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Gas cylinders — Refillable welded steel cylinders containing materials for sub-atmospheric gas packaging (excluding acetylene) — Design, construction, testing, use and periodic inspection

Bouteilles à gaz — Bouteilles en acier soudées rechargeables contenant des matériaux pour le stockage des gaz à une pression sub-atmosphérique (à l'exclusion de l'acétylène) — Conception, fabrication, essais, utilisation et contrôle périodique

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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).

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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 3, *Cylinder design*.

This second edition cancels and replaces the first edition (ISO 11513:2011), which has been technically revised. The main changes compared to the previous edition are as follows:

— references to packing instruction P200 of the UN Model Regulations have been replaced with packing instruction P208 as this document is referenced in only P208 of the UN Model Regulations;

— the prohibition on the use of ultrasonic testing during periodic inspection and test has been removed from Annex B;

— the unit “weight” has been replaced with “mass” to align with ISO 80000.

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.

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Introduction

This document provides a specification for the design, manufacture, use and periodic inspection and testing of a welded steel cylinder necessary to facilitate sub-atmospheric pressure gas packaging technology on a worldwide basis. The specifications given are based on knowledge of, and experience with, materials, design requirements, manufacturing processes and control at manufacture of cylinders in common use in the countries of the ISO member bodies.

The pressure shell of the cylinder is fabricated by manufacturing a cylindrical shape with a base and welding a machined plug (boss) or semi-ellipsoidal or torispherical shape onto the open end of the shell to form the cylinder. This method of fabrication allows for insertion of material prior to sealing the cylinder.

A further objective of this document is to balance design and economic efficiency against international acceptance and universal utility. It aims to eliminate the concerns about climate, duplicate inspections and restrictions currently existing because of lack of definitive International Standards.

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

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Gas cylinders — Refillable welded steel cylinders containing materials for sub-atmospheric gas packaging (excluding acetylene) — Design, construction, testing, use and periodic inspection

1 Scope

This document specifies minimum requirements for the material, design, construction, workmanship, examination and testing at manufacture of refillable welded steel cylinders for the sub-atmospheric pressure storage of liquefied and compressed gases. It only applies to the cylinders themselves, irrespective of the materials contained therein (e.g. adsorbents, media, materials and/or gases) and other related applications. The cylinders have a test pressure not greater than 42 bar and a water capacity from 0,5 l up to and including 12 l exposed to ambient temperatures for the purpose of facilitating the sub-atmospheric pressure storage of liquefied and compressed gases as adsorbed gases.

Minimum requirements for inspection at the time of fill and periodic inspection and testing are also specified.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitute 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 4136, *Destructive tests on welds in metallic materials — Transverse tensile test*

ISO 4978, *Steel sheet and strip for welded gas cylinders*

ISO 5817, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections*

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 7438, *Metallic materials — Bend test*

ISO 9809-3:2010, *Gas cylinders — Refillable seamless steel gas cylinders — Design, construction and testing — Part 3: Normalized steel cylinders*

ISO 10286, *Gas cylinders — Terminology*

ISO 11117, *Gas cylinders — Valve protection caps and valve guards — Design, construction and tests*

ISO 13769, *Gas cylinders — Stamp marking*

ISO 15614-1, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys*

ISO 17636-1, *Non-destructive testing of welds — Radiographic testing — Part 1: X- and gamma-ray techniques with film*

ISO 17637, *Non-destructive testing of welds — Visual testing of fusion-welded joints*

ISO 17639, *Destructive tests on welds in metallic materials — Macroscopic and microscopic examination of welds*

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3 Terms, definitions and symbols

3.1 Terms and definitions

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

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

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

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

3.1.1
yield strength
value corresponding to the lower yield strength, R_{eL}, or 0,92 · the upper yield strength, R_{eH}, or for steels that do not exhibit a defined yield, the 0,2 % proof strength, $R_p0{,}2$

3.1.2
stress relieving
heat treatment given to the drawn pressure shell by heating to a uniform temperature below the lower critical point, AC_1, of the steel and cooling in a still atmosphere

Note 1 to entry: The object is to reduce the residual stresses without altering the metallurgical structure of the steel.

3.1.3
batch
quantity of finished cylinders made consecutively during the same or consecutive days to the same design, size and material specifications and cast for each pressure-containing part on the same equipment and subjected to the same heat-treatment conditions

Note 1 to entry: Different suppliers can be used for the different pressure-containing parts within a batch, e.g. one supplier for shells, another for plugs.

3.1.4
F
design stress factor
ratio of equivalent wall stress at test pressure, p_h, to guaranteed minimum yield strength, R_{eg}

3.1.5
sub-atmospheric gas packaging
gas source package that stores and delivers gas at sub-atmospheric pressure, which includes a container (e.g. gas cylinder and outlet valve) that stores and delivers gas at a pressure of less than 1 bar at normal conditions of temperature and pressure

Note 1 to entry: The container can incorporate a medium in order to reduce the pressure of the gas to sub-atmospheric levels.

3.2 Symbols

a calculated minimum thickness, in millimetres, of the cylindrical shell

a' guaranteed minimum thickness, in millimetres, of the cylindrical shell (including any corrosion allowance, see 8.1)

a_1 guaranteed minimum thickness, in millimetres, of a concave base at the knuckle (see Figure 1 a)

a_2 guaranteed minimum thickness, in millimetres, at the centre of a concave base (see Figure 1 a)

b calculated minimum thickness, in millimetres, of the cylinder end

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