SLOVENSKI STANDARD
SIST EN 13445-6:2009/oprA1:2014

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Neogrevane tlačne posode - 6. del: Zahteve za konstruiranje in proizvodnjo tlačnih posod in tlačnih delov posode iz nodularne litine - Dopolnilo A1

Unfired pressure vessels - Part 6: Requirements for the design and fabrication of pressure vessels and pressure parts constructed from spheroidal graphite cast iron

Unbefeuerte Druckbehälter - Teil 6: Anforderungen an die Konstruktion und Herstellung von Druckbehältern und Druckbehälterteilen aus Gusseisen mit Kugelgraphit

Récipients sous pression non soumis à la flamme - Partie 6: Exigences pour la conception et la fabrication des récipients sous pression et des parties sous pression moulés en fonte à graphite sphéroïdal

Ta slovenski standard je istoveten z: **EN 13445-6:2009/prA1**

ICS:

23.020.30	Tlačne posode, plinske jeklenke	Pressure vessels, gas cylinders

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This draft amendment is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 54.

This draft amendment A1, if approved, will modify the European Standard EN 13445-6:2009. If this draft becomes an amendment, 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.

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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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Contents

Page

Foreword

This document (EN 13445-6:2009/prA1:2013) has been prepared by Technical Committee CEN/TC 54 “Unfired pressure vessels”, the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

Contents

Insert the following headings in the contents list:

1 Clause 1 Scope

Delete the existing paragraph 1 and substitute the revised scope as follows:

This European Standard specifies requirements for the design, materials, manufacturing and testing of pressure vessels and pressure vessel parts intended for use with a maximum allowable pressure, PS, equal or less than:

— 100 bar when containing gases in group 1 or 2

— 100 bar when containing liquids in group 1

— 1000 bar when containing liquids in group 2,

— and shell wall thicknesses not exceeding 60 mm, which are constructed of ferritic or austenitic spheroidal graphite cast iron. The thickness limitation of the shell does not apply to thickness of flanges, reinforcements, bosses etc.

2 Clause 2 Normative references

Delete the existing clause 2 and substitute the following:

EN 287-6, *Qualification test of welders — Fusion Welding — Part 6: Cast iron*

EN 764-2:2012, *Pressure equipment — Part 2: Quantities, symbols and units*

EN 764-5:2013, *Pressure equipment — Part 5: Compliance and inspection documentation of materials*

EN 837-1:1996, *Pressure gauges — Part 1: Bourdon tube pressure gauges — Dimensions, metrology, requirements and testing*

EN 837-3:1996, *Pressure gauges — Part 3: Diaphragm and capsule pressure gauges — Dimensions, metrology, requirements and testing*

EN 1011-8:2004, *Welding — Recommendations for welding of metallic materials — Part 8: Welding of cast irons*

EN 1369:2012, *Founding — Magnetic particle inspection*

EN 1370:2011, *Founding — Examination of surface condition*

EN 1371-1:2011, *Founding — Liquid penetrant testing — Part 1: Sand, gravity die and low pressure die castings*

EN 1559-1:2011, *Founding — Technical conditions of delivery — Part 1: General*

EN 1559-3:2011, *Founding — Technical conditions of delivery — Part 3: Additional requirements for iron castings*

EN 1563:2011, *Founding — Spheroidal graphite cast irons*

EN 12680-3:2011, *Founding — Ultrasonic testing — Part 3: Spheroidal graphite cast iron castings.*

EN 12681:2003, *Founding — Radiographic examination*

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

EN 13445-3:2009, EN 13445-3:2009/A1:012, *Unfired pressure vessels — Part 3: Design*

EN 13445-5:2009, EN 13445-5:2009/A1:2011; EN 13445-5:2009/A2:2011; EN 13445-5:2009/A3:2011; EN 13445-5:2009/A4:2012, *Unfired pressure vessels — Part 5: Inspection and testing*

EN 13835:2012, *Founding — Austenitic cast irons*

EN 15776:2011, *Unfired pressure vessels. Requirements for the use of cast irons with an elongation after fracture equal or less than 15 %*

EN ISO 945-1:2008/Cor. 1:2010, *Microstructure of cast irons — Part 1: Graphite classification by visual analysis (*ISO 945-1:2008/Cor. 1:2010)

EN ISO 8062-1:2007, *Geometrical product specifications (GPS) — Dimensional and geometrical tolerances for moulded parts — Part 1: Vocabulary* (ISO 8062-1:2007)

EN ISO 8062-3:2007, *Geometrical product specifications (GPS) — Dimensional and geometrical tolerances for moulded parts — Part 3: General dimensional and geometrical tolerances and machining allowances for castings* (ISO 8062-3:2007)

EN ISO 15614-3:, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 3: Fusion welding of non-alloyed and low-alloyed cast irons (ISO 15614-3:2008)*

This European standard, EN 13445-6, does not include lamellar graphite cast iron grades for ferritic and austenitic grades, which are explicitly excluded. Requirements for the use of cast irons with an elongation after fracture equal or less than 15 % are given in EN 15776 [1].

3 Table 3.3.1

Insert the following rows:

e_c	Required thickness of cover (Annex G)	mm
e_f	Required thickness of flange (Annex G)	mm

4 Clause 5.1

Delete the existing paragraphs 1 and 2 and substitute the following:

All cast iron grades subject to internal or external pressure shall comply with EN 1563:2012 for ferritic spheroidal graphite cast iron and EN 13835:2012 for austenitic spheroidal graphite cast iron.

The material grades listed in Table 5.1-1 and Table 5.1-2 may be produced in the as-cast or heat treated condition (see EN 1563:2012, Clause 6).

Delete the existing note and substitute the following:

NOTE The use of materials working in the creep domain is not applicable to this standard since stress ranges are limited to elastic material behaviour.

5 Tables 5.1.1 and 5.1.2

Delete the existing tables and substitute the following:

Table 5.1-1 — Allowable material grades for usual design temperatures (-10 °C up to 300 °C)

Material standard	Material designation [a]		Design temperature limits °C
	Symbol	Number	
EN 1563:2012	EN-GJS-350-22-RT	5.3101	$-10 \leq TS \leq 300$
	EN-GJS-350-22	5.3102	$-10 \leq TS \leq 300$
	EN-GJS-400-18-RT	5.3104	$-10 \leq TS \leq 300$
	EN-GJS-400-18	5.3105	$-10 \leq TS \leq 300$
	EN-GJS-450-18	5.3108	$-10 \leq TS \leq 300$
[a] When materials specified in these tables are not available, other suitable materials may be used when the technical documentation defining the characteristics of the materials has been accepted in accordance with the requirements for European approval for materials (EAM) or particular material appraisal (PMA).			

Table 5.1-2 — Allowable material grades for low or high temperature design conditions

Material standard	Material designation [a]		Design temperature limits °C
	Symbol	Number	
EN 1563:2012	EN-GJS-350-22-LT	5.3100	$-40 \leq TS \leq 300$
	EN-GJS-400-18-LT	5.3103	$-20 \leq TS \leq 300$
EN 13835:2012	EN-GJSA-XNiMn23-4	5.3501	$-196 \leq TS \leq 300$
	EN-GJSA-XNi22	5.3503	$-40 \leq TS \leq 540$
	EN-GJSA-XNiMn13-7	5.3506	$-40 \leq TS \leq 300$
[a] When materials specified in these tables are not available, other suitable materials may be used when the technical documentation defining the characteristics of the materials has been accepted in accordance with the requirements for European approval for materials (EAM) or particular material appraisal (PMA).			

6 Clause 5.2.2

Delete the existing 5.2 and substitute the following:

5.2.2.1 Principle

The loadings to be accounted for shall be in accordance with EN 13445-3:2011, Clause 5.

The service conditions of Clause 4 shall be accounted for.

Design methods and design of specific components shall be in accordance with this European Standard and, when applicable, with the relevant clauses of EN 13445-3:2011 except as otherwise noted in this Part 6. For castings containing no welds, the weld joint coefficient z=1 shall be used for determining the required thickness. For fatigue, designs shall be checked against Annex D simplified or detailed method of this standard. Attention is drawn to radius requirements according to 5.2.2.7.

NOTE 1 Testing factors (0, 8 or 0, 9) are already accounted for in determining nominal design stress in Clause 5.2.2.2 of this Part 6.

NOTE 2 For non-circular sections (rectangular sections), see EN13445-3 Clause 15 (see remark about fatigue design and radius requirements in 5.2.2.1).

If the geometry of the component or the loading case does not allow calculation by the formulas given in EN 13445-3:2011 and Annex G of this standard, design by analysis (DBA) (see Annex E) or design by experiment (DBE) shall be applied.

Depending on the complexity of the component, the loading conditions and the level of NDT testing, the designer may choose one of the following available design methods mentioned below. Guidance is given on the correlation between safety factor, testing factor and the method to assess dynamic loading (see Table 5.2-1).

5.2.2.1.1 Static loading

In order to design the part for static loading, the following options can be considered by the designer.

5.2.2.1.1.1 Design by formula (DBF)

Equations for the calculation of the various components of the pressure part are given in EN 13445-3:2011 and Annex G. Annex G gives additional equations for non-standard shaped parts often used in casting design.

5.2.2.1.1.2 Design by analysis (DBA)

The following applies:

1) decide whether the direct route (limit load – EN 13445-3:2011, Annex B) or the stress categorisation method (EN 13445-3:2011, Annex C) will be followed. Decide whether linear or non-linear approach will be used;

2) base modelling and interpretation of calculation results shall be based on analysis thicknesses (e_a) and material characteristics at operation temperature;

3) for interpretation of calculation results, follow the evaluation procedures and assessment criteria in order to evaluate the fitness for purpose of the real structure. These design checks and related procedures are typical for the failure mode to be dealt with. For the different failure modes see EN 13445-3:2011.

5.2.2.1.1.3 Design by experiment (DBE)

Where design by equations according to EN 13445-3:2011 is not considered appropriate due to complex shape of the component, a hydraulic burst test to determine the analysis thickness ea and the minimum thickness e_{min} shall be performed according to the procedure in 5.2.2.1.1.3. This test is also a part of the technical documentation.

This design method may be used without additional calculations if $P_d \cdot V < 6000$ bar·L.

If $P_d \cdot V > 6000$ bar·L for the complete vessel, this method can be used in addition to DBA or DBF.

The minimum required thickness at a specific location is given by:

$$e_a = e_{act} \cdot \left(\frac{S \cdot PS \cdot R_{m(3)}}{P_{b,act} \cdot R_{p0,2} \cdot C_Q \cdot C_T \cdot C_e} \right)^{1/n} \quad (5\text{-}1)$$

$$e_{min} \geq e_a + c \quad (5\text{-}2)$$

where

$e_{act.}$ is the minimum measured wall thickness at the specific location;

$R_{p0,2}$ is in accordance with Annex A;

$P_{b,act}$ is the actual obtained value of burst pressure or the highest pressure during the test;

$n = 1$ for curved surfaces (cylinders, spheres) or cones with angles $\alpha \leq 60°$, stayed surfaces and stressed parts if bending stress is less than 2/3 of the total stress;

$n = 2$ for all other surfaces.

Determination of the hydraulic burst pressure and maximum allowable pressure for static loading

A random sample from the production of the vessel or vessel part shall be taken for the burst test or to determine the maximum allowable working conditions. The procedure shall be as follows:

1) verify that the part or vessel to be tested is cast according to the specified drawing and any revision thereof. The material used shall be the same type and grade as for the production part;

2) verify that the part or vessel is machined to the same dimensions as the production part;

3) verify that the material properties meet the requirements of 5.1. For each casting used for the burst test, 3 test pieces for tensile testing, and, if applicable, for impact testing, shall be separately cast and tested. The results and the calculated average tensile strength shall be certified in accordance with 6.5;

4) the wall thicknesses of the entire casting shall be measured (at least one measurement per 100 mm x 100 mm). The results shall be marked on the casting at the location of the measurement or on the drawing;

5) verify that a calibrated pressure gauge is used; maximum tolerance shall conform to at least class 1 or better according to EN 837-1 and EN 837-3. The scale of the pressure gauge shall be approximately 4/3 of the anticipated burst pressure;

6) the pressure shall be increased in a controlled manner until the minimum required burst pressure is obtained:

$$P_b \geq PS \cdot \frac{R_{m(3)}}{f} \left(\frac{e_{act}}{e_{min} - c} \right)^n \quad (5\text{-}3)$$