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NATIONAL FOREWORD

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English Version

Unfired pressure vessels - Part 2: Materials

Réceptacles sous pression non soumis à la flamme - Partie 2
: matériaux

Unbefeuerte Druckbehälter - Teil 2: Werkstoffe

This European Standard was approved by CEN on 30 June 2009.

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Foreword

This document (EN 13445-2:2009) has been prepared by Technical Committee CEN/TC 54 “Unfired pressure vessels”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by *December 2009*, and conflicting national standards shall be withdrawn at the latest by *December 2009*.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative annex ZA, which is an integral part of this document.

This European Standard consists of the following Parts:

- Part 1: *General*.
- Part 2: *Materials*.
- Part 3: *Design*.
- Part 4: *Fabrication*.
- Part 5: *Inspection and testing*.
- Part 6: *Requirements for the design and fabrication of pressure vessels and pressure parts constructed from spheroidal graphite cast iron*.
- CR 13445-7, *Unfired pressure vessels* — Part 7: *Guidance on the use of conformity assessment procedures*.
- Part 8: *Additional requirements for pressure vessels of aluminium and aluminium alloys*.
- CEN/TR 13445-9, *Unfired pressure vessels* — Part 9: *Conformance of EN 13445 series to ISO 16528*

This document supersedes EN 13445-2:2002. This new edition incorporates the Amendments which have been approved previously by CEN members, and the corrected pages up to Issue 36 without any further technical change. Annex Y to EN 13445-1:2009 and Annex Y to this Part provides details of significant technical changes between this European Standard and the previous edition.

Amendments to this new edition may be issued from time to time and then used immediately as alternatives to rules contained herein. It is intended to deliver a new Issue of EN 13445:2009 each year, consolidating these Amendments and including other identified corrections. Issue 5 (2013-07) includes the corrected pages listed in Annex Y.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This Part of this European Standard specifies the requirements for materials (including clad materials) for unfired pressure vessels and supports which are covered by EN 13445-1:2009 and manufactured from metallic materials; it is currently limited to steels with sufficient ductility but it is, for components operating in the creep range, also limited to sufficiently creep ductile materials .

It specifies the requirements for the selection, inspection, testing and marking of metallic materials for the fabrication of unfired pressure vessels.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 764-1:2004, *Pressure equipment — Terminology — Part 1: Pressure, temperature, volume, nominal size.*

EN 764-2:2002, *Pressure equipment — Part 2: Quantities, symbols and units.*

EN 764-3:2002, *Pressure equipment — Part 3: Definition of parties involved.*

EN 1092-1:2007, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 1: Steel flanges*

EN 10002-1:2001, *Metallic materials - Tensile testing - Part 1: Method of test at ambient temperature*

EN 10028-2:2003, *Flat products made of steels for pressure purposes — Part 2: Non-alloy and alloy steels with specified elevated temperature properties.*

EN 10028-3:2003, *Flat products made of steels for pressure purposes — Part 3: Weldable fine grain steels, normalized.*

EN 10028-4:2003, *Flat products made of steels for pressure purposes — Part 4: Nickel alloy steels with specified low temperature properties.*

EN 10028-5:2003, *Flat products made of steels for pressure purposes — Part 5: Weldable fine grain steels, thermomechanically rolled.*

EN 10028-6:2003, *Flat products made of steels for pressure purposes — Part 6: Weldable fine grain steels, quenched and tempered.*

EN 10028-7:2007, *Flat products made of steels for pressure purposes — Part 7: Stainless steels.*

EN 10045-1:1990, *Metallic materials — Charpy impact test — Part 1: Test method.*

EN 10164:2004, *Steel products with improved deformation properties perpendicular to the surface of the product — Technical delivery conditions.*

EN 10204:2004, *Metallic products — Types of inspection documents.*

EN 10216-3:2002, EN 10216-3:2002/A1:2004, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 3: Alloy fine grain steel tubes*

EN 10216-4:2002, EN 10216-4:2002/A1:2004, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 4: Non-alloy and alloy steel tubes with specified low temperature properties.*

EN 10217-3:2002, EN 10217-3:2002/A1:2005, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 3: Alloy fine grain steel tubes.*

EN 10217-4:2002, EN 10217-4:2002/A1:2005, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 4: Electric welded non-alloy steel tubes with specified low temperature properties.*

EN 10217-6:2002, EN 10217-6:2002/A1:2005, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 6: Submerged arc welded non-alloy steel tubes with specified low temperature properties.*

EN 10222-3:1998, *Steel forgings for pressure purposes — Part 3: Nickel steels with specified low temperature properties.*

EN 10222-4:1998, EN 10222-4:1998/A1:2001, *Steel forgings for pressures purposes — Part 4: Weldable fine grain steels with high proof strength.*

EN 10269:1999, EN 10269:1999/A1:2006, *Steels and nickel alloys for fasteners with specified elevated and/or low temperature properties.*

EN 10273:2007, *Hot rolled weldable steel bars for pressure purposes with specified elevated temperature properties.*

EN 10291:2000, *Metallic materials — Uniaxial creep testing in tension – Method of test.*

EN 12074:2000, *Welding consumables — Quality requirements for manufacture, supply and distribution of consumables for welding and allied processes.*

EN 13445-1:2009, *Unfired pressure vessels — Part 1: General.*

EN 13445-3:2009, *Unfired pressure vessels — Part 3: Design.*

EN 13445-4:2009, *Unfired pressure vessels — Part 4: Fabrication.*

EN 13445-5:2009, *Unfired pressure vessels — Part 5: Inspection and testing.*

EN 13479:2004, *Welding consumables — General product standard for filler metals and fluxes for fusion welding of metallic materials.*

EN 20898-2:1993, *Mechanical properties of fasteners — Part 2: Nuts with specified proof load values — Coarse thread (ISO 898-2:1992)*

EN ISO 898-1:1999, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs (ISO 898-1:1999)*

EN ISO 2566-1:1999, *Steel — Conversion of elongation values — Part 1: Carbon and low alloy steels (ISO 2566-1:1984).*

EN ISO 2566-2:1999, *Steel — Conversion of elongation values — Part 2: Austenitic steels (ISO 2566-2:1984).*

EN ISO 3506-1:1997, *Mechanical properties of corrosion-resistant stainless-steel fasteners — Part 1: Bolts, screws and studs (ISO 3506- 1:1997)*

EN ISO 3506-2:1997, *Mechanical properties of corrosion-resistant stainless-steel fasteners — Part 2: Nuts (ISO 3506-2:1997)*

CR ISO 15608:2000, *Welding — Guidelines for a metallic material grouping system (ISO/TR 15608:2000)*.

3 Terms, definitions, symbols and units

3.1 Terms and definitions

For the purposes of this European Standard the terms and definitions given in EN 13445-1:2009, EN 764-1:2004, EN 764-3:2002 and the following terms and definitions shall apply.

3.1.1

minimum metal temperature T_M

the lowest temperature determined for any of the following conditions (also see 3.1.2, 3.1.3):

- normal operations;
- start up and shut down procedures;
- possible process upsets, such as flashings of fluid, which have an atmospheric boiling point below 0 °C;
- during pressure or leak testing.

3.1.2

temperature adjustment term T_S

relevant to the calculation of the design reference temperature T_R and is dependent on the calculated tensile membrane stress at the appropriate minimum metal temperature

NOTE 1 Values for T_S are given in Table B.2-12.

NOTE 2 For tensile membrane stress reference is made to EN 13445-3:2009, Annex C.

3.1.3

design reference temperature T_R

the temperature used for determining the impact energy requirements and is determined by adding the temperature adjustment T_S to the minimum metal temperature T_M :

$$T_R = T_M + T_S$$

3.1.4

impact test temperature T_{KV}

the temperature at which the required impact energy has to be achieved (see clause B.2).

3.1.5

impact energy KV

the energy absorbed by a sample of material when subjected to a Charpy-V-notch test in accordance with EN 10045-1:1990

3.1.6

reference thickness e_B

thickness of a component to be used to relate the design reference temperature T_R of the component with its required impact test temperature T_{KV} , (see Tables B.2-2 to B.2-7 and Figures B.2-1 to B.2-11). For unwelded parts the reference thickness e_B is equal to the nominal wall thickness (including corrosion allowance). For welded parts the reference thickness is defined in Table B.4-1.