

---

---

**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**

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

*Partie 1: Bouteilles en acier trempé et revenu ayant une résistance à la  
traction inférieure à 1 100 MPa*

Dit document mag slechts op een stand-alone PC worden geïnstalleerd. Gebruik op een netwerk is alleen toestaan als een aanvullende licentieovereenkomst voor netwerkgebruik met NEN is afgesloten. This document may only be used on a stand-alone PC. Use in a network is only permitted when a supplementary license agreement for us in a network with NEN has been concluded.

Preview



Reference number  
ISO 9809-1:2010(E)

© ISO 2010

**PDF disclaimer**

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

Copyright  
Preview



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2010

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
Case postale 56 • CH-1211 Geneva 20  
Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.org](mailto:copyright@iso.org)  
Web [www.iso.org](http://www.iso.org)

Published in Switzerland

## Contents

Page

Foreword .....	iv
Introduction .....	v
1 Scope .....	1
2 Normative references .....	1
3 Terms and definitions .....	2
4 Symbols .....	2
5 Inspection and testing .....	3
6 Materials .....	4
7 Design .....	7
8 Construction and workmanship .....	11
9 Type approval procedure .....	13
10 Batch tests .....	15
11 Tests/examinations on every cylinder .....	24
12 Certification .....	25
13 Marking .....	25
<b>Annex A</b> (informative) <b>Description and evaluation of manufacturing imperfections and conditions for rejection of seamless steel gas cylinders at time of final inspection by the manufacturer</b> .....	26
<b>Annex B</b> (normative) <b>Ultrasonic examination</b> .....	32
<b>Annex C</b> (informative) <b>Type approval certificate</b> .....	38
<b>Annex D</b> (informative) <b>Acceptance certificate</b> .....	39
<b>Bibliography</b> .....	41

## 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 9809-1 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 9809-1:1999), which has been technically revised by the following:

- a) the reduction of maximum sulfur content in 6.2.2 from 0,020 % to 0,010 %, 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 9.2.3 for all cylinder types during prototype testing;
- e) the addition of the requirement of a base check according to 9.2.3 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 concerns 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 testing 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.

Orbbee.nl  
Preview

Voorbeeld  
Preview

# 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

### 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 actual tensile strength  $R_{ma}$  of less than 1 100 MPa.

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 greater than or equal to 1 100 MPa, see ISO 9809-2. For normalized steel cylinders, see ISO 9809-3.

### 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 11114-4, *Transportable gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 4: Test methods for selecting metallic materials resistant to hydrogen embrittlement*

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,  $R_{eH}$ , or for steels which do not exhibit a defined yield, the 0,2 % proof strength (non-proportional extension),  $R_{p0,2}$

See ISO 6892-1.

### 4 Symbols

- $a$  Calculated minimum thickness, in millimetres, of the cylindrical shell
- $a'$  Guaranteed minimum thickness, in millimetres, of the cylindrical shell
- $a_1$  Guaranteed minimum thickness, in millimetres, of a concave base at the knuckle (see Figure 2)



$a_2$	Guaranteed minimum thickness, in millimetres, at the centre of a concave base (see Figure 2)
$A$	Percentage elongation after fracture
$b$	Guaranteed minimum thickness, in millimetres, at the centre of a convex base (see Figure 1)
$c$	Maximum permissible deviation of burst profile, in millimetres (see Figures 10 and 11)
$D$	Nominal outside diameter of the cylinder, in millimetres (see Figure 1)
$D_f$	Diameter, in millimetres, of former (see Figure 6)
$F$	Design stress factor (variable) (see 3.3)
$h$	Outside depth (concave base end), in millimetres (see Figure 2)
$H$	Outside height, in millimetres, of domed part (convex head or base end) (see Figure 1)
$L_0$	Original gauge length, in millimetres, as defined in ISO 6892-1 (see Figure 5)
$N$	Ratio of the diameter of the bend test former to actual thickness of test piece, $t$
$p_b$	Measured burst pressure, in bars <sup>1)</sup> , above atmospheric pressure
$P_h$	Hydraulic test pressure, in bars, above atmospheric pressure
$P_y$	Observed pressure when cylinder starts yielding during hydraulic burst test, in bars, above atmospheric pressure
$r$	Inside knuckle radius, in millimetres (see Figures 1 and 2)
$R_{eg}$	Minimum guaranteed value of the yield strength (see 7.1.1), in megapascals, for the finished cylinder
$R_{ea}$	Actual value of the yield strength, in megapascals, as determined by the tensile test (see 10.2)
$R_{mg}$	Minimum guaranteed value of the tensile strength, in megapascals, for the finished cylinder
$R_{ma}$	Actual value of tensile strength, in megapascals, as determined by the tensile test (see 10.2)
$S_0$	Original cross-sectional area of tensile test piece, in square millimetres, in accordance with ISO 6892-1
$t$	Actual thickness of the test specimen, in millimetres
$t_m$	average cylinder wall thickness at position of testing during the flattening test, in millimetres
$u$	Ratio of distance between knife edges or platens in the flattening test to average cylinder wall thickness at the position of test
$V$	Water capacity of cylinder, in litres
$w$	Width, in millimetres, of the tensile test piece (see Figure 5)

## 5 Inspection and testing

NOTE Evaluation of conformity can be carried out according to the regulations recognized by the country(ies) in which the cylinders are intended to be used.

1) 1 bar =  $10^5$  Pa =  $10^5$  N/m<sup>2</sup>.

# ALTIJD DE ACTUELE NORM IN UW BEZIT HEBBEN?

Nooit meer zoeken in de systemen en uzelf de vraag stellen:  
'Is ISO 9809-1:2010 en de laatste versie?'

Via het digitale platform NEN Connect heeft u altijd toegang tot de meest actuele versie van deze norm. Vervallen versies blijven ook beschikbaar. **U en uw collega's** kunnen de norm via NEN Connect makkelijk raadplagen, online en offline.

Kies voor slimmer werken en bekijk onze mogelijkheden op [www.nenconnect.nl](http://www.nenconnect.nl).

## Heeft u vragen?

Onze Klantenservice is bereikbaar maandag tot en met vrijdag, van 8.30 tot 17.00 uur.

Telefoon: 015 2 690 391

E-mail: [klantenservice@nen.nl](mailto:klantenservice@nen.nl)

