

## საქართველოს სტანდარტი

არაგაცხელვადი წნევის ჭურჭელი. ნაწილი 4: დამზადება

საქართველოს სტანდარტებისა და მეტროლოგიის  
ეროვნული სააგენტო  
თბილისი

სსტ ენ 13445-4:2014/2015

### საინფორმაციო მონაცემები

1 დამტკიცებულია და შემოღებულია სამოქმედოდ საქართველოს სტანდარტებისა და მეტროლოგიის ეროვნული სააგენტოს 2015 წლის 1 აპრილის № 24 და 2015 წლის 10 თებერვლის № 9 განკარგულებებით

2 მიღებულია გარეკანის თარგმნის მეთოდით სტანდარტიზაციის ევროპული კომიტეტის სტანდარტი ენ 13445-4:2014 „ არაგაცხელებადი წნევის ჭურჭელი. ნაწილი 4: დამზადება“

### 3 პირველად

4 რეგისტრირებულია საქართველოს სტანდარტებისა და მეტროლოგიის ეროვნული სააგენტოს რეესტრში: 2015 წლის 1 აპრილი №268-1.3-7112

აკრძალულია ამ სტანდარტის გადაცემა მესამე პირებისათვის ან/და მისი სხვა ფორმით გავრცელება

English Version

## Unfired pressure vessels - Part 4: Fabrication

Réipients 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

საინფორმაციო ნაწილი. სრული ტექსტის სახსრად შეიძლება სტანდარტი.

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

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

საინფორმაციო ნაწილი. სრული ტექსტის სანახავად შეიძინეთ სტანდარტი.

## 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.

საინფორმაციო ნაწილი. სრული ტექსტის სანახავად შეიძინეთ სტანდარტი.