



**SLOVENSKI STANDARD**  
**SIST EN 13445-3:2002/A16:2009**  
**01-april-2009**

Unfired pressure vessels - Part 3: Design

Unbefeuerte Druckbehälter - Teil 3: Konstruktion

Récipients non soumis à la flamme - Partie 3: Conception

Ta slovenski standard je istoveten z: EN 13445-3:2002/A16:2008

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EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**EN 13445-3:2002/A16**

December 2008

ICS 23.020.30

English Version

## Unfired pressure vessels - Part 3: Design

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

Unbefeuerte Druckbehälter - Teil 3: Konstruktion

This amendment A16 modifies the European Standard EN 13445-3:2002; it was approved by CEN on 25 September 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.

CEN members are the national standards bodies of 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 United Kingdom.

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EUROPEAN COMMITTEE FOR STANDARDIZATION  
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EUROPÄISCHES KOMITEE FÜR NORMUNG

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## Foreword

This document (EN 13445-3:2002/A16:2008) 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 13445-3:2002 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2009, and conflicting national standards shall be withdrawn at the latest by June 2009.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 13445-3 will be delivered as issue 34 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 13445-3:2002/A16:2008 (E)**

Add the following new clause:

**22 Circular flat ends with radial reinforcement ribs****22.1 Purpose**

The purpose of the rules in this Clause is to allow the design of circular flat ends reinforced by radial ribs, with or without uniformly distributed peripheral bending moment, subject to pressure.

The components considered in this Clause consist of a circular flat end, reinforced by radial uniformly spaced ribs; the height of the ribs is generally constant, however their profile may be slightly inclined at the outer edge (see Figures 22.2-1, 22.2-2, 22.2-3 and 22.2-4).

The ribs shall be connected with each other at the centre of the end; this may be obtained either by welding them together, or by welding them to a central ring or to a rigid plug. The number of the ribs should be neither smaller than 3 nor greater than 24.

These rules do not deal with the calculation for leak tightness of the connection between the end and the corresponding flange on the vessel; in case the leak tightness has to be assured, the required thickness of the end might be greater than the thickness required by the static calculation, at least in the area of the gasket and relevant bolting.

This kind of construction is not recommended in case of cyclic loadings or in case of external corrosion.

**22.2 Specific definitions**

The following definitions are in addition to those in Clause 3.

**22.2.1****reinforcing rib**

rectangular plate located along the radius of a circular flat end, located perpendicularly to its plane and welded to it from both sides

**22.2.2****continuous weld**

weld between the rib and the end, located on both sides of the rib, for its entire length

**22.2.3****intermittent weld**

weld between the rib and the end, located on both sides of the rib, composed by different segments interesting only a portion of its length.

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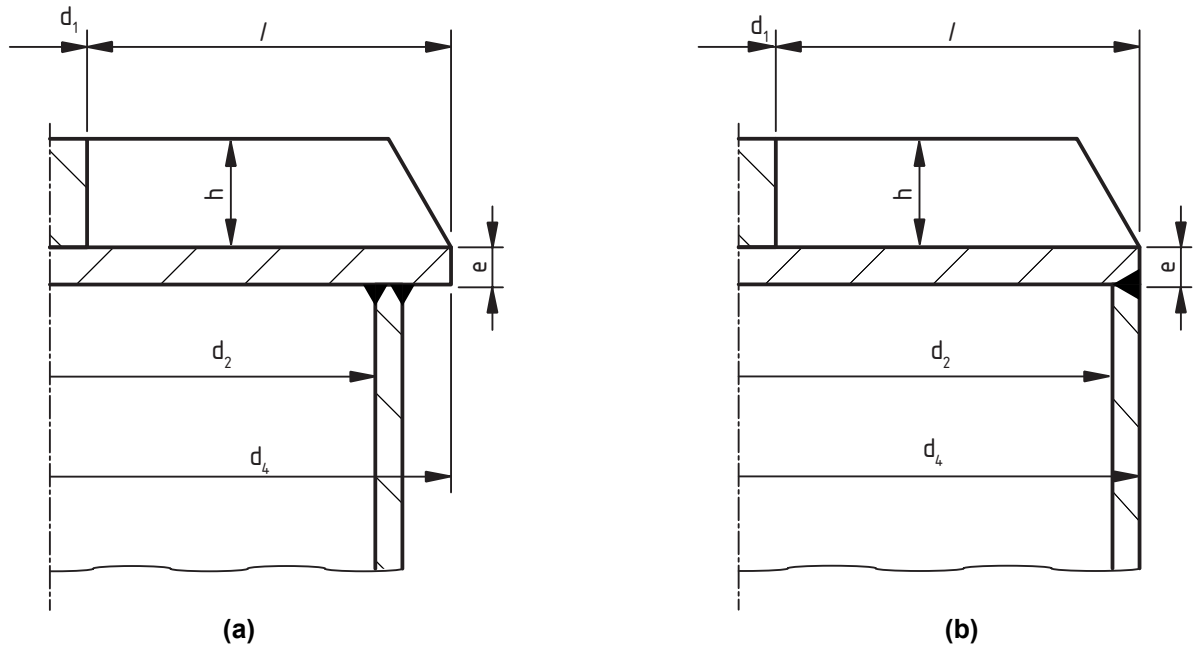


Figure 22.2-1 Welded ends with ribs

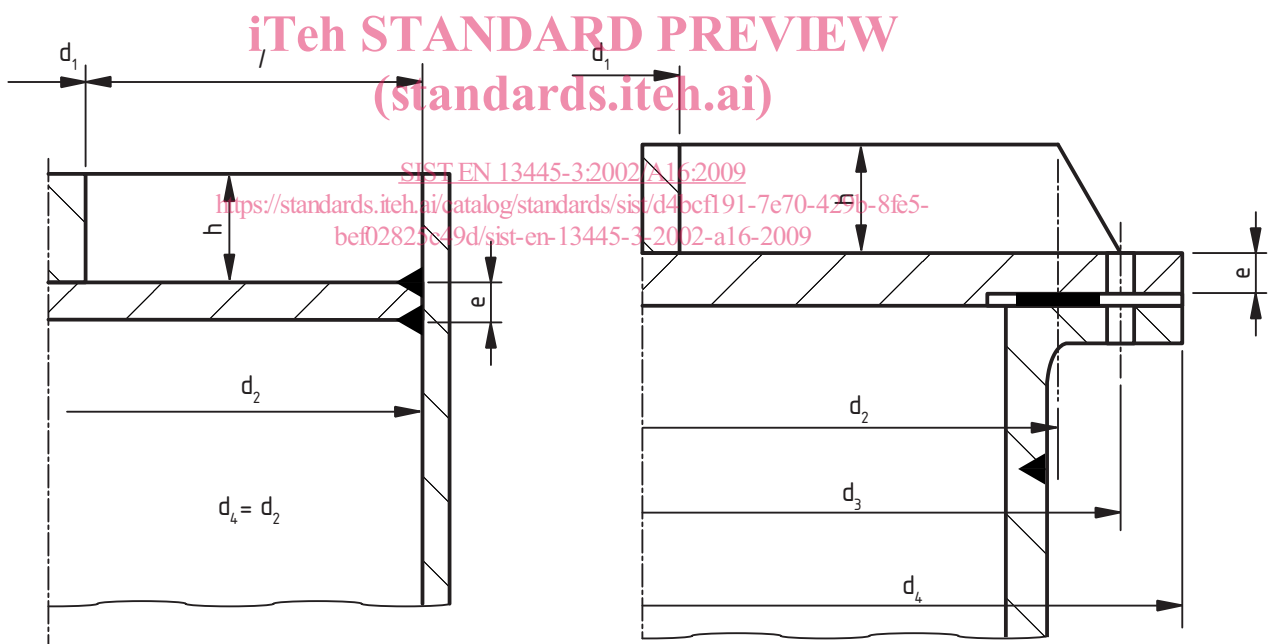


Figure 22.2-2 Welded end with ribs (Ribs welded to a protruding shell)

Figure 22.2-3 Bolted end with ribs and additional peripheral bending moment

## EN 13445-3:2002/A16:2008 (E)

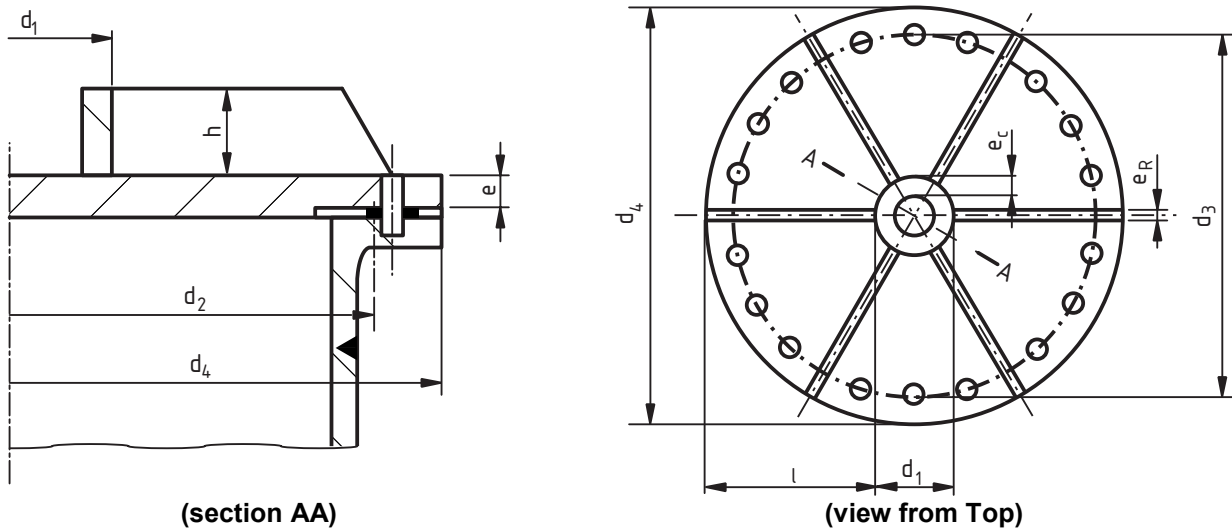


Figure 22.2-4 Bolted end with ribs without additional peripheral bending moment

### 22.3 Specific symbols and abbreviations

The following symbols and abbreviations are in addition to those in clause 4.

$d_1$	diameter of central plug or ring
$d_2$	diameter subject to pressure
$d_3$	diameter of bolt circle
$d_4$	outside diameter of end
$e$	thickness of end
$e_R$	thickness of reinforcing ribs
$e_C$	thickness of central circular ring
$f$	nominal design stress of end at design temperature
$f_R$	nominal design stress of rib at design temperature
$f_B$	nominal design stress of bolts at design temperature
$f_C$	nominal design stress of central ring at design temperature

NOTE Design temperature means the temperature of the condition to be assessed (bolting-up, operating or testing).

$g_o$	minimum required throat thickness of the weld between end and reinforcing rib
$g_1 \dots g_i$	throat thicknesses of the intermittent welds between end and reinforcing ribs (Figure 22.7-1)
$h$	height of reinforcing ribs
$l$	length of reinforcing ribs
$l_o$	in case of intermittent welds is the length of the most external weld between end and reinforcing rib



$l_1 \dots \dots$	$l_i$ lengths of the intermittent welds between end and reinforcing ribs
$n_V$	number of reinforcing ribs
$p_A$	maximum allowable pressure in operating or testing conditions
$t$	spacing between two consecutive ribs calculated on the diameter $d_2$
$W$	total bolt load in the different conditions (bolting-up, operating and testing) as defined in Clause 11
$z_R$	joint efficiency of the weld between the end and the reinforcing ribs
$z_C$	joint efficiency of the weld in the central ring
$\beta$	angle of the circular sectors free of openings

## 22.4 Ends without additional peripheral bending moment

### 22.4.1 Maximum allowable pressure

The maximum allowable pressure shall be the smaller of the values calculated with the following equations:

$$P_{\max} = \left( \frac{e}{C d_2} \right)^2 f \quad (22.4-1)$$

$$P_{\max} = \frac{0,25}{K} \left\{ \left( \frac{h}{l} \right)^2 + u + \sqrt{\left[ \left( \frac{h}{l} \right)^2 - u \right]^2 + 4 \left( \frac{h}{l} \right)^2} \right\} f_R \left( \frac{e_R}{d_2} \right) \quad (22.4-2)$$

where  $C$  and  $K$  are taken from Figure 22.4-1 and 22.4-2 respectively, while  $u$  is equal to 0,5 for continuous welds between the end and the ribs; when these welds are intermittent as in Figure 22.7-1, and are composed by  $m$  segments having each one the length  $l_i$ ,  $u$  shall be calculated with the following equation:

$$u = 0,9 - \frac{1}{2l} \sum_{i=1}^{i=m} l_i \quad (22.4-3)$$

NOTE 1 The length  $l$  of the reinforcing ribs shall be extended, whenever possible, up to the external diameter  $d_4$ , in any case at least up to the diameter  $d_3$ .

NOTE 2 When a central ring as in Figure 22.2-4 is provided, this one shall comply with the provisions of Clause 7.4.2.