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**Gas cylinders — Refillable welded steel  
cylinders — Test pressure 60 bar and  
below**

*Bouteilles à gaz — Bouteilles en acier soudées rechargeables —  
Pression d'essai de 60 bar et moins*



Reference number  
ISO 4706:2008(E)

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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 4706 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 4706:1989), which has been technically revised.

ISO 4706 has been prepared to address the general requirements in Chapter 6.2 of the UN model regulations for the transportation of dangerous goods ST/SG/AC.10/1/Rev.15. It is intended to be used under a variety of regulatory regimes but has been written so that it is suitable for use with the conformity assessment system in 6.2.2.5 of ST/SG/AC.10/1/Rev.15.

This corrected version incorporates the following corrections:

- following the cancellation of a proposed ISO 4706-2, the reference number has been changed from ISO 4706-1 to ISO 4706, therefore
  - reference to individual parts of ISO 4706 has been removed from the foreword,
  - references to ISO 4706-1 have been replaced by ISO 4706, and
  - the page headers have been changed to read “ISO 4706:2008”;
- the term “proof stress” has been replaced by the term “proof strength”;
- Subclause 7.4, Design of openings, has been moved to Clause 6, Design, and renumbered 6.3;
- the title of Figure 5 now relates to longitudinal welds, not circumferential welds;
- the graphics in Figure 5 have been modified to depict a longitudinal weld.

## Introduction

The purpose of this International Standard is to facilitate agreement on the design and manufacture of welded-steel gas cylinders in all countries. The requirements are based on knowledge of, and experience with, materials, design requirements, manufacturing processes and controls in common use for the manufacture of gas cylinders.

With respect to those aspects concerning construction materials, approval of design rules and inspection during manufacture, which are subject to national or international regulations, it is necessary for interested parties to ensure that in the practical application of this International Standard, the requirements of the relevant authority are also satisfied.

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# Gas cylinders — Refillable welded steel cylinders — Test pressure 60 bar and below

## 1 Scope

This International Standard specifies the minimum requirements concerning material selection, design, construction and workmanship, procedure and test at manufacture of refillable welded-steel gas cylinders of a test pressure not greater than 60 bar<sup>1)</sup>, and of water capacities from 0,5 l up to and including 500 l exposed to extreme worldwide temperatures (–50 °C to +65 °C) used for compressed, liquefied or dissolved gases.

Transportable large cylinders of water capacity above 150 l and up to 500 l may be manufactured and certified to this International Standard provided handling facilities are provided (see 8.6.4).

This International Standard is primarily intended to be used for industrial gases other than Liquefied Petroleum Gas (LPG), but may also be applied for LPG. For specific LPG applications see ISO 22991.

## 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 4136, *Destructive tests on welds in metallic materials — Transverse tensile test*

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

ISO 6892, *Metallic materials — Tensile testing — Method of testing at ambient temperature*

ISO 7438, *Metallic materials — Bend test*

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

ISO 10297:2006, *Transportable gas cylinders — Cylinder valves — Specification and type testing*

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

ISO 13769, *Gas Cylinders — Stamp marking*

ISO 11622, *Gas cylinders — Conditions for filling gas cylinders*

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*

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

ISO 17636, *Non-destructive testing of welds — Radiographic testing of fusion-welded joints*

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*

ISO 22991, *Gas Cylinders — Transportable refillable welded steel cylinders for liquefied petroleum gas (LPG) — Design and construction*

### 3 Terms, definitions and symbols

#### 3.1 Terms and definitions

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

##### 3.1.1

##### **yield strength**

value corresponding to the upper yield strength,  $R_{eH}$ , or, for steels when yielding does not occur at tensile testing, the 0,2 % proof strength (non-proportional elongation),  $R_{p0,2}$

##### 3.1.2

##### **normalizing**

heat treatment in which a cylinder is heated to a uniform temperature above the upper critical point ( $Ac_3$ ) of the steel to regenerate or homogenize the metallurgical structure of the steel, to a sufficient degree to achieve the desired mechanical properties, and then cooled in a controlled or still air atmosphere

##### 3.1.3

##### **stress relieving**

heat treatment given to the cylinder, the object of which is to reduce the residual stresses without altering the metallurgical structure of the steel, by heating it to a uniform temperature below the lower critical point ( $Ac_1$ ) of the steel, then cooling it in a controlled or still air atmosphere

##### 3.1.4

##### **stabilizing**

heat treatment given to the cylinder, the object of which is to stabilize the structure of the steel by heating it to a uniform temperature above the lower critical point ( $Ac_1$ ) of the steel and subsequently cooling it to obtain the desired mechanical properties

##### 3.1.5

##### **batch**

quantity of 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, welding procedures and to the same heat treatment conditions

NOTE 1 In this context, “consecutively” need not apply to continuous production (start to finish).

NOTE 2 See 10.2 for specific batch quantities.

##### 3.1.6

##### **base materials**

steel used to manufacture the cylinder including the pressure and non-pressure retaining materials of construction

##### 3.1.7

##### **cylinder shell**

cylinder after completion of all forming, welding and heat treatment operations