
Premične plinske jeklenke – Ponovno polnljivi varjeni vsebniki s prostornino, ne večjo kot 150 litrov – 3. del: Varjene jeklenke iz ogljičnega jekla, izdelane po metodi, ki je eksperimentalno potrjena

Transportable gas cylinders – Refillable welded receptacles of a capacity not exceeding 150 litres – Part 3: Welded carbon steel cylinders made to a design justified by experimental methods

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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

DRAFT
prEN 14638-3

December 2005

ICS

English Version

Transportable gas cylinders - Refillable welded receptacles of a capacity not exceeding 150 litres - Part 3: Welded carbon steel cylinders made to a design justified by experimental methods

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 23.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (prEN 14638-3:2005) has been prepared by Technical Committee CEN/TC 23 "Transportable gas cylinders", the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

This European Standard has been submitted for reference into the RID and/or in the technical annexes of the ADR. Therefore in this context the standards listed in the normative references and covering basic requirements of the RID/ADR not addressed within the present standard are normative only when the standards themselves are referred to in the RID and/or in the technical annexes of the ADR.

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Introduction

The purpose of this European Standard is to provide a specification for the design, manufacture, inspection and approval of welded carbon steel gas cylinders for use in the countries of the CEN members.

The specifications given in the present standard establish the methodology to be adopted in order to demonstrate that a cylinder conforms to the functional requirements demanded, based on the experience about materials, design prescriptions, manufacturing processes and controls manufacturing.

This standard comprises experimental methods and appropriate stress analysis calculations. It does not cover methods exclusively by means of traditional calculation.

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1 Scope

This European Standard gives minimum requirements concerning material, design, construction and workmanship, procedures and tests at manufacture of refillable transportable welded cylinders made of carbon steel, justified by experimental methods, of water capacities from 0,5 l up to and including 150 l for compressed or liquefied gases and of a test pressure up to 90 bar.

NOTE This standard may also be used as a guideline for cylinders less than 0,5 l water capacity.

This standard is primarily for industrial gases other than LPG but may also be applied for LPG. However for dedicated LPG cylinders, see EN 14140, *Transportable refillable welded steel cylinders for liquefied petroleum gas (LPG) – Alternative design and construction* prepared by CEN/TC 286 *Liquefied petroleum gas equipment and accessories*.

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.

EN 287-1, *Approval testing of welders — Fusion welding — Part 1: Steels*.

EN 288-1, *Specification and qualification of welding procedures for metallic materials — Part 1: General rules for fusion welding*.

EN 288-3/A1: 1997, *Specification and approval of welding procedures for metallic materials — Part 3: Welding procedure tests for the arc welding of steels*.

EN 629-2, *Transportable gas cylinders — 25 E taper thread for connection of valves to gas cylinders — Part 2: Gauge inspection*.

EN 962, *Transportable gas cylinders — Valve protection caps and valve guards for industrial and medical gas cylinders — Design, construction and tests*.

EN 1435, *Non destructive examination of welds — Radiographic examination of welded joints*.

EN 1803, *Transportable gas cylinders — Periodic inspection and testing of welded carbon steel gas cylinders*.

EN 10002-1, *Metallic materials — Tensile testing — Part 1: Method of test*.

EN 10003-1, *Metallic materials — Brinell hardness test — Part 1: Test method*.

EN 10028-1, *Flat products made of steels for pressure purposes — Part 1: General requirements*.

EN 10028-3, *Flat products made of steels for pressure purposes — Part 3: Weldable fine grain steels, normalized*.

EN 10028-5, *Flat products made of steels for pressure purposes — Part 5: Weldable fine grain steels, thermomechanically rolled*.

EN 10045-1, *Metallic materials — Charpy impact test — Part 1: Test method*.

EN 10052, *Vocabulary of heat treatment terms for ferrous products*.

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prEN 10083-1, *Steels for quenching and tempering — Part 1: General technical delivery conditions / Note: Intended as replacement for EN 10083-1+A1 (1996-08).*

EN 10120, *Steel sheet and strip for welded gas cylinders.*

EN 10130, *Cold-rolled low carbon steel flat products for cold forming — Technical delivery conditions / Note: Intended as replacement for EN 10130+A1 (1998-05).*

EN 13445-2, *Unfired pressure vessels — Part 2: Materials.*

EN 14140, *Transportable refillable welded steel cylinders for Liquefied Petroleum Gas (LPG) — Alternative design and construction.*

EN 25817, *Arc-welded joints in steel — Guidance on quality levels for imperfections (ISO 5817:1992).*

EN ISO 10692-2, *Gas cylinders — Gas cylinder valve connections for use in the micro-electronics industry — Part 2: Specification and type testing for valve to cylinder connections.*

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

EN ISO 11114-3, *Transportable gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 3: Autogenous ignition test in oxygen atmosphere (ISO 11114-3: 1997).*

EN ISO 13341, *Transportable gas cylinders — Fitting of valves to gas cylinders (ISO 13341: 1997).*

prEN ISO 13769: 2005, *Gas cylinders — Stampmarking (ISO 13769:2002).*

EN ISO 15607, *Specification and qualification of welding procedures for metallic materials — General rules (ISO 15607:2003).*

EURONORM 6-55, *Bend test for steel.*

EURONORM 12-55, *Bend tests for steel sheet and strip less than 3 mm thick.*

ISO 4978: 1983, *Flat rolled steel products for welded gas cylinders.*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purpose of this standard, the following definitions apply:

3.1.1 yield stress

value corresponding to the lower yields stress, R_{el} , or $0,92$ x the upper yield stress (R_{eh}) or for steels that do not exhibit a defined yield, the 0,2% proof stress ($R_{p0,2}$)

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3.1.2 normalizing

heat treatment in which the steel is heated to a uniform temperature above the upper critical point (A_{c3} , as defined in EN 10052) of the steel and then cooled in a controlled atmosphere

3.1.3 stress relieving

heat treatment given to the finished cylinder, the object of which is to reduce the residual stresses without altering the metallurgical structure of the steel, by heating to a uniform temperature below the critical point (A_{c1} , as defined in EN 10052) of the steel and cooling in a still atmosphere

3.1.4**parent material**

material corresponding to the cylinder after finishing its manufacturing process and ready for service/operation

NOTE The material characteristics may be variable at any point of the cylinder.

3.1.5**batch**

a batch consists of finished cylinders made consecutively during the same or consecutive days to the same design, size and material specifications and from the same material supplier for each pressure containing parts on the same automatic welding machines and, if applicable, heat-treated under the same conditions of temperature and duration

NOTE 1 In this context consecutively need not imply continuous production.

NOTE 2 This definition allows different suppliers to be used for the different pressure containing parts within a batch, e.g. one supplier for heads, another for bases.

3.1.6**cylinder**

a transportable pressure receptacle of a water capacity not exceeding 150 l

3.1.7**finished cylinder**

a cylinder which is fully assembled and appropriately stampmarked, but without any external coatings

3.1.8**coldforming**

final deformation treatment at ambient temperature given to the prefabricated cylinder, known as the preform, which results in a permanent increase in the material strength

3.1.9**valve boss or pad**

connection between valve and cylinder

3.2 Symbols

a Minimum thickness, in millimetres, for calculation of weld clearance (see Figure 1)

a_{si} Calculated minimum thickness, in millimetres, at a determined area " i " of the cylinder

a_{bi} Minimum thickness, in millimetres, at a determined area " i " of the cylinder (including any corrosion allowance) guaranteed by the manufacturer

A_i Percentage elongation after fracture, at a determined area " i " of the cylinder

i Area of the cylinder used for the calculation under consideration.

L , Original gauge length, in millimetres, in accordance with EN 10002-1

n Ratio of diameter of bend test former to the thickness of the test piece

P_h Test pressure, in bar, above atmospheric pressure

P_b Minimum burst pressure, in bar

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P_{ba} Actual burst pressure, in bar

$R_{pi0,2}$ Minimum value of 0,2 % proof stress in MPa, guaranteed by the cylinder manufacturer for the finished cylinder, at a determined area "i" of the cylinder

R_{gi} Minimum value of tensile stress, in MPa, guaranteed by the cylinder manufacturer for the finished cylinder, at a determined area "i" of the cylinder

R_{mi} Actual value of tensile stress, in MPa, determined by tensile test specified in clause 7, at a determined area "i" of the cylinder

R_{ei} Yield stress means the stress at which a permanent elongation of 1 % of the gauge length on the test-piece, has been produced, at a determined area "i" of the cylinder

R_{eai} Actual value of yield stress used for calculation, in MPa, at a determined area "i" of the cylinder

s nominal butt weld thickness

4 Materials and heat treatment

4.1 General

4.1.1 The cylinder materials subject to pressure, shall conform to EN 10028-1 and EN 10028-3, or EN 10028-1 and EN 10028-5, or EN 10120 or EN 10130.

NOTE These materials correspond to the materials received by the manufacturer, before having been submitted to any manufacturing process.

4.1.2 Materials supplied for bungs shall conform to EN 10083-1

4.1.3. The welding consumables shall be such that they are capable of giving consistent welds. The material characteristics on the welds shall have to be considered by design

4.1.4 Grades of steel used for the cylinder manufacture shall be compatible with the intended gas service, e.g. corrosive gases, embrittling gases. (See EN ISO 11114-1)

4.1.5 The manufacturer shall be able to guarantee cylinder steel casting traceability for each pressure retaining part.

4.1.6 All parts welded or in contact with the cylinder shall be made of compatible material with the cylinder without harming its characteristics or favouring corrosion processes.

4.1.7 The cylinder manufacturer shall obtain and provide certificates of the ladle analysis of the steel supplied for the construction of the pressure retaining parts of the cylinder and of welding consumables.

4.2 Heat treatment

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When the manufacturer considers the necessity of a heat treatment, it should be in accordance with EN 10052. When no heat treatment is performed, because there is a risk of strain ageing, especially for cylinders which experience deep drawing, the manufacturer shall demonstrate that there is no risk of deterioration in the properties of the cylinder over its expected lifetime.

4.3 Test requirements

The material of the finished cylinders shall satisfy the requirements of clause 7.

4.4 Failure to meet test requirements

4.4.1 In the event of failure to meet test requirements, retesting shall be carried out as given in **4.4.2** and **4.4.3**.

4.4.2 If there is evidence of a fault in carrying out a test or an error of measurement, a further test shall be performed. If the result of the test is satisfactory, the first test shall be ignored.

4.4.3 If the test has been carried out in a satisfactory manner, the cause of test failure shall be identified.

— If the failure is considered to be due to inappropriate heat treatment (if applied), the manufacturer may subject all the cylinders of the batch to a further heat treatment;

— If the failure is not due to inappropriate heat treatment (if applied), all the identified defective cylinders shall be rejected or repaired by an approved method. The remaining cylinders are then considered as a new batch.

In both cases the new batch shall be tested. All the relevant prototype or batch tests needed to prove the acceptability of the new batch, shall be performed again and shall satisfy the requirements for batch or prototype testing.

If one or more tests prove even partially unsatisfactory, all the cylinders of the batch shall be rejected.

5 Design

5.1 General

For any new design, the concepts outlined in **5.2** and **5.3** shall be followed. It is recommended that an approximate calculation for the initial design be made. This initial calculated design may then be optimised if results from the experimental method exceed the minimum requirements.

5.2 Calculation

Where a calculation is to be used as the basis for the design, the following conditions shall be considered.

— The calculation of the wall thickness of the pressure containing parts “*i*” shall be related to the yield stress of the material, of the finished product in each area “*i*” to be considered;

— For calculation purposes, the value of the yield stress R_{eai} , is limited to a maximum of $0,85 R_{gi}$;

— The internal pressure upon which the calculation of gas cylinders is based, shall be the test pressure P_h .

NOTE At the test pressure, the stress in the metal at the most severely stressed point of the cylinder shall not exceed 77% of the guaranteed yield stress (R_{eai}). This can be verified by for example, studying the stress analysis.

5.3 Experimental method

An experimental method shall be used as the basis for the design. The following conditions shall be met.

— The actual wall thickness, mechanical properties and the geometry of the cylinders submitted to the prototype tests shall be recorded;

— The manufacturer shall take into account the requirements of **7.2** and ensure that the properties recorded represent the minimum values that would be used for production.

5.4 Openings

Each opening in the cylinder shall be reinforced, either by a valve boss or pad, of weldable and compatible steel, securely attached by welding and so designed as to be of adequate strength and to result in no harmful stress concentrations. This shall be confirmed by prototype testing.

Openings shall be clear of longitudinal and circumferential joints by a distance not less than $3a$ (see Figure 1).

6 Construction and workmanship

6.1 Manufacturing methods

6.1.1 The essential characteristics of the manufacturing processes applied and the corresponding parameters shall be defined in the technical specification of the cylinder (see 7.1).

6.1.2 The manufacturer shall have the technical capability, have at his disposal all appropriate means, and qualified personnel to carry out the manufacture of cylinders.

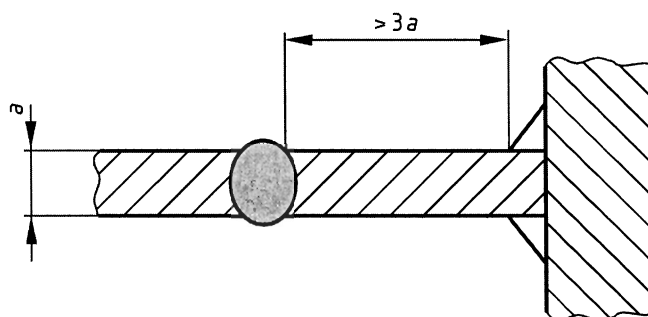


Figure 1 — Weld clearance

6.2 Welding procedures

Each manufacturer, before proceeding with the production of a given design of cylinder, shall qualify the welding procedures and welders according to EN 288-3/A1:1997 and EN 287-1. Records of such qualification shall be kept on file by the manufacturer.

6.3 Pressure-retaining welded joints

Except for the boss weldments, all welded joints shall be either of a butt or a joggle configuration. For cylindrical shapes, longitudinal joints shall be butt welded.

6.4 Non-pressure-containing attachments

6.4.1 Non pressure containing parts such as footrings, handles and neckrings which are not submitted to pressure shall be made in accordance with 4.1.6.

6.4.2 Each attachment shall be designed to permit inspection of the welds, which shall be clear of longitudinal and circumferential joints, and so designed as to avoid trapping water.