INTERNATIONAL STANDARD

ISO 11118

Second edition
2015-09-15

Gas cylinders — Non-refillable metallic gas cylinders — Specification and test methods

Bouteilles à gaz — Bouteilles à gaz métalliques non rechargeables — Spécifications et méthodes d'essai

Reference number
ISO 11118:2015(E)

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

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).

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 meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary Information

The committee responsible for this document is ISO/TC 58, *Gas cylinders*, Subcommittee SC 3, *Cylinder design*.

This second edition cancels and replaces the first edition (ISO 11118:1999) and ISO 13340:2001, which have been technically revised with the following changes:

— removed references to dissolved gases from the Scope;

— the edition aligns ISO 11118 and EN 12205;

— incorporates ISO 13340 in ISO 11118;

— incorporated new titles of ISO referenced documents;

— incorporated definitions and use of R_{ea}, R_{eg}, R_{ma}, and R_{mg};

— clarified requirements for the processing of carbon steel to avoid strain aging;

— added pierceable metal membranes to cylinder non-refillability;

— added test requirement for aluminium materials for intercrystalline corrosion for seamless and welded aluminium cylinders;

— included alternative temperatures for artificial aging of carbon steel cylinder prior to burst testing;

— modified markings to align with UN requirements;

— clarified inspection criteria for each cylinder;

— corrected references to correct Annexes;

— modified burst pressure to align with other ISO Standards;

— aligned test pressure requirement of non-refillable sealing device to the same as the cylinder;

— modified Annex B for completeness;

— deleted existing Annex C since it was not needed and inserted a new Annex C for accuracy;

— added new informative Annex D for informational purposes on yield point elongation (YPE).

Introduction

This International Standard addresses the general requirements on design, construction, and initial inspection and testing of non-refillable metallic gas cylinders and their non-refillable sealing devices of the United Nations Recommendations on the Transport of Dangerous Goods: Model Regulations. The purpose of this International Standard is to provide a specification for the design, manufacture, inspection, and testing of non-refillable metallic gas cylinders for worldwide safe use, handling, and transport.

The objective is to balance design and economic efficiency against international acceptance and universal utility.

This International Standard aims to eliminate the concern about climate, duplicate inspections, and restrictions currently existing because of lack of definitive International Standards. This International Standard does not reflect on the suitability of the practice of any nation or region.

Gas cylinders — Non-refillable metallic gas cylinders — Specification and test methods

1 Scope

This International Standard specifies minimum requirements for the material, design, inspections, construction and workmanship, manufacturing processes, and tests at manufacture of non-refillable metallic gas cylinders of welded, brazed, or seamless construction for compressed and liquefied gases including the requirements for their non-refillable sealing devices and their methods of testing.

NOTE The specific gases permitted in cylinders constructed to this International Standard can be limited by national or international requirements.

This International Standard is applicable to cylinders where

a) the test pressure does not exceed 250 bar (i.e. $p_h \leq 250$ bar) for liquefied gases and 450 bar for compressed gases;

b) the product of the test pressure and the water capacity does not exceed 1 000 bar·litres (i.e. $p_h V \leq 1\,000$ bar L);

c) the test pressure exceeds 45 bar and the water capacity does not exceed 5 l (i.e. for $p_h > 45$ bar, then $V \leq 5$ l).

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3651-2, *Determination of resistance to intergranular corrosion of stainless steels — Part 2: Ferritic, austenitic and ferritic-austenitic (duplex) stainless steels — Corrosion test in media containing sulfuric acid*

ISO 4706:2008, *Gas cylinders — Refillable welded steel cylinders — Test pressure 60 bar and below*

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

ISO 7866:2012, *Gas cylinders — Refillable seamless aluminium alloy gas cylinders — Design, construction and testing*

ISO 9329-1, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 1: Unalloyed steels with specified room temperature properties*

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

ISO 9809-1:2010, *Gas cylinders — Refillable seamless steel gas cylinders — Design, construction and testing — Part 1: Quenched and tempered steel cylinders with tensile strength less than 1 100 MPa*

ISO 9809-4:2014, *Gas cylinders — Refillable seamless steel gas cylinders — Design, construction and testing — Part 4: Stainless steel cylinders with an Rm value of less than 1 100 MPa*

ISO 10156, *Gases and gas mixtures — Determination of fire potential and oxidizing ability for the selection of cylinder valve outlets*

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

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 15613, *Specification and qualification of welding procedures for metallic materials — Qualification based on pre-production welding test*

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 20703:2006, *Gas cylinders — Refillable welded aluminium-alloy cylinders — Design, construction and testing*

3 Terms and definitions

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

3.1
batch
quantity of completed and pressure tested cylinders made consecutively by the same manufacturer using the same manufacturing techniques to the same design, size, and material specifications using the same type of welding machines (when applicable), welding procedures (when applicable), and to the same heat treatment conditions (when applicable)

Note 1 to entry: See Clause 10 for details.

3.2
cylindrical shell
portion of the cylinder excluding the cylinder ends which is parallel to the centreline axis of the cylinder

3.3
cylinder shell
empty cylinder before affixing the *non-refillable sealing device* (3.12), but including all other permanent attachments

3.4
material certificate
document issued by the material manufacturer which certifies the chemical analysis, mechanical properties, heat treatment, processing techniques, or other properties/features if required

3.5
burst pressure
highest pressure reached in a cylinder during the burst test

3.6
test pressure
required pressure applied during the pressure test

3.7
working pressure
settled pressure of compressed gas at a uniform reference temperature of 15 °C (288 K) in a full gas cylinder

3.8
minimum operating temperature
minimum ambient temperature to which the cylinder contents can be exposed, but not exceeding –20 °C

Note 1 to entry: See 5.1.6.

3.9
non-refillable cylinder
cylinder including a *non-refillable sealing device* (3.12) that permits the cylinder to be filled only once

Note 1 to entry: Where there is no risk of ambiguity, the short abbreviated form "cylinder" is used in this International Standard.

3.10
water capacity
volume of water required to completely fill an empty cylinder

3.11
processor
facility that anneals, rolls, slits, or otherwise, changes the material from the form received from the location where the steel was melted

3.12
non-refillable sealing device
device permanently attached to the cylinder which, once activated, prevents the cylinder from being refilled

4 Symbols

a	calculated minimum thickness, in millimetres, of the cylindrical shell
D	nominal outside diameter of the cylinder, in millimetres
F	design stress factor (variable)
P_b	burst pressure of the cylinder, in bar
p_h	test pressure, in bar above atmospheric pressure
p_w	working pressure, in bar above atmospheric pressure
p_{vt}	non-refillable sealing device test pressure, in bar above atmospheric pressure
R_{ea}	actual value of the yield strength, in megapascals, of the cylinder when tested
R_{eg}	minimum guaranteed value of the yield strength, in megapascals, for the finished cylinder
R_{ma}	actual value of the tensile strength, in megapascals, of the cylinder when tested
R_{mg}	minimum guaranteed value of the tensile strength, in megapascals, for the finished cylinder
V	water capacity of the cylinder, in litres

5 Materials

5.1 General requirements

5.1.1 Cylinder shells shall be made of carbon or low alloy steels, austenitic stainless steel, aluminium, or aluminium alloys. The materials used shall be specified by type (see 5.2) and chemical composition (see 5.3). Materials shall not contain seams, cracks, laminations, or other injurious defects. For material requirements of non-refillable sealing devices, see Annex A.

5.1.2 The cylinder manufacturer shall specify the chemical and mechanical requirements to the material supplier.

5.1.3 The cylinder manufacturer shall obtain a material certificate from the manufacturer/processor of the material certifying the chemical analysis of the cast. The certificate shall be issued by the manufacturer of the material and shall confirm compliance to the material specification.

5.1.4 The cylinder manufacturer shall verify that the materials are in accordance with the cylinder manufacturer specifications.

5.1.5 All materials used in the construction of the pressure containing parts of the cylinder shall be traceable.

5.1.6 All materials shall be suitable for use at the minimum operating temperature or at –20 °C, whichever is the lower.

5.1.7 The materials used for manufacture of the cylinder shell shall be compatible with the intended gas service as specified in ISO 11114-1 or ISO 11114-2.

5.1.8 Contact between dissimilar metals which could result in damage by galvanic corrosion shall be avoided.

5.2 Material types

5.2.1 Carbon and low-alloy steels

5.2.1.1 The steel used for the fabrication of gas cylinder shells shall be made in an electric furnace or, by the basic oxygen process, shall have non-ageing properties and shall be fully killed by aluminium and/or silicon.

5.2.1.2 Carbon steel for cold deep drawn seamless, welded, or brazed cylinder shells shall have non-ageing properties, processed free of stretcher strain, and shall be fully killed with aluminium and/or silicon. The chemical composition shall meet the requirements of 5.3.1.1.

5.2.1.3 Carbon steel for other welded cylinder shells shall have a chemical composition which meets the requirements of 5.3.1.2. The maximum tensile strength shall not exceed 700 MPa.

5.2.1.4 Carbon steel for cylinder shells made from seamless steel tubing with integrally formed ends, hot drawn, and finished shall have a chemical composition which meets the requirements of 5.3.1.3.

5.2.1.5 Low alloy steels shall conform to ISO 4706:2008, 5.9.1 or ISO 9809-1:2010, 6.1, 6.2, and 6.3

5.2.2 Aluminium and aluminium alloy

5.2.2.1 Aluminium alloys with a tensile strength greater than 500 MPa shall not be used.

5.2.2.2 Aluminium alloys used for cylinders shall conform to the material requirements of ISO 7866:2012, 6.1 and 6.2 or ISO 20703:2006, 4.1 and 4.2, as appropriate.

5.2.2.3 Pure aluminium is permitted and shall have a minimum aluminium content of 99,0 %.

5.2.3 Austenitic stainless steels

5.2.3.1 For austenitic stainless steels, the maximum tensile strength shall not exceed 800 MPa.

5.2.3.2 The cylinder manufacturer shall take into consideration the loss of material strength within the heat affected zone of any weld.

5.2.3.3 Austenitic stainless steels for all types of cylinder shells shall conform to ISO 9809-4:2014, 6.1 and 6.2.

5.2.3.4 Due to the risk of sensitization to inter-granular corrosion resulting from hot working/welding for each material specification and heat-treatment method, a corrosion test shall be carried out according to ISO 3651-2 on a specimen taken from a finished cylinder.

Some grades of stainless steels can be susceptible to environmental stress corrosion cracking. Special precautions should be taken in such cases.

5.3 Chemical compositions

5.3.1 Carbon and low-alloy steels

5.3.1.1 Carbon steels having non-aging properties for cold deep drawn welded or brazed cylinder shells shall have the following chemical composition limits in % mass fraction.

Carbon	≤0,12
Manganese	≤0,50
Phosphorus	≤0,025
Sulfur	≤0,025

5.3.1.2 Carbon steels for welded cylinder shells other than cold deep drawn shall have the following chemical composition limits in % mass fraction.

Carbon	≤0,25
Manganese	≤0,50
Phosphorus	≤0,025
Sulfur	≤0,025

5.3.1.3 Carbon steels for cylinders made of seamless steel with integrally formed ends, hot drawn, and finished shall have the following chemical composition limits in % mass fraction.

Carbon	≤0,55
Manganese	≤1,70
Phosphorus	≤0,025
Sulfur	≤0,025

5.3.2 Aluminium and aluminium alloys

Aluminium and aluminium alloys shall have a maximum lead and bismuth contents not exceeding 0,003 % each.