SLOVENSKI STANDARD
SIST EN 13445-3:2014/oprA16:2019

01-november-2019

Neogrevane (nekurjene) tlačne posode - 3. del: Konstruiranje - Dopolnilo A16

Unfired pressure vessels - Part 3: Design

Unbefeuerte Druckbehälter - Teil 3: Konstruktion

Récipients sous pression non soumis à la flamme - Partie 3 : Conception

Ta slovenski standard je istoveten z: **EN 13445-3:2014/prA16**

ICS:

23.020.32 Tlačne posode Pressure vessels

SIST EN 13445-3:2014/oprA16:2019 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT EN 13445-3:2014 prA16

October 2019

ICS 23.020.30

English Version

Unfired pressure vessels - Part 3: Design

Récipients sous pression non soumis à la flamme - Partie 3 : Conception

Unbefeuerte Druckbehälter - Teil 3: Konstruktion

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 A16, if approved, will modify the European Standard EN 13445-3:2014. 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.

This draft amendment was established by CEN 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.

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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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Ref. No. EN 13445-3:2014/prA16:2019 E

Contents

Page

European foreword

This document (EN 13445-3:2014/prA16:2019) 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.

This document has been prepared under a standardization request 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 EN 13445-3:2014.

1 Modification to 7.6.5, Junctions - general

Add the following NOTE:

“

NOTE If this requirement for the distance to another cone/cylinder junction is not fulfilled a conical shell and conical transition without knuckles can be designed according to 16.15.”.

2 Modification to Clause 16, Additional non-pressure loads

Replace “Equation (***)” with “Formula (***)” and “Equations (***)” with “Formulae (***)”.

3 Modifications to 16.6.2, Additional specific symbols and abbreviations

Add the following definitions:

“

F_L is the resulting force due to the constant radial line load acting on a shell (see Figures 16.6.-2 and 16.6-3), $F_L > 0$ radial outwards, $F_L < 0$ radial inwards;

M_L is the resulting moment due to the variable radial line load acting on a shell (see Figures 16.6-2 and 16.6-3);”.

Replace the definition of υ_1 with the following one:

“

υ_1 is the ratio between local membrane stress and absolute value of local bending stress;”.

4 Modifications to 16.6.8, Single line loads (see Figures 16.6-2 and 16.6-3)

Amend Formula (16.6-14) as follows:

“

$$\upsilon_1 = \min\left(0,08 \cdot \lambda_1 ; 0,20\right) \quad \text{for } F_L > 0 \text{ and all values of } M_L \qquad (16.6\text{-}14a)$$

$$\upsilon_1 = -\min\left(0,08 \cdot \lambda_1 ; 0,20\right) \quad \text{for } F_L < 0 \qquad (16.6\text{-}14b)”.$$

Amend Formula (16.6-18) as follows:

“

$$\upsilon_1 = \min\left(0,08 \cdot \lambda_1 ; 0,30\right) \quad \text{for } F_L > 0 \text{ and all values of } M_L \qquad (16.6\text{-}18a)$$

$$\upsilon_1 = -\min\left(0,08 \cdot \lambda_1 ; 0,30\right) \quad \text{for } F_L < 0 \qquad (16.6\text{-}18b)”.$$

Amend the last sentence in step 4) as follows:

“

with bending limit stress $\sigma_{b,all}$ from 16.6.6 with υ_1 and υ_2 for $F_{L,max}$ and with υ_1 and the absolute value of $|\upsilon_2|$ for $M_{L,max}$.”.

5 Modification to 16.7.5, Load limits for shell

Amend step 4) as follows:

“

4) With the appropriate value of λ, and the absolute values of $|\upsilon_1|$ and $|\upsilon_2|$, calculate the bending limit stress from 16.6.6, Formula (16.6-6);”.

6 Modification to 16.10.1, General

Replace Subclause 16.10.1 with the following one:

“

This clause gives rules for the design of vertical cylindrical shells supported by brackets.

Rules for the design of the support brackets are given in 16.10.6. Four types of bracket are considered, as shown in Figure 16.10-1. Rules for the design of vertical vessels with legs located on the dished end are given in 16.11. The design of support legs is not included.”

7 Modifications to 16.10.2, Additional specific symbols and abbreviations (see Figure 16.10-1)

Replace Subclause 16.10.2 with the following one:

“

16.10.2 Additional specific symbols and abbreviations

The following symbols and abbreviation are in addition to those in Clause 4.

A_w is the cross-section area of bracket or reinforcing plate attachment weld;

a_e is the eccentricity of normal force in gusset plate (see Figure 16.10-10);

a_s is the eccentricity of applied load in gusset plate (see Figure 16.10-10);

a_1 is the distance from centre of vertical force to shell or reinforcing plate (see Figure 16.10-1);

a_2 is the distance from centre of resultant horizontal force to shell or reinforcing plate (see Figure 16.10-7);

a_3 is the distance from centre of vertical force to shell or reinforcing plate, measured along centre-line of gusset plate (see Figure 16.10-10);

b_s is the width of idealized rectangular gusset plate (see Figure 16.10-10);

b_1 is the width of bearing plate (see Figure 16.10-1);

b_2 is the width of reinforcing plate (see Figure 16.10-1);

b_3 is the height of reinforcing plate (see Figure 16.10-1);

b_4 is the distance between centres of gusset plates (see Figure 16.10-1);

b_5 is the bolt centre-to-centre distance for type A, B or C brackets with one gusset plate or type D brackets;

D_{eq} is the equivalent calculation diameter (see 16.6.3);

D_i is the cylindrical shell inside diameter;

d_h is the diameter of bolt holes;

E is the modulus of elasticity of gusset plate;

e_a is the analysis thickness of shell;

e_n is the nominal thickness of shell;

e_s is the analysis thickness of gusset plate (see Figure 16.10-1);

e_1 is the analysis thickness of bearing plate (see Figure 16.10-1);

e_2 is the analysis thickness of reinforcing plate (see Figure 16.10-1)

F is the global axial force defined in Table 22–1 as vertical force F_V for the different load condition status, positive when acting downwards; F is the sum of F_1 and F_2;

F_1 is the global axial force acting on the part of the vessel above underside of bearing plates, positive when acting downwards;

F_2 is the global axial force acting on the part of the vessel below underside of bearing plates, positive when acting downwards; this force will normally include the weight of the vessel contents;

F_A is the preloading force on one anchor bolt;

F_B is the largest bolt force on one anchor bolt due to global axial force F and global moment M_A;

F_H is the global horizontal force defined in Table 22–1 as lateral force F_H for the different load condition status;

F_{Hi} is the radial horizontal force acting at base of support bracket i, positive when acting inwards;

$F_{Hi,max}$ is the maximum allowable radial horizontal force at base of support bracket;

$F_{Hi,R}$ is the resultant horizontal force acting at base of support bracket i;

$F_{Hi,R,max}$ is the maximum allowable resultant horizontal force at base of support bracket;

$F_{Hi,T}$ is the tangential horizontal force acting at base of support bracket i;

$F_{Hi,T,max}$ is the maximum allowable tangential horizontal force at base of support bracket;

F_{Ns} is the normal force acting on gusset plate (see Figure 16.10-10);

$F_{Ns,max}$ is the maximum allowable normal force acting on gusset plate;

F_{Vi} is the upward vertical force acting on support bracket i;

f_s is the nominal design stress for gusset plate as defined in Table 5.3.2.4-1 depending on load condition;

f_1 is the nominal design stress for bearing plate as defined in Table 5.3.2.4-1 depending on load condition;

f_2 is the nominal design stress for reinforcing plate as defined in Table 5.3.2.4-1 depending on load condition;

f_y is the yield strength for gusset plate;

h is the vertical distance from neutral axis of support bracket to underside of bearing plate or base of leg (see Figure 16.10-2 and Figure 16.10-6);

h_A is the vertical distance from underside of bearing plate to base of leg (see Figure 16.10-2);

h_S is the vertical distance from underside of bearing plate to location of horizontal neutral axis of bracket joint to shell or reinforcing plate (see Figure 16.10-2);

h_1 is the height of support bracket (see Figure 16.10-1);

h_2 is the depth of support bracket measured from outside of shell or reinforcing plate (see Figure 16.10-1);

h_3 is the width of contact between bearing plate and support structure (see Figure 16.10-9);

h_4 is the horizontal distance from outside of shell or reinforcing plate to inner edge of gusset plate at attachment to bearing plate (see Figure 16.10-10);

h_5 is the horizontal distance from outside of shell or reinforcing plate to outer edge of gusset plate at attachment to bearing plate (see Figure 16.10-10);

h_6 is the horizontal distance from inner edge of gusset plate to centre-line of idealized rectangular gusset plate at attachment to bearing plate (see Figure 16.10-10);

I_{yy} is the second moment of area of cross-section of each leg about an axis yy normal to surface of vessel;

I_{zz} is the second moment of area of cross-section of each leg about a horizontal axis zz parallel to surface of vessel;

k is a coefficient;

$K_1 \ldots K_{17}$ are coefficients;

K_{1U} is a coefficient;

l_s is the length of idealized rectangular gusset plate (see Figure 16.10-10);

M_A is the total global moment at centre-line of vessel at underside of bearing plates (see 16.10.4.1), defined in Table 22–1 as bending moment M_B for the different load condition status; M_A is the difference between the moments M_{A1} and M_{A2} acting above and below underside of bearing plates;

M_{A1} is the global moment at centre-line of vessel acting on the part of the vessel above underside of bearing plates;

M_{A2} is the global moment at centre-line of vessel acting on the part of the vessel below underside of bearing plates;

M_{Ab} is the global moment at centre-line of vessel at base of legs (see 16.10.4.1);

M_L is the longitudinal moment acting on support bracket;

$M_{L,max}$ is the maximum allowable longitudinal moment on support bracket;

M_U is the circumferential moment acting on support bracket;

$M_{U,max}$ is the maximum allowable circumferential moment on support bracket;

n is the number of support brackets;

n_B is the number of bolts for each support bracket;

n_s is the number of gusset plates per support bracket;

P_1 is the calculation pressure or test pressure;

R_o is the radius to outside of shell or reinforcing plate;

W_L is the elastic section modulus of bracket or reinforcing plate attachment weld in longitudinal direction;

W_U is the elastic section modulus of bracket or reinforcing plate attachment weld in circumferential direction;

β is the angle between direction of force $F_{Hi,max}$ and a line normal to surface of shell (see Figure 16.10-8);

γ_{M0} & γ_{M1} are partial safety factors;

δ is the angle in radians between direction of global horizontal force F_H and centre-line of support bracket i (see Figure 16.10-3);

λ_1 & λ_2 are factors;

λ_3 is the non-dimensional slenderness of gusset plate;

θ is the angle between bearing plate and normal force in gusset plate (see Figure 16.10-10);

σ_B is the bearing pressure;

$\sigma_{b,all}$ is the bending limit stress for shell;

σ_{mx} is the global membrane stress in shell in longitudinal direction;

σ_{my} is the global membrane stress in shell in circumferential direction;

$\sigma_{w,all}$ is the allowable stress in bracket or reinforcing plate attachment welds;

$\sigma_{w,eq}$ is the combined stress in bracket or reinforcing plate attachment welds;

σ_{wL} is the stress in bracket or reinforcing plate attachment welds due to longitudinal moment;

σ_{wU} is the stress in bracket or reinforcing plate attachment welds due to circumferential moment;

τ_w is the shear stress in bracket or reinforcing plate attachment welds;

υ_1 & υ_2 are factors;

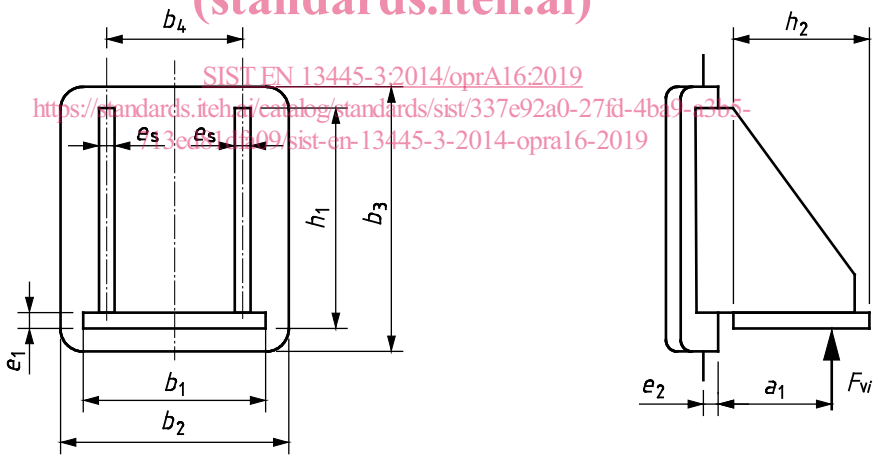
υ_{1U} & υ_{2U} are factors;

ϕ is a factor;

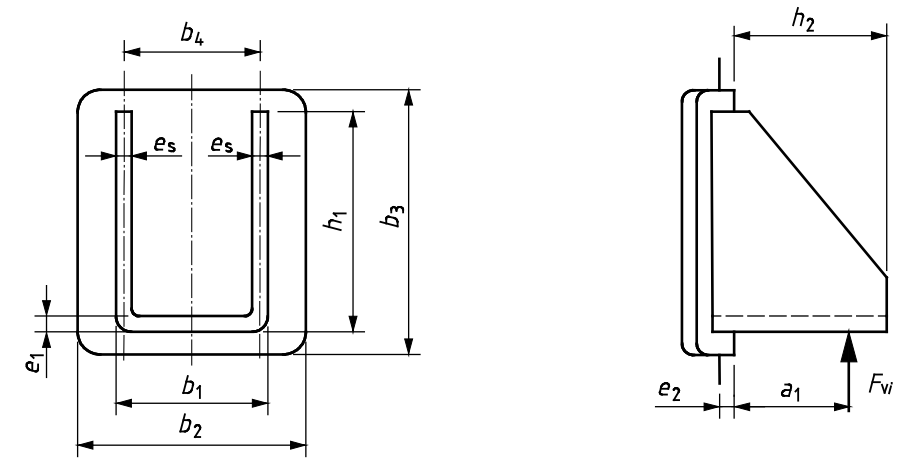
χ is the reduction factor.”.

Delete Figure 16.10-1 and replace with the following one at the end of Subclause 16.10.2:

“



(a)



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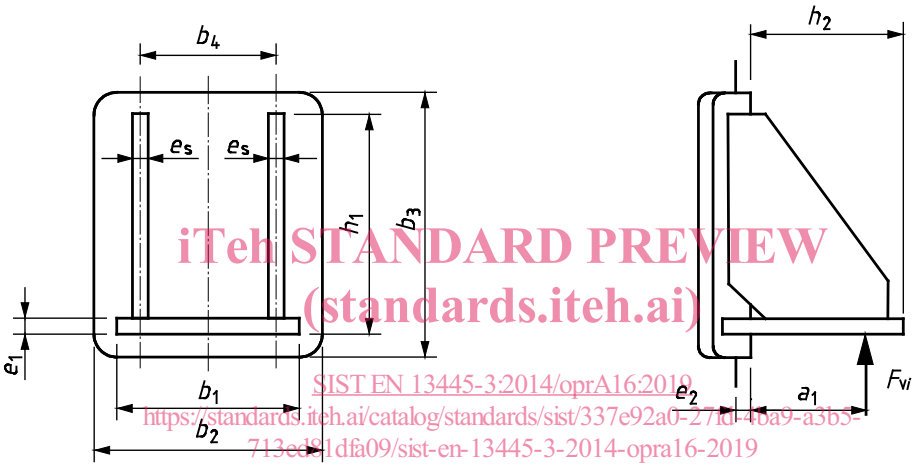

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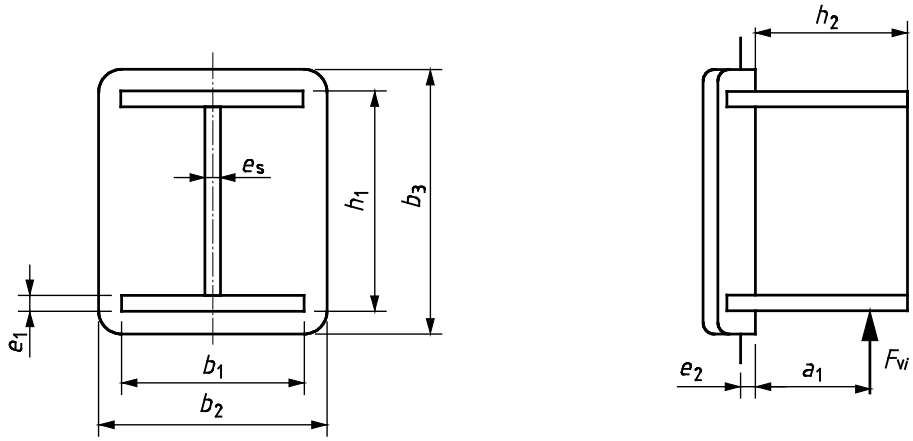

(d)

Figure 16.10-1 – Support brackets for vertical vessels".

8 Modification to 16.10.3, Conditions of applicability

Amend Subclause 16.10.3 as follows:

“

16.10.3 Conditions of applicability

The following conditions shall apply:

a) $0{,}001 \leq e_n / D_{eq} \leq 0{,}05$ (where e_n is the nominal thickness of the shell and D_{eq} is obtained from 16.6.3 Formula (16.6-1) for cylindrical shells);

b) For bracket supports type A, B and C (Figure 16.10-1)

$0{,}2 \leq b_4 / h_1 \leq 1{,}0$;

c) For bracket supports type D (Figure 16.10-1)

$0{,}5 \leq b_1 / h_1 \leq 1{,}5$;

d) If a reinforcing plate is applied:

$1{,}0 \leq e_2 / e_n \leq 1{,}5$;

$b_3 / h_1 \leq 1{,}5$;

$b_2 / b_3 \geq 0{,}6$;

e) The bracket is connected to a cylindrical shell;

f) The vertical bracket force F_{Vi} acts parallel to the shell axis;

g) $h_3 / h_2 \geq 1/3$ (see Figure 16.10-1 and Figure 16.10-9).

The following requirements and recommendations shall also be taken into account:

h) Application of more than 3 brackets requires special care during assembly to guarantee a nearly equal loading of all brackets;

i) Special consideration should be given to the stability of vessels with two brackets;

j) Type A supports are not recommended for vessels subject to significant horizontal loads.”.

9 Modifications to 16.10.4, Applied forces

Replace Subclause 16.10.4 with the following one:

“

16.10.4 Applied forces

16.10.4.1 Vertical forces

The applied vertical force F_{Vi} on the support brackets is obtained from Formula (16.10-1) or (16.10-2). The global axial force F and the global moment M_A are defined in Table 22-1 as the vertical force F_V and