

STN	Nevyhrievané tlakové nádoby. Časť 4: Výroba.	STN EN 13445-4 69 0010
------------	---	--

Unfired pressure vessels - Part 4: Fabrication

Táto norma obsahuje anglickú verziu európskej normy.
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 12/14

Obsahuje: EN 13445-4:2014

Oznámením tejto normy sa ruší
STN EN 13445-4 (69 0010) z apríla 2012

119885

Úrad pre normalizáciu, metrológiu a skúšobníctvo SR, odbor SÚTN, 2015
Podľa zákona č. 264/1999 Z. z. v znení neskorších predpisov sa môžu slovenské technické normy
rozmnožovať a rozširovať iba so súhlasom Úradu pre normalizáciu, metrológiu a skúšobníctvo SR.

English Version

Unfired pressure vessels - Part 4: FabricationRécipients sous pression non soumis à la flamme - Partie 4:
Fabrication

Unbefeuerte Druckbehälter - Teil 4: Herstellung

This European Standard was approved by CEN on 19 August 2014.

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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists 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 CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, 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 United Kingdom.



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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents

Page

Foreword.....	5
1 Scope	7
2 Normative references	7
3 Requirements for manufacturing and subcontracting	9
3.1 Manufacturing	9
3.2 Subcontracting.....	9
4 Materials	10
4.1 General.....	10
4.2 Material traceability	10
4.2.1 General.....	10
4.2.2 Identification system	10
4.2.3 Visibility	11
4.2.4 Review of material certification and material identification	11
4.2.5 Transfer of markings	11
5 Manufacturing tolerances	11
5.1 Surface geometry of welds	11
5.2 Middle line alignment	11
5.3 Surface alignment.....	13
5.3.1 Surface misalignment between parts	13
5.3.2 Joining of parts of different thickness	13
5.4 Tolerances for vessels subjected to internal pressure	13
5.4.1 External diameter.....	13
5.4.2 Out of roundness.....	13
5.4.3 Deviation from the longitudinal axis.....	14
5.4.4 Irregularities in profile.....	14
5.4.5 Local thinning	16
5.4.6 Dished ends.....	17
5.5 Tolerances for vessels subjected to external pressure	19
5.6 Structural tolerances	19
6 Weld details	19
6.1 General.....	19
6.2 Vessels or parts made of more than one course	19
6.3 Lapped joints, joggle joints, permanent backing strips	19
7 Welding	19
7.1 General.....	19
7.2 Welding procedure specification (WPS)	20
7.3 Welding procedure qualification record (WPQR).....	20
7.4 Qualification of welders and welding operators.....	21
7.5 Filler metals and auxiliary materials.....	21
7.6 Joint preparation.....	21
7.7 Execution of welded joints	22
7.8 Attachments, supports and stiffeners.....	22
7.9 Preheat.....	23
7.10 Permanent joints other than welding.....	23
7.10.1 General.....	23
7.10.2 Mechanical roller expansion.....	23
7.10.3 Brazing.....	23
8 Manufacture and testing of welds — Production test.....	23
8.1 General.....	23
8.2 Reference criteria.....	24

8.3	Extent of testing.....	27
8.4	Performance of tests and acceptance criteria.....	29
8.4.1	General.....	29
8.4.2	Transverse tensile test.....	29
8.4.3	Longitudinal weld tensile test	29
8.4.4	Impact test.....	29
8.4.5	Bend test.....	29
8.4.6	Macro examination	30
8.4.7	Micro examination	30
8.4.8	Hardness test	30
8.4.9	Retests	30
8.4.10	Test report	31
9	Forming of pressure parts	31
9.1	General.....	31
9.2	Ratio of deformation.....	31
9.2.1	Dished circular products	31
9.2.2	Cylinders and cones made by rolling.....	32
9.2.3	Other product types	33
9.2.4	Tube bends.....	34
9.2.5	Forming of Segments.....	34
9.3	Forming procedures.....	35
9.3.1	Cold forming	35
9.3.2	Hot forming	35
9.4	Heat treatment after forming	38
9.4.1	General.....	38
9.4.2	Heat treatment of flat products after cold forming	38
9.4.3	Heat treatment of tubular products after cold forming.....	40
9.4.4	Heat treatment of clad steels after cold forming.....	40
9.4.5	Heat treatment after hot forming.....	40
9.4.6	Heat treatment of clad steels after hot forming.....	41
9.5	Sampling of formed test coupons	41
9.5.1	Cold formed products without heat treatment	41
9.5.2	Hot formed or cold formed products with heat treatment.....	41
9.6	Tests.....	42
9.6.1	Base material	42
9.6.2	Butt welds.....	42
9.6.3	Acceptance criteria for formed test coupons.....	43
9.6.4	Retests of formed coupons	43
9.7	Visual inspection and control of dimension.....	43
9.8	Marking	44
9.9	Documentation.....	44
10	Post weld heat treatment (PWHT)	44
10.1	General.....	44
10.2	Heat treatment conditions	45
10.3	Method of PWHT	49
10.4	PWHT procedure.....	50
10.5	Mechanical properties after heat treatment	50
10.6	Dissimilar ferritic joints.....	51
10.7	Special materials	52
10.8	Heat Treatment for reasons other than welding.....	52
11	Repairs.....	53
11.1	Repairs of surface defects in the parent metal	53
11.2	Repair of weld defects.....	53
12	Finishing operations	53
Annex A (informative) Structural tolerances		55
Annex B (informative) Example of a sub-contractors form		59

Annex C (normative) Specification and approval of expansion procedures and operators	60
C.1 General	60
C.1.1 Introduction	60
C.1.2 Responsibility	60
C.1.3 Specification of expansion procedures	60
C.1.4 Technical content of expansion procedure specification (EPS)	61
C.1.5 Expansion procedure qualification test (EPQT)	62
C.2 Examination and testing	62
C.2.1 General	62
C.2.2 Visual examination	62
C.2.3 Dimensional verification	62
C.2.4 Testing	63
C.3 Range of approval	63
C.3.1 General	63
C.3.2 Manufacturer	63
C.3.3 Material	63
C.3.4 Tube dimensions	63
C.3.5 Expansion factor	63
C.3.6 Joint design	64
C.3.7 Tool	64
C.3.8 PWHT	64
C.4 Expansion Procedure Approval Record (EPAR)	64
C.5 Expansion operator approval	64
C.5.1 General	64
C.5.2 Validity range of expansion operator qualification	65
C.5.3 Qualification tests	65
C.5.4 Examination and testing	65
C.5.5 Period of validity	65
C.5.6 Certification	66
Annex Y (informative) History of EN 13445-4	67
Y.1 Differences between EN 13445-4:2009 and EN 13445-4:2014	67
Annex ZA (informative) Relationship between this European Standard and the Essential Requirements of the EU Pressure Equipment Directive 97/23/EC	68
Bibliography	69

Foreword

This document (EN 13445-4:2014) 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 2014, and conflicting national standards shall be withdrawn at the latest by December 2014.

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.*

Although these Parts may be obtained separately, it should be recognised that the Parts are inter-dependant. As such the manufacture of unfired pressure vessels requires the application of all the relevant Parts in order for the requirements of the Standard to be satisfactorily fulfilled.

Corrections to the standard interpretations where several options seem possible are conducted through the Migration Help Desk (MHD). Information related to the Help Desk can be found at <http://www.unm.fr> (en13445@unm.fr). A form for submitting questions can be downloaded from the link to the MHD website. After subject experts have agreed an answer, the answer will be communicated to the questioner. Corrected pages will be given specific issue number and issued by CEN according to CEN Rules. Interpretation sheets will be posted on the website of the MHD.

This document supersedes EN 13445-4:2009. This new edition incorporates the Amendments which have been approved previously by CEN members, and the corrected pages up to Issue 5 without any further technical change. Annex Y provides details of significant technical changes between this European Standard and the previous edition.

EN 13445-4:2014 (E)
Issue 1 (2014-09)

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 13445:2014 each year, starting with the present document as Issue 1, consolidating these Amendments and including other identified corrections.

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, Croatia, 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 document specifies requirements for the manufacture of unfired pressure vessels and their parts, made of steels, including their connections to non-pressure parts. It specifies requirements for material traceability, manufacturing tolerances, welding requirements, requirements for permanent joints other than welding, production tests, forming requirements, heat treatment, repairs and finishing operations.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 287-1:2011¹⁾, *Qualification test of welders — Fusion welding — Part 1: Steels*

EN 10028-2:2009, *Flat products made of steels for pressure purposes — Part 2: Non-alloy and alloy steels with specified elevated temperature properties*

EN 10028-3:2009, *Flat products made of steels for pressure purposes — Part 3: Weldable fine grain steels, normalized*

EN 10028-4:2009, *Flat products made of steels for pressure purposes — Part 4: Nickel alloy steels with specified low temperature properties*

EN 10216-1:2013, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 1: Non-alloy steel tubes with specified room temperature properties*

EN 10216-2:2013, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties*

EN 10216-3:2013, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 3: Alloy fine grain steel tubes*

EN 10216-4:2013, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 4: Non-alloy and alloy steel tubes with specified low temperature properties*

EN 10217-1:2002, EN 10217-1:2002/A1:2005, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 1: Non-alloy steel tubes with specified room temperature properties*

EN 10217-2:2002, EN 10217-2:2002/A1:2005, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 2: Electric welded non-alloy and alloy steel tubes with specified elevated 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 and alloy steel tubes with specified low temperature properties*

1) EN ISO 9606-1 has been published in 2013 replaces EN 287-1. CEN has decided to have a transition period for EN 287-1. As a consequence, EN 287-1 is valid until October 2015.

EN 13445-4:2014 (E)
Issue 1 (2014-09)

EN 10217-5:2002, EN 10217-5:2002/A1:2005, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 5: Submerged arc welded non-alloy and alloy steel tubes with specified elevated 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 10222-2:1999, *Steel forgings for pressure purposes — Part 2: Ferritic and martensitic steels with specified elevated temperature properties*

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

EN 10222-4:1998+A1:2002, *Steel forgings for pressure purposes — Part 4: Weldable fine grain steels with high proof strength*

EN 13134:2000, *Brazing — Procedure approval*

EN 13445-1:2014, *Unfired pressure vessels — Part 1: General*

EN 13445-2:2014, *Unfired pressure vessels — Part 2: Materials*

EN 13445-3:2014, *Unfired pressure vessels — Part 3: Design*

EN 13445-5:2014, *Unfired pressure vessels — Part 5: Inspection and testing*

EN 14276-1:2006+A1:2011, *Pressure equipment for refrigerating systems and heat pumps — Part 1: Vessels — General requirements*

EN ISO 3834-2:2005, *Quality requirements for fusion welding of metallic materials — Part 2: Comprehensive quality requirements (ISO 3834-2:2005)*

EN ISO 3834-3:2005, *Quality requirements for fusion welding of metallic materials — Part 3: Standard quality requirements (ISO 3834-3:2005)*

EN ISO 4136:2012, *Destructive tests on welds in metallic materials — Transverse tensile test (ISO 4136:2012)*

EN ISO 5173:2010, *Destructive tests on welds in metallic materials — Bend tests (ISO 5173:2009)*

EN ISO 5178:2011, *Destructive tests on welds in metallic materials — Longitudinal tensile test on weld metal in fusion welded joints (ISO 5178:2001)*

EN ISO 9015-1:2011, *Destructive tests on welds in metallic materials — Hardness testing — Part 1: Hardness test on arc welded joints (ISO 9015-1:2001)*

EN ISO 9016:2012, *Destructive tests on welds in metallic materials — Impact tests — Test specimen location, notch orientation and examination (ISO 9016:2012)*

EN ISO 13585:2012, *Brazing — Qualification test of brazers and brazing operators (ISO 13585:2012)*

EN ISO 14732:2013, *Welding personnel — Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials (ISO 14732:2013)*

EN ISO 15609-1:2004, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding (ISO 15609-1:2004)*

EN ISO 15611:2003, *Specification and qualification of welding procedures for metallic materials — Qualification based on previous welding experience* (ISO 15611:2003)

EN ISO 15612:2004, *Specification and qualification of welding procedures for metallic materials — Qualification by adoption of a standard welding procedure* (ISO 15612:2004)

EN ISO 15613:2004, *Specification and qualification of welding procedures for metallic materials — Qualification based on pre-production welding test* (ISO 15613:2004)

EN ISO 15614-1:2004, EN ISO 15614-1:2004/A1:2008, *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* (ISO 15614-1:2004, ISO 15614-1:2004/A1:2008)

EN ISO 17639:2013, *Destructive tests on welds in metallic materials — Macroscopic and microscopic examination of welds* (ISO 17639:2003)

koniec náhľadu – text ďalej pokračuje v platenej verzii STN