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Gas cylinders — Cylinder bundles — Design, manufacture, testing and inspection

Bouteilles à gaz — Cadres de bouteilles — Conception, fabrication, essais et inspection

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Contents

Page

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 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.

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 10961:2010), which has been technically revised.

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

— the terminology was brought in line with ISO 10286, as far as possible,

— storage was added throughout the document as a possible use case,

— the descriptions of the drop tests were clarified,

— the descriptions of the leak tests were clarified,

— a new figure was added showing the angle for the vertical drop test,

— the rotating drop test has been differentiated by whether the bundle is fitted with cylinders vertically or horizontally,

— the additional requirements for acetylene cylinder bundles were clarified,

— the information for the bundle identification for filling was moved to Annex C.

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 https://www.iso.org/members.html.

Introduction

For some applications, the contents of an individual gas cylinder might not satisfy the gas demand, in which case assemblies of cylinders can be used to supply larger volumes of gas in a single unit. The single unit, which contains a number of cylinders, is known as a cylinder bundle.

Such a cylinder bundle is a portable assembly, designed to be routinely lifted, that consists of a frame and two or more cylinders connected to a manifold by cylinder valves or fittings so that the cylinders can be filled, transported and emptied without disassembly.

A cylinder bundle can be subjected to rough handling in the course of normal operations.

There are types of gas cylinder assemblies that use cylinder bundle components but are designed to be disassembled at each filling to enable the cylinders to be filled individually. Although these assemblies do not conform to the basic definition of a cylinder bundle, they are commonly referred to as bundles. Their special requirements are provided in Annex A.

Acetylene cylinder bundles are often filled without disassembly. The confirmation of solvent content can be achieved with or without disassembling the bundle. Replenishing of solvent is usually done after a defined number of fillings. Their special requirements are provided in Annex B.

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”, but this practice is deprecated (see ISO 80000-4).

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

Gas cylinders — Cylinder bundles — Design, manufacture, testing and inspection

1 Scope

This document specifies the requirements for the design, construction, testing and initial inspection of a transportable cylinder bundle.

It is applicable to cylinder bundles containing cylinders containing compressed gas, liquefied gas and mixtures thereof. It is also applicable to cylinder bundles for acetylene. Additional requirements for acetylene cylinder bundles containing acetylene in a solvent are provided in Annex B. This document does not, however, cover acetylene cylinder bundles with solvent-free acetylene cylinders.

This document specifies the additional requirements that apply when individual cylinders are assembled into a bundle. Unless otherwise stated, individual cylinders within a cylinder bundle conform to applicable standards for single cylinders.

This document is intended primarily for industrial gases other than liquefied petroleum gas (LPG), but it can also be used for LPG.

This document does not apply to packages in which cylinders are manifolded together in a frame that is designed to be fixed permanently to a road vehicle, to a railway wagon or to the ground as a customer storage vessel. It also does not apply to cylinder bundles that are designed for use in extreme environmental or operational conditions (e.g. offshore cylinder bundles) when additional and extraordinary requirements are imposed to maintain safety standards, reliability and performance.

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 3807, *Gas cylinders — Acetylene cylinders — Basic requirements and type testing*

ISO 9606-1, *Qualification testing of welders — Fusion welding — Part 1: Steels*

ISO 10297, *Gas cylinders — Cylinder valves — Specification and type testing*

ISO 10286:2015, *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 13585, *Brazing — Qualification test of brazers and brazing operators*

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

ISO 15607, *Specification and qualification of welding procedures for metallic materials — General rules*

ISO 15615:2013, *Gas welding equipment — Acetylene manifold systems for welding, cutting and allied processes — Safety requirements in high-pressure devices*

ISO 16964, *Gas cylinders — Flexible hoses assemblies — Specification and testing*

EN 13134, *Brazing — Procedure approval*

3 Terms and definitions

For the purposes of this document, the terms and definitions 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
cylinder bundle
bundle of cylinders
assembly of cylinders that are fastened together and interconnected by a manifold and transported as a unit having a total water capacity not exceeding 3 000 l

Note 1 to entry: In ISO/TC 58 documents the term “bundle” is frequently used for simplification.

Note 2 to entry: Bundles intended for the transport of toxic gases shall be limited to 1 000 l total water capacity.

[SOURCE: ISO 10286:2015, 204, modified — preferred term and admitted term reversed, "which are" deleted and requirement for toxic gases moved into Note 2 to entry]

3.2
frame
structural and non-structural members of a bundle that combine all other components together, whilst providing protection for the bundle's cylinders, *valves* (3.3) and *manifold* (3.5) and which enable the bundle to be transported

[SOURCE: ISO 10286:2015, 264]

3.3
cylinder valve
valve that is fitted into a cylinder and to which a *manifold* (3.5) is connected in a *bundle* (3.1)

3.4
cylinder fitting
component with no gas shut-off capability that serves as a method for connecting a bundle's *manifold* (3.5) to its individual cylinders when *cylinder valves* (3.3) are not fitted to the cylinders

3.5
manifold
piping system for connecting pressure receptacle(s) valves or *fittings* (3.4) to the *main valve(s)* (3.6) or the *main connection(s)* (3.7)

[SOURCE: ISO 10286:2015, 265]

3.6
main valve
valve which is fitted to the *manifold* (3.5) of a *bundle* (3.1), isolating it from the *main connection(s)* (3.7)

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

3.7
main connection
means of making a gas connection to a *bundle* (3.1)

[SOURCE: ISO 10286:2015, 266, modified — battery vehicle/MEGC deleted]

3.8
tare
weight of the pressure receptacle when empty, including accessories fitted as presented for filling

Note 1 to entry: Additional information regarding tare for acetylene cylinder bundles is provided in B.2.

3.9
maximum gross weight
sum of the tare of the *bundle* (3.1) and the maximum permissible filling weight

Note 1 to entry: Maximum gross weight is to be understood as "maximum gross mass" as per regional transport regulations.

[SOURCE: ISO 10286:2015, 743, amended — Note 1 to entry added]

3.10
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]

3.11
liquefied gas
gas, which, when packaged for transport, is partially liquid (or solid) at temperatures above –50 °C

Note 1 to entry: A distinction is made between

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

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

[SOURCE: ISO 10286:2015, 706, modified — Note 1 to entry added to incorporate definitions in ISO 10286:2015, 707 and 708]

3.12
test pressure
required pressure applied during a pressure test

Note 1 to entry: In some cases, the test pressure of the bundle can be different from the test pressure of the cylinders in the bundle.

[SOURCE: ISO 10286:2015, 729, modified — Note 1 to entry added]

3.13
burst pressure
highest pressure reached in a cylinder during a burst test

Note 1 to entry: The burst pressure also applies to hoses and manifolds.

[SOURCE: ISO 10286:2015, 732, modified — Note 1 to entry added]

3.14
working pressure
<compressed gas> settled pressure of a compressed gas at a uniform reference temperature of 15 °C in a full cylinder bundle

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 — "in a full gas cylinder" substituted with "in a full cylinder bundle"]

3.15
maximum filling weight
product of the minimum guaranteed water capacity of the pressure receptacle and the filling ratio of the gas contained

Note 1 to entry: For liquefied gas.

[SOURCE: ISO 10286:2015, 740]

3.16
toxic gas
gas which is known to be so toxic or corrosive to humans to pose a health hazard or which is presumed to be toxic or corrosive to humans because it has a LC_{50} value for acute toxicity equal to or less than 5 000 ml/m^3 (ppm)

Note 1 to entry: Other risks such as tissue corrosiveness are sometimes associated.

[SOURCE: ISO 10286:2015, 716]

3.17
filling pressure
pressure to which a cylinder bundle 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 (because of the heat of compression) and always less than the test pressure.

[SOURCE: ISO 10286:2015, 734, modified — "cylinder" substituted with "cylinder bundle"]

3.18
bundle manufacturer
entity that assembles the various components of the bundle into its final configuration

3.19
inspection body
body that performs inspection

Note 1 to entry: An inspection body can be an organization, or part of an organization.

[SOURCE: ISO/IEC 17020:2012, 3.5]

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*[1] only use "competent authority" and "inspection body."

[SOURCE: ISO 10286:2015, 620]

3.21
saturation gas
<acetylene> amount of acetylene needed to saturate the solvent at atmospheric pressure and a temperature of 15 °C

4 Design

4.1 General

The design of the bundle shall allow for the:

— inspection of all parts of the manifold for leaks during filling without obstructions;

— operation of all valves without requiring removal of any items such as shielding or a grill for the protection of the manifold.

All pressurized components shall, as a minimum requirement, be designed to operate safely (e.g. impact transition temperature for steels) in the temperature range of –20 °C to +65 °C. Operating at temperatures outside this range can require that cylinders, valves and fittings be designed for the appropriate temperature range.

Bundles that are filled by weight shall use component parts that are removable only with the use of tools, with the exception of the main valve outlet protection cap.

If the bundle is intended for acetylene or toxic liquefied gas service, it shall be designed to allow individual cylinders to be removed from the frame for filling in accordance with Annex A to ensure that these cylinders are not overfilled.

4.2 Materials

Materials for cylinders, valves and all parts that are in contact with the intended gas shall be selected in accordance with ISO 11114-1 or ISO 11114-2. Specific requirements for materials for dissolved acetylene are given in B.3.7.

The materials of construction of the frame shall be verified to be in accordance with the approved drawings.

4.3 Frame

4.3.1 The frame shall securely retain all components of the bundle, protect them from damage that can cause leaks, and minimize corrosion on all external surfaces of the cylinder. Such damage can be caused by environment, vibration, impact loads, storage loads or handling loads that can be expected in normal operation. The method of cylinder restraint shall minimize any vertical or horizontal movement or rotation of the cylinder. Any cylinder displacement that would impose undue strain on the manifold shall be prevented (see 7.2.2). The total assembly shall fulfil the requirements given in 7.2.

Additionally, lifting of the bundle shall cause no leakage of gas (see 4.3.2).

4.3.2 The frame shall include features designed for the handling, storage and transportation of the bundle. Bundles can typically be lifted by forklift, lift-jack trolley or overhead crane. If the bundle is designed to be lifted by an overhead crane, lifting eyes shall be provided on the frame. Different designs with one or more lifting eyes are permitted.

NOTE National regulations can be applicable when lifting eyes are used.

In all cases, lifting eyes shall be designed to withstand a design load of 2 times the maximum gross weight of the bundle. Bundles with more than one lifting eye shall be designed so a minimum sling leg angle α of 45° to the horizontal can be achieved during lifting using the lifting eyes (see Figure 1).