
**Gas cylinders — Refillable seamless steel
gas cylinders — Design, construction and
testing —**

Part 2:

**Quenched and tempered steel cylinders
with tensile strength greater than or equal
to 1 100 MPa**

*Bouteilles à gaz — Bouteilles à gaz rechargeables en acier sans
soudure — Conception, construction et essais —*

*Partie 2: Bouteilles en acier trempé et revenu ayant une résistance à la
traction supérieure ou égale à 1 100 MPa*



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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 9809-2 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 9809-2:2000), which has been technically revised.

- a) the reduction of maximum sulfur content in 6.2.2 from 0,010 % to 0,005 %, which is now applicable to all strength levels;
- b) the note in 7.3 regarding limitation of the F factor was deleted (as required by the United Nations *Recommendations on the Transport of Dangerous Goods: Model Regulations*);
- c) the modification of provisions for ultrasonic examination in 8.4 to include ultrasonic examination on the cylindrical area to be closed, prior to the forming process;
- d) the addition of the requirement of a base check according to 9.2.6 for all cylinder types during prototype testing;
- e) the addition of the requirement of a base check according to 9.2.6 for cylinders made from continuously cast billet material during batch testing.

ISO 9809 consists of the following parts, under the general title *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*
- *Part 2: Quenched and tempered steel cylinders with tensile strength greater than or equal to 1 100 MPa*
- *Part 3: Normalized steel cylinders*

Stainless steel cylinders with tensile strength of less than 1 100 MPa will form the subject of a part 4.

Introduction

This part of ISO 9809 provides a specification for the design, manufacture, inspection and testing of a seamless steel cylinder for worldwide usage. The objective is to balance design and economic efficiency against international acceptance and universal utility.

ISO 9809 (all parts) aims to eliminate existing concern; about climate, duplicate inspections and restrictions because of a lack of definitive International Standards. This part of ISO 9809 should not be construed as reflecting on the suitability of the practice of any nation or region.

This part of ISO 9809 addresses the general requirements on design, construction and initial inspection and test of pressure receptacles of the United Nations *Recommendations on the Transport of Dangerous Goods: Model Regulations*.

It is intended to be used under a variety of regulatory regimes, but is suitable for use with the conformity assessment system in 6.2.2.5 of the above-mentioned Model Regulations.

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Gas cylinders — Refillable seamless steel gas cylinders — Design, construction and testing —

Part 2:

Quenched and tempered steel cylinders with tensile strength greater than or equal to 1 100 MPa

1 Scope

This part of ISO 9809 specifies minimum requirements for the material, design, construction and workmanship, manufacturing processes, examination and testing at manufacture of refillable quenched and tempered seamless steel gas cylinders of water capacities from 0,5 l up to and including 150 l for compressed, liquefied and dissolved gases. This part of ISO 9809 is applicable to cylinders with a maximum tensile strength $R_{ma} \geq 1\,100$ MPa. It is not applicable to cylinders with $R_{ma, max} > 1\,300$ MPa for diameters > 140 mm and guaranteed wall thicknesses $a' \geq 12$ mm and $R_{ma, max} > 1\,400$ MPa for diameters ≤ 140 mm and guaranteed wall thicknesses $a' \geq 6$ mm, because beyond these limits, additional requirements can apply.

NOTE 1 If desired, cylinders of water capacity less than 0,5 l and between 150 l and 500 l can be manufactured and certified to be in compliance with this part of ISO 9809.

NOTE 2 For quenched and tempered steel cylinders with maximum tensile strength less than 1 100 MPa, see ISO 9809-1. For normalized steel cylinders, see ISO 9809-3.

NOTE 3 Grades and strength ranges of steels used for these types of cylinders might not be compatible with some gas service (see 6.1.4) and operational conditions.

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 148-1, *Metallic materials — Charpy pendulum impact test — Part 1: Test method*

ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method*

ISO 6508-1, *Metallic materials — Rockwell hardness test — Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T)*

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

ISO 7438, *Metallic materials — Bend test*

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

ISO 9712, *Non-destructive testing — Qualification and certification of personnel*

ISO 11114-1, *Transportable gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 1: Metallic materials*

ISO 13769, *Gas cylinders — Stamp marking*

3 Terms and definitions

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

**3.1
batch**
quantity of up to 200 cylinders plus cylinders for destructive testing of the same nominal diameter, thickness, length and design made successively on the same equipment, from the same cast of steel and subjected to the same heat treatment for the same duration of time

**3.2
burst pressure**
 p_b
highest pressure reached in a cylinder during a burst test

**3.3
design stress factor**
 F
ratio of equivalent wall stress at test pressure, p_h , to guaranteed minimum yield strength, R_{eg}

**3.4
quenching**
hardening heat treatment in which a cylinder, which has been heated to a uniform temperature above the upper critical point, Ac_3 , of the steel, is cooled rapidly in a suitable medium

**3.5
tempering**
toughening heat treatment which follows quenching, in which the cylinder is heated to a uniform temperature below the lower critical point, Ac_1 , of the steel

**3.6
test pressure**
 p_h
required pressure applied during a pressure test

NOTE It is used for cylinder wall thickness calculation.

**3.7
working pressure**
settled pressure of a compressed gas at a uniform reference temperature of 15 °C in a full gas cylinder

**3.8
yield strength**
stress value corresponding to the upper yield strength, ReH , or for steels which do not exhibit a defined yield, the 0,2 % proof strength (non-proportional extension), $Rp0,2$ (see ISO 6892-1)