



SLOVENSKI STANDARD
SIST EN 13445-2:2002/A5:2009
01-april-2009

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Unfired pressure vessels - Part 2: Materials

Unbefeuerte Druckbehälter - Teil 2: Werkstoffe

Réipients sous pression non soumis a la flamme - Partie 2: Matériaux

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Ta slovenski standard je istoveten z: EN 13445-2:2002/A5:2009

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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 13445-2:2002/A5

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English Version

Unfired pressure vessels - Part 2: Materials

Réceptifs sous pression non soumis à la flamme - Partie
2: Matériaux

Unbefeuerte Druckbehälter - Teil 2: Werkstoffe

This amendment A5 modifies the European Standard EN 13445-2:2002; it was approved by CEN on 9 August 2008.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for inclusion of this amendment into the relevant national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Management Centre or to any CEN member.

This amendment 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 Management Centre has the same status as the official versions.

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

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Foreword

This document (EN 13445-2:2002/A5:2009) has been prepared by Technical Committee CEN/TC 54 "Unfired pressure vessels", the secretariat of which is held by BSI.

This Amendment to the European Standard EN 13445-2:2002 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2009, and conflicting national standards shall be withdrawn at the latest by July 2009.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 EC Directive(s).

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

This document includes the text of the amendment itself. The corrected pages of EN 13445-2 will be delivered as issue 35 of the standard.

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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

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EN 13445-2:2002/A5:2009 (E)

Add the following references to clause 2:

2 Normative references

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

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

EN 10216-4:2002, *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, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 3: Alloy fine grain steel tubes*

EN 10217-4:2002, *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, *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, *Pièces forgées en acier pour appareils à pression — Partie 3 : Aciers au nickel avec caractéristiques spécifiées à basse température.*

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

EN 10269:1999, *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 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 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)*

Delete existing Annex B and replace it with the following text:

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Annex B (normative)

Requirements for prevention of brittle fracture at low temperatures

B.1 General

This annex distinguishes between pressure equipment that has design temperature for normal operation higher or lower than 50 °C.

For pressure equipment with normal operation temperatures higher than 50 °C B.5 applies. If B.5 is not applicable, the following rules for lower normal operation temperatures shall be used.

For pressure equipment with design temperature equal to or less than 50 °C this annex specifies three alternative methods for establishing criteria for the prevention of low temperature brittle fracture¹⁾ of steels in the form of plate, strip, tubes, fittings, forgings, castings, flanges, fasteners and weldments used in pressure parts. The criteria are based on impact energy requirements at specified temperatures for the base material, heat affected zone (including the fusion line) and weld metals.

The three methods are:

Method 1 Code of Practice:

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- a) Technical requirements based on the choice of $T_R = T_{27J}$ as specified in harmonised European Material Standards and on the assumption that it is possible to achieve these minimum properties after fabrication. Calculated from the principles of fracture mechanics used for method 2 for C and CMn steels with yield strength < 460 MPa and
- b) based on operating experience for Ni-alloyed steels with Ni ≥ 3 % up to 9 %, for austenitic steels and for bolts and nuts.

Method 2 Method developed from the principles of fracture mechanics and from operating experiences:

A more flexible approach than method 1 for derivation of technical requirements applicable to C, CMn and low alloy ferritic steels with a specified minimum yield strength ≤ 500 MPa and for austenitic-ferritic steels with a specified minimum yield strength ≤ 550 MPa. This method can be applied for these steels to a wider range of thicknesses and temperatures than method 1 because T_R must not be equal to T_{27J} (see Figures B.2–1 to B.2–11). In addition for ferritic steels with max 355 MPa in PWHT condition operation experience was considered for higher thicknesses.

Method 3 The application of a fracture mechanics analysis. This general method is applicable to cases not covered by methods 1 or 2. This method may also be used to justify deviations from the requirements of method 1 or 2. Only general guidance is given on the use of this method which shall only be used in agreement with the parties concerned.

Each of the three methods may be used independently. It is only necessary to satisfy the requirement of any one method.

¹⁾ Including temperatures at pressure tests

All applicable combinations of the temperatures T_M (minimum metal temperature) and T_S (temperature adjustment term) shall be considered and the lowest possible T_R -value (design reference temperature) shall be used for the determination of the required material impact test temperature.

NOTE For definitions of temperature terms see 3.1.1 to 3.1.4.

B.2 Material selection and impact energy requirements

B.2.1 Introduction

The methods specified in B.2.2 (method 1) or B.2.3 (method 2) shall be used to determine the impact energy required to avoid brittle fracture. Alternatively, B.2.4 (method 3) may be used to determine the required toughness. The method used shall be fully documented, in order to ensure that compliance can be verified.

Reference thickness for constructional details is defined in Table B.4-1.

B.2.2 Method 1

B.2.2.1 General

Method 1 allows the selection of materials taken from harmonised European material standards with regard to prevention of brittle fracture. Table B.2-1 gives an overview to the following tables by steel type and product form.

The weld metal, the heat affected zone and other parts affected by manufacturing processes shall satisfy the same impact energy requirements as the guaranteed minimum properties for the base material at T_R given in the tables.

The Table lists design reference temperatures for maximum thickness at given strength levels represented by steels from harmonised European material standards with guaranteed minimum strength and impact properties. Where it is not possible to achieve these minimum properties after fabrication, a tougher starting material shall be selected.

Table B.2-1 — Guide to material selection

Table	Material or product form	Steel group	Clause
B.2-2	Plates and strips	Ferritic steels	B.2.2.2
B.2-3	Seamless and welded pipes		
B.2-4	Bars		
B.2-5	Forgings		
B.2-6	Ni alloyed steels ($1,5 < Ni \leq 5 \%$)	Ferritic steels	B.2.2.3
B.2-7	Ni-alloyed steel (9 % Ni)		
B.2-8	Bolts and nuts	Ferritic steels	B.2.2.4
B.2-9		Austenitic steels	
B.2-10			
B.2-11	Austenitic steel grades	Austenitic steels	B.2.2.5

NOTE Requirements for austenitic-ferritic steels are only given in B.2.3 (method 2).

Where test pieces of at least 5 mm wide can not be obtained the material need not be subject to impact testing.

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Values of the design reference temperature T_R shall be calculated from the metal temperature T_M using the values of the temperature adjustment T_S given in Table B.2–12.

B.2.2.2 Ferritic steels

Tables B.2–2 to B.2–5 list ferritic steels taken from harmonised European material standards with specified impact properties below $-10\text{ }^\circ\text{C}$.

The tabulated value of T_R is based on the impact test temperature T_{KV} for $KV = 27\text{ J}$.

Table B.2–2 — General requirements for prevention of brittle fracture with reference thickness for plates and strips

Plates and Strips									
No. as per Table E.2-1	European Standard	Grade	Material No.	Max. reference thickness e_B		Design reference temperature T_R ($^\circ\text{C}$)	Material group to CR ISO 15608:2000	Remarks	
				AW	PWHT				
1	EN 10028-2:2003	P235GH	1.0345	35	90	- 20	1.1		
2		P265GH	1.0425	35	75				
3		P295GH	1.0481	35	65		1.2		
4		P355GH	1.0473	35	55				
29	EN 10028-3:2003	P275NH	1.0487	35	75	- 20	1.1		
30		P275NL1	1.0488	35	75	- 40			
31		P275NL2	1.1104	35	90	- 50			
32		P355N	1.0562	35	55	- 20	1.2		
33		P355NH	1.0565	35	55	- 20			
34		P355NL1	1.0566	35	55	- 40			
35		P355NL2	1.1106	35	55	- 50			
39	EN 10028-4:2003	11MnNi5-3	1.6212	35	50	- 60	9.1		
40		13MnNi6-3	1.6217	35	50	- 60			
41		15NiMn6	1.6228	35	50	- 80			
50	EN 10028-5:2003	P355M	1.8821	35	-	- 20	1.2	a)	
51		P355ML1	1.8832	35	-	- 40			a)
52		P355ML2	1.8833	35	-	- 50			a)
53		P420M	1.8824	35	-	- 20	2.1	a)	
54		P420ML1	1.8835	35	-	- 40			a)
55		P420ML2	1.8828	35	-	- 50			a)
59	EN 10028-6:2003	P355Q	1.8866	35	60	- 20	1.2		
60		P355QH	1.8867	35	60	- 20			
61		P355QL1	1.8868	35	60	- 40	3.1		
62		P355QL2	1.8869	35	60	- 60			

a) TMCP steels shall not be Post Weld Heat Treated

Table B.2-3 — General requirements for prevention of brittle fracture with reference thickness for seamless and welded tubes

Seamless and welded tubes								
No. as per Table E.2-1	European Standard	Grade	Material No.	Max. reference thickness		Design reference temperature T_R (°C)	Material group to CR ISO 15608:2000	Remarks
				AW	e_B PWHT			
231	EN 10216-3:2002	P275NL1	1.0488	35	75	- 40	1.1	
232		P275NL2	1.1104	35	75	- 50		
233		P355N	1.0562	35	55	- 20	1.2	
234		P355NH	1.0565	35	55	- 20		
235		P355NL1	1.0566	35	55	- 40		
236		P355NL2	1.1106	35	55	- 50		
248	EN 10216-4:2002	P215NL	1.0451	10	10	- 40	1.1	a)
249		P255QL	1.0452	35	40	- 50		
250		P265NL	1.0453	25	25	- 40		
251		26CrMo4-2	1.7219	15	40	- 60	5.1	
252		11MnNi5-3	1.6212	35	40	- 60	9.1	
253		13MnNi6-3	1.6217	35	40	- 60	9.1	
306	EN 10217-3:2002	P275NL1	1.0488	35	40	- 40	1.1	
307		P275NL2	1.1104	35	40	- 50		
308		P355N	1.0562	35	40	- 20	1.2	
309		P355NH	1.0565	35	40	- 20		
310		P355NL1	1.0566	35	40	- 40		
311		P355NL2	1.1106	35	40	- 50		
316	EN 10217-4:2002	P215NL	1.0451	10	10	- 40	1.1	a)
317		P265NL	1.0453	16	16	- 40	1.1	a)
321	EN 10217-6:2002	P215NL	1.0451	10	10	- 40	1.1	a)
322		P265NL	1.0453	25	25	- 40	1.1	a)

a) Thickness limitation results from wall thickness limitation in the European material standard and in the European component standards respectively.

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Table B.2-4 — General requirements for prevention of brittle fracture with reference thickness for bars

Bars								
No. as per Table E.2-1	European Standard	Grade	Material No.	Max. reference thickness		Design reference temperature T_R (°C)	Material group to CR ISO 15608:2000	Remarks
				AW	PWHT			
147	EN 10273:2000	P275NH	1.0487	35	75	- 20	1.1	
148		P355NH	1.0565	35	55		1.2	
150		P355QH	1.8867	35	55		1.2	

Table B.2-5 — General requirements for prevention of brittle fracture with reference thickness for forgings

Forgings								
No. as per Table E.2-1	European Standard	Grade	Material No.	Max. ref. thickness		Design reference temperature T_R (°C)	Material group to CR ISO 15608:2000	Remarks
				AW	PWHT			
367	EN 10222-3:1998	13MnNi6-3	1.6217	35	70	- 60	9.1	
369		15NiMn6	1.6228	35	50	- 80	9.1	
378	EN 10222-4:1998	P285QH	1.0478	35	85	- 20	1.2	
380		P355QH1	1.0571	35	60	- 20	1.2	
382		P420QH	1.8936	35	50	20	3.1	

B.2.2.3 Ni –alloyed steels (Ni > 1.5 %)

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Table B.2-6 lists Ni alloyed steels up to and including 5 % Nickel taken from harmonised European material standards.

Table B.2-7 lists Ni alloyed steels with 9 % Nickel taken from harmonised European material standards.

The tabulated value of T_R is based on the impact test temperature T_{KV} for $KV = 27$ J.