entry: This category includes all gases with a critical temperature less than or equal to −50 °C.

[SOURCE: ISO 10286:2015, 705]

3.2
liquefied gas
gas, which, when packaged under pressure, is partially liquid (or solid) at temperatures above −50 °C

Note 1 to entry: A distinction is made between:

— high pressure liquefied gas, a gas with a critical temperature between −50 °C and +65 °C;

— low pressure liquefied gas, a gas with a critical temperature above +65 °C.

[SOURCE: ISO 10286:2015, 706, modified — Note 1 to entry has been added.]

3.3
dissolved gas (under pressure)
gas, which when packaged under pressure for transport, is dissolved in a liquid phase solvent

[SOURCE: ISO 10286:2015, 709]

3.4
main valve
valve which is fitted to the *manifold* (3.11) of a *bundle* (3.5), isolating it from the *main connection(s)* (3.12)

[SOURCE: ISO 10286:2015, 267, modified — "battery vehicle/battery wagon/MEGC" has been deleted.]

3.5
bundle of cylinders
cylinder bundle
assembly of *cylinders* (3.7) that are fastened together and which are interconnected by a *manifold* (3.11) and transported as a unit having a total water capacity not exceeding 3 000 l except that bundles intended for the transport of toxic gases shall be limited to 1 000 l total water capacity

Note 1 to entry: In ISO/TC 58 standards, the term "bundle" is frequently used for simplification.

[SOURCE: ISO 10286:2015, 204]

3.6
frame
structural and non-structural members of a *bundle* (3.5) that combine all other components together, while providing protection for the bundle's *cylinders* (3.7), valves and *manifold* (3.11) and which enable the bundle to be transported

[SOURCE: ISO 10286:2015, 264]

3.7
gas cylinder
cylinder
transportable pressure receptacle of a water capacity not exceeding 150 l

Note 1 to entry: In ISO/TC 58 standards, the term “gas cylinder” is frequently used for clarification.

[SOURCE: ISO 10286:2015, 201]

3.8
cylinder valve
valve that is fitted into a cylinder and to which a *manifold* (3.11) is connected in a *bundle* (3.5)

3.9
cylinder fitting
component with no gas shut-off capability that serves as a method for connecting a bundle's *manifold* (3.11) to its individual cylinders when *cylinder valves* (3.8) are not fitted to the cylinders

3.10
fitting
connecting piece, of one or more parts having no shut-off function

3.11
manifold
piping system for connecting pressure receptacle(s) valves or *cylinder fittings* (3.9) to the *main valve(s)* (3.4) or the *main connection(s)* (3.12)

[SOURCE: ISO 10286:2015, 265]

3.12
main connection
means of making a gas connection to a *bundle* (3.5)

[SOURCE: ISO 10286:2015, 266, modified — “battery vehicle/MEGC” has been deleted.]

3.13
tare
<general> weight of the pressure receptacle when empty, including accessories fitted as presented for filling

[SOURCE: ISO 10286:2015, 745]

3.14
maximum gross weight
<cylinder bundle> sum of the *tare* (3.13) of the *bundle* (3.5) and the maximum permissible filling weight

Note 1 to entry: To be understood as “maximum gross mass” as per regional transport regulations.

[SOURCE: ISO 10286:2015, 743, modified — Note 1 to entry has been added.]

3.15
test pressure
required pressure applied during a pressure test

3.16
working pressure
<compressed gas> settled pressure of a *compressed gas* (3.1) at a uniform temperature of 288 °K (15 °C) in a full *bundle* (3.5)

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, usually at 35 °C.

[SOURCE: ISO 10286:2015, 736, modified — "gas cylinder" has been replaced by "bundle".]

3.17
competent person
person who has acquired through training, qualifications or experience, or a combination of these, the knowledge and skills enabling that person to perform a specified task

EXAMPLE The specified tasks can include periodic inspection, testing, welding, etc.

3.18
filling pressure
pressure to which a *cylinder* (3.7) is filled at the time of filling

Note 1 to entry: It varies according to the gas temperature in the cylinder, which is dependent on the charging parameters and the ambient conditions. It is normally higher than the *working pressure* (3.16) (because of the heat of compression) and always less than the *test pressure* (3.15).

[SOURCE: ISO 10286:2015, 734]

3.19
inspection body
independent inspection and testing body approved by the *competent authority* (3.20)

[SOURCE: ISO 10286:2015, 621]

3.20
competent authority
any body or authority designated or otherwise recognized as such for any purpose in each country by its government

Note 1 to entry: "Competent body" is not to be used; UN Model Regulations[10] only use "competent authority" and "*inspection body*" (3.19).

[SOURCE: ISO 10286:2015, 620]

4 Procedures for periodic inspections and tests

4.1 General

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.

4.2 Periodic inspection and tests

Each bundle shall be submitted to periodic inspections and tests. The following procedures, when applicable, form the requirements for such inspections and tests and are explained more fully in Clause 5:

a) identification of the bundle, i.e. cylinders, valves, manifold and frame, and preparation for inspections and tests;

b) depressurization of manifold and individual cylinders;

c) disassembly of the bundle including devalving in accordance with ISO 25760 and the safe removal of cylinder fittings;

NOTE The removal of the valve is not always necessary when cylinders are examined ultrasonically.

d) cylinder periodic inspection and testing in accordance with ISO 10460, ISO 10462, ISO 11623 or ISO 18119;

e) inspection of the frame, manifold, fittings and valve condition;

f) bundle reassembly and testing.

5 Inspections and tests

5.1 General

Depending upon the nature of the operation, an existing bundle may, upon dismantling, be reassembled using the same frame, cylinders and components. Alternatively, frames, cylinders and components may be interchanged for ease of operation during the periodic inspection and testing, provided these parts are in compliance with the type approval of the bundle.

If a replacement of any part of the bundle takes place at any stage during the periodic inspection and testing, the new parts shall be compatible with the original design type specification and the tare of the bundle shall be adjusted if necessary.

5.2 Identification of cylinders/bundles and preparation for inspections and tests

Upon receipt of the bundle for inspection, the gas content within the bundle shall be identified.

Before any work is carried out, the relevant cylinder data and ownership shall be identified and the bundle type approval made available to the inspection body, if necessary.

5.3 Depressurization of manifold and individual cylinders

WARNING — Safety measures shall be taken to protect personnel carrying out the periodic inspection and testing of bundles due to the considerable damage that could be caused from the stored energy if released. The uncontrolled removal of valves from the elements of the bundle can lead to injury, death or property damage. Additional precautions shall be taken when the bundle has been used in flammable gas service.

Cylinders and any pressure-retaining devices, e.g. valves, fittings, hoses, pigtails or piping, shall be depressurized to atmospheric pressure and emptied in a safe, controlled manner before carrying out any inspection or test work on the individual cylinders.

Particular attention shall be given to cylinders containing flammable, oxidizing, corrosive or toxic gases to eliminate risks at the internal inspection stage, e.g. by purging the cylinders and associated fittings prior to devalving and removal from the bundle.

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 cylinders are fully depressurized in accordance with the requirements of ISO 15996.

Main or cylinder valves that are found to be inoperative or blocked shall be depressurized in accordance with the requirements of ISO 25760. In the case of cylinders disassembled from bundles and not equipped with cylinder valves, the cylinder fittings shall be checked to determine whether the gas is able to pass freely from the cylinders, e.g. using the device shown in ISO 25760.

WARNING — Failing to follow ISO 25760 requirements can cause loss of life, injury and/or property damage.

Provided the requirements described in this clause have been met, the manifold and cylinders may be depressurized safely and the corresponding valves may be removed.

5.4 Disassembly of the bundle

The bundle components shall be safely removed from the frame in accordance with the requirements of 5.3.

5.5 Periodic inspection and testing of cylinders

Cylinders shall be subjected to periodic inspection and testing as specified for the particular cylinder type in accordance with ISO 10460, ISO 10462, ISO 11623 or ISO 18119.

In lieu of the test methods specified in ISO 18119, an acoustic emission test in accordance with ISO 16148 may be applied.

5.6 Inspection of the frame, manifold and valve condition

5.6.1 General

If any portion of the existing frame, manifold and/or valves is intended to be reused, the relevant equipment shall be inspected in accordance with the following requirements.

5.6.2 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.

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, ultra-sonic, dye penetrant, shall be carried out following any structural repair to the frame to verify the integrity of the weld.

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

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

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, ultra-sonic, dye penetrant, shall be carried out following any structural repairs to the lifting devices to verify the integrity of the weld.

If the frame and/or lifting devices require repair, care shall be taken that they comply with the original design specification after repair.

5.6.3 Manifolds

Whenever the manifold is intended to be reused, it shall be visually inspected for damage, fire traces and local material abrasion. The manifold shall be clean and degreased depending on the type of gas and its purity. When repairs are necessary, they shall be carried out by a competent person in accordance with a written procedure that meets the requirements of ISO 10961.

If a manifold is reused, it shall be subjected to a pressure test and leak checked in accordance with the requirements of ISO 10961 or the original design specification. If a new manifold is used, it does not have to be retested at time of periodic inspection provided it was pressure tested after manufacturing.

5.6.4 Valves and fittings

Valves that are to be reused in the bundle shall be inspected and maintained in accordance with the requirements of ISO 22434.

If new valves are fitted, they shall conform to the type approval of the bundle.

If a valve is replaced, the new valve shall be compatible with both the gas and the test pressure of the bundle. The main valve shall not protrude from the frame.

Fittings shall be inspected for defects, e.g. thread damage. If the fitting fails this inspection, it shall be repaired or replaced.

5.7 Bundle reassembly and testing

When the bundle is reassembled, the following requirements shall be met. These steps may be performed in a different order depending on the bundle design.

a) All pressure retaining devices may be reused if they pass a visual examination. Valves may be reused if they meet the requirements of ISO 22434. When repairs or replacement are necessary, they shall be carried out by a competent person in accordance with a written procedure that meets the requirements of ISO 10961.

b) An internal inspection of each cylinder shall be performed immediately prior to installing a valve or fitting to ensure that the cylinder is not contaminated. This step is not applicable to acetylene cylinders. Additional requirements for the periodic inspection and testing of acetylene bundles are specified in Annex A.

c) The manifold shall be attached to the cylinder valves/fittings on the cylinders one by one. Appropriate torque values shall be used depending on the type of thread and sealing material used. For the manifold fittings, appropriate torque values shall be used depending on the type of thread and sealing material used. All sealing material used shall be new and compatible with the intended gas service. Sealing surfaces of reused parts shall ensure a gas tight connection.

d) Depending on the bundle design, the main valve(s) may be preassembled to the manifold or assembled after the manifold has been attached to the cylinders.

e) Any detachable parts, e.g. manifold protection, plates or covers, that have been removed from the bundle shall be refitted or replaced.

f) A leak test may not be required as a part of periodic inspection. When requested for compressed gases, a pneumatic leak test using dry, oil-free air, nitrogen, helium or a nitrogen/helium mixture shall be performed. Leak test pressures used may depend on local requirements. For liquefied gases, the leak test pressure shall be the developed pressure. This test may be performed at the time of the first fill after the periodic inspection and test of the bundle using the gas for which the bundle is intended.

6 Stamp marking

After completion of the periodic inspection and testing, the bundle identification plate, e.g. as specified in ISO 10961, shall be permanently stamp marked with the date of the periodic inspection (shown as YYYY/MM) preceded by the registered mark of the inspection body.

The indication of the next periodic inspection date is not a requirement of this document. It may be required to satisfy local regulations.

7 Documentation

Records of the components used to assemble a bundle and of the history of how and where the bundle was assembled and tested shall be maintained for every retested and reassembled bundle.

The bundle documentation prepared in accordance with ISO 10961 shall be modified to include the data of any new cylinders or other components incorporated into the bundle.

These records shall contain at least the following:

a) the unique serial number of the bundle;

b) the unique serial number of the frame, when available;

c) the gas service for which the bundle is intended;

d) the total water capacity of the bundle in litres (for liquefied gases);

e) the working pressure of the cylinders in the bundle (for compressed gases that are filled under pressure);

f) the test pressure of the bundle (in accordance with the test pressure of the cylinders);

g) the previous date(s) of periodic inspections and testing;

h) the serial numbers of the cylinders in the bundle;

i) the symbol and/or number and country of the inspection body;

j) the name and address of the approved inspection body;

k) the date of the periodic inspection and test;

l) the crack detection report (see 5.6.2);

m) the tare (for liquefied gases);

n) the maximum gross weight;

o) the certificate of conformity, when applicable.

Test records of individual components or batches of components shall be maintained such that they may be cross-referenced to individual bundle records. These test records shall cover the original manufacture, repair and periodic inspection and test.

All records shall be maintained by the owner of the bundle for at least as long as required.