INTERNATIONAL STANDARD

ISO 10961

First edition
2010-01-15

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

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

Reference number
ISO 10961:2010(E)

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Published in Switzerland

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 10961 was prepared by Technical Committee ISO/TC 58, *Gas cylinders*, Subcommittee SC 4, *Operational requirements for gas cylinders*.

Introduction

For some applications, the contents of an individual gas cylinder may 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.

A cylinder bundle is a portable assembly which is designed to be routinely lifted and which 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 assembly which use cylinder bundle components, but which 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 included in Annex A.

Acetylene cylinder bundles are often filled without disassembly. However, in order to confirm their solvent content, they are disassembled after a defined number of fillings.

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

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

1 Scope

This International Standard specifies the requirements for the design, construction, testing and initial inspection of a transportable cylinder bundle. It is applicable to cylinder bundles containing compressed gas, liquefied gas and mixtures thereof. It is also applicable to cylinder bundles for acetylene.

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

Some special applications (e.g. electronics) require an alternative design approach. With the agreement of the inspection body, the manifold and its piping components may be designed and tested at a pressure which is appropriate to the service conditions.

Specific requirements for acetylene cylinder bundles containing acetylene in a solvent are included in Annex B. This International Standard does not, however, cover acetylene cylinder bundles with solvent-free acetylene cylinders.

This International Standard is intended primarily for industrial gases other than liquefied petroleum gases (LPGs), but it may also be used for LPGs.

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

2 Normative references

The following referenced documents are indispensable for the application 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 7225, *Gas cylinders — Precautionary labels*

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

ISO 13769, *Gas cylinders — Stamp marking*

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
cylinder bundle
bundle
portable assembly which consists of a frame and two or more cylinders, each of a capacity up to 150 litres and with a combined capacity of not more than 3 000 litres, or 1 000 litres in the case of toxic gases, connected to a manifold by cylinder valves or fittings such that the cylinders are filled, transported and emptied without disassembly

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

3.3
cylinder valve
valve which is fitted into a cylinder and to which a manifold is connected in a bundle

3.4
cylinder fitting
component, with no gas shut-off capability, which serves as a method for connecting a bundle's manifold to its individual cylinders when cylinder valves are not fitted to the cylinders

3.5
manifold
piping system for connecting cylinder valves or cylinder fittings to the main valve(s) or main connection(s)

3.6
main valve
valve which is fitted to the manifold and which is used for the isolation of the bundle

3.7
main connection
means of making a gas connection to a bundle

3.8
tare weight
weight of the bundle when empty of gas product

3.9
maximum gross weight
sum of the tare weight of the bundle and the maximum permissible filling weight

3.10
compressed gas
gas which, when packaged under pressure, is entirely gaseous at –50 °C (including all gases with a critical temperature $\leqslant$ –50 °C)

[GHS]

3.11
liquefied gas
gas which, when packaged under pressure, is partially liquid at temperatures above –50 °C

[GHS]

NOTE A distinction is made between:

a) high-pressure liquefied gas: a gas with a critical temperature between –50 °C and +65 °C, and

b) low-pressure liquefied gas: a gas with a critical temperature above +65 °C.

3.12
proof test pressure
hydraulic pressure which demonstrates the structural integrity of the manifold

3.13
burst pressure
〈gas cylinder bundles〉 highest pressure reached in a cylinder or the bundle manifold during a burst test

NOTE Adapted from ISO 10286.

3.14
working pressure
settled pressure for a compressed and dissolved gas at a uniform temperature of 288 K (15 °C) for a full bundle

3.15
bundle test pressure
test pressure of the cylinder and manifold assembled together

3.16
maximum permissible filling weight
product of the minimum guaranteed water capacity of the cylinders of the bundle and the filling ratio of the gas contained

3.17
very toxic gas
gas with an LC_{50} of less than or equal to 200 ppm (*V/V*), where the LC_{50} value corresponds to one hour of exposure to gas and ppm (*V/V*) indicates parts per million, by volume

NOTE Adapted from ISO 10298.

3.18
toxic gas
gas with an LC_{50} of more than 200 ppm but less than or equal to 5 000 ppm, where the LC_{50} value corresponds to one hour of exposure to gas and ppm (*V/V*) indicates parts per million, by volume

NOTE Adapted from ISO 10298.

3.19
filling pressure
pressure to which a bundle is filled at the time of filling

3.20
bundle manufacturer
entity that assembles the various components of the bundle into its final configuration

3.21
inspection body
independent inspection and testing body approved by the competent authority

[*UN Model Regulations*]

3.22
competent authority
any national body or authority designated or otherwise recognized as such, having jurisdiction for the transport of dangerous goods and the approval of gas cylinders

NOTE Adapted from *UN Model Regulations*.

4 Design

4.1 General

The design of the bundle shall take into consideration its ease of assembly, inspection and operation.

All pressurized components shall, as a minimum requirement, be designed to operate safely in the temperature range –20 °C to +65 °C.

Where service temperatures outside this range are required, the bundle design shall include additional requirements (e.g. specific sealing material). Bundles that are filled by weight shall not feature component parts which are de-mountable without the use of tools, with the exception of the main valve outlet protection cap.

4.2 Material

Materials for cylinders, valves and all parts which are in contact with the intended gas shall be selected in accordance with the relevant International Standards on compatibility (e.g. ISO 11114-1 and ISO 11114-2).

4.3 Frame

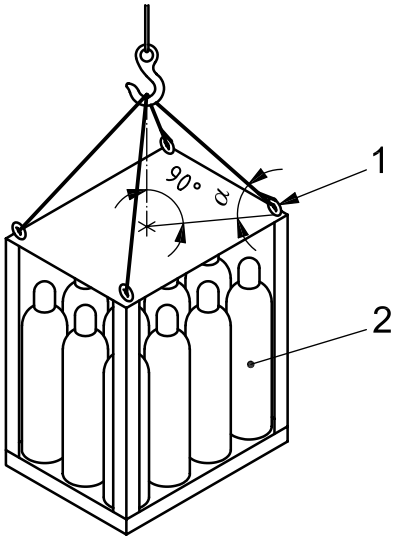
4.3.1 The frame shall retain securely all the components of the bundle and shall protect them from damage which might cause leaks. Such damage can be caused by vibration, impact loads or handling loads which can be expected in normal operation. The method of cylinder restraint shall minimize any vertical or horizontal movement or rotation of the cylinder. All cylinder displacement which would impose undue strain on the manifold (see 7.2.2.2) shall be prevented. The total assembly shall be capable of withstanding rough handling, including being dropped or toppled.

Additionally, no leakage of gas shall be caused during the lifting of the bundle (see 4.3.2).

4.3.2 The frame shall include features designed for the handling and transportation of the bundle. Bundles can typically be lifted by fork-lift, 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 might be applicable when lifting eyes are used.

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



Key

1 lifting eye
2 gas cylinder bundle
α sling leg angle

Figure 1 — Minimum sling leg angle

Where four lifting eyes are used, their design shall be such that they are strong enough to allow the bundle to be lifted by only two.

Where two or four lifting eyes are used, diametrically opposite lifting eyes shall be aligned with each other to allow correct lifting using shackle pins.

Lifting equipment shall be designed so that it does not interfere with any pressurized component, e.g. the manifold.

When a bundle is designed to be moved by fork-lift truck, it shall feature two fork apertures on each side from which it is to be lifted. The fork apertures shall be positioned symmetrically about the centre of gravity and their size shall be appropriate to the forks used to move the bundle. The fork apertures shall be designed such that the bundle cannot accidentally disengage from the forks.

4.3.3 Frame structural members shall be designed for a vertical load of 2 × the maximum gross weight of the bundle. Design stress levels shall not exceed 0,9 × the yield strength of the material.

4.3.4 The frame design shall ensure that there are no protrusions from the exterior frame structure which could cause hazards.

4.3.5 There shall be no features in which water and debris can collect to increase the tare weight of bundles filled by weight, or cause corrosion.

4.3.6 The floor of the bundle frame shall not buckle under normal operational conditions and shall facilitate the drainage of water and debris from around the base of the cylinders.

4.3.7 The design shall ensure stability under normal operating conditions. The centre of gravity shall stay within the footprint of the bundle when rotated to an angle of not more than 12° in both directions.

4.3.8 If the frame design includes any movable doors or covers, these shall be capable of being secured in position with latches, which shall not be capable of being dislodged by operational impact loads.