SIST

# SLOVENSKI STANDARD
# SIST EN 13480-3:2012/A1:2018

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**Kovinski industrijski cevovodi - 3. del: Konstruiranje in izračun - Dopolnilo A1**

Metallic industrial piping - Part 3: Design and calculation

Metallische industrielle Rohrleitungen - Teil 3: Konstruktion und Berechnung

Tuyauteries industrielles métalliques - Partie 3 : Conception et calcul



**Ta slovenski standard je istoveten z:** **EN 13480-3:2012/A1:2017**



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| 77.140.75 | Jeklene cevi in cevni profili za posebne namene | Steel pipes and tubes for specific use |

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# EN 13480-3:2012/A1

June 2017

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English Version

# Metallic industrial piping - Part3: Design and calculation

Tuyauteries industrielles métalliques - Partie 3 : Conception et calcul

Metallische industrielle Rohrleitungen - Teil 3: Konstruktion und Berechnung

This amendment A1 modifies the European Standard EN 13480-3:2012; it was approved by CEN on 21 May 2017.

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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-CENELEC Management Centre has the same status as the official versions.



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EUROPEAN COMMITTEE FOR STANDARDIZATION
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# European foreword

This document (EN 13480-3:2012/A1:2017) has been prepared by Technical Committee CEN/TC 267 “Industrial piping and pipelines”, the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by December 2017, and conflicting national standards shall be withdrawn at the latest by December 2017.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN 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 EN 13480-3:2012.

This document includes the text of the amendment itself. The amended/corrected pages of EN 13480-3:2012 will be published in the new Edition 2017 of the European Standard.

According to the CEN-CENELEC Internal Regulations, the national standards organisations 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, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

# 1 Modifications to Clause 2

*Update the list of normative references as follows:*

*Replace reference* EN 1591-1:2001+A1:2009+AC:2011 *by* EN 1591-1:2013, *Flanges and their joints — Design rules for gasketed circular flange connections — Part 1: Calculation*

*Add reference* EN 10216-2:2013, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties*

*Delete reference* EN 287-1:2004+A2:2006, *Qualification test of welders — Fusion welding — Part 1: Steels*

*Delete reference* EN 12953-3:2002, *Shell boilers — Part 3: Design and calculation for pressure parts*

*Delete reference* EN ISO 15614-1:2004, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys (*ISO 15614-1:2004*)*

# 2 Modification to Clause 3

*In Table 3.2-1, add the following definition at the top of the table:*

| **Symbol** | **Description** | **Unit** |
|---|---|---|
| $P_{max}$ | maximum pressure obtained from the design by formulae or relevant procedures for a given component | MPa (N/mm²) |



# 3 Modification to 4.1



*Add the new following text as the last paragraph of 4.1:*

"Piping for fluids which are likely to cause condensation shall be installed with adequate slopes and traps."

# 4 Modification to 4.2.3.4

*Replace subclause 4.2.3.4 with the following:*

"For all pressure temperature conditions ($p_o$, $t_o$) specified in 4.2.3.3 calculation pressures $p_c$ shall be determined.

The calculation pressure $p_c$ shall be not less than the associated operating pressure $p_o$, taking into account the adjustments of the safety devices. The conditions ($p_o$, $t_o$) resulting in the greatest wall thickness shall be considered.

Alternatively, the pressure equipment shall be designed with the pressure/temperature combination ($p_c$, $t_c$) which results in the highest calculated wall thickness or the highest stress, and which is based on the pressure/temperature combination ($p_o$, $t_o$) under normal operating conditions (see EN 764-1:2015+A1:2016, Figure A.1). In this case the pressure $p_c$, associated with the temperature $t_c$, can be lower than PS.

NOTE 1 For guidance, designation of $p_c$ and $t_c$ is $P_d$ and $T_d$ in EN 764–1:2015+A1:2016, $P_D$ and $T_D$ in EN 764–1:2015+A1:2016, Figure A.1.

The design of the pressure equipment should be consistent with PS and $TS_{max}$, that is:

— compatible with the combination of PS with the temperature T($p_{omax}$) where $p_{omax}$ is the maximum pressure under normal operating conditions;

— compatible with the combination of $TS_{max}$ at the pressure $P(t_{omax})$ where $t_{omax}$ is the maximum temperature under normal operating conditions.

When the calculation temperature $t_c$ is such that the creep rupture strength characteristics are relevant for the determination of the nominal design stress, the calculation pressure shall be considered equal to the operating pressure ($p_o$) which is associated with the corresponding temperature ($t_o$).

If there is a condition where $p_o = PS$ and $t_o = TS$, only this condition has to be calculated."

## 5 Modification to 4.3

*Replace the first four paragraphs of subclause 4.3 with the following:*

"The thickness shall be determined with regard to the manufacturing process for pipes and fittings.

Corrosion can be internal or external or both at the same time (the term corrosion includes erosion).

The value of the corrosion allowance $c_0$ (which may be zero if no corrosion is to be expected) shall be determined by the manufacturer in accordance with the nature, temperature, pressure, velocity etc. of the products in contact with the wall, only if all this information has been given by the purchaser.

Corrosion allowance should be given by the purchaser, if not, reasonable values shall be proposed by the manufacturer and stated in the documentation.

All thicknesses, the corrosion allowance $c_0$, the tolerance $c_1$ and the thinning $c_2$ are shown in Figures 4.3-1 and 4.3-2."



*As the 6th paragraph of 4.3, add the new following text:*

"Piping which is subjected to external corrosion and is made of materials which are not sufficiently corrosion resistant shall be protected, if no suitable corrosion allowance is provided."



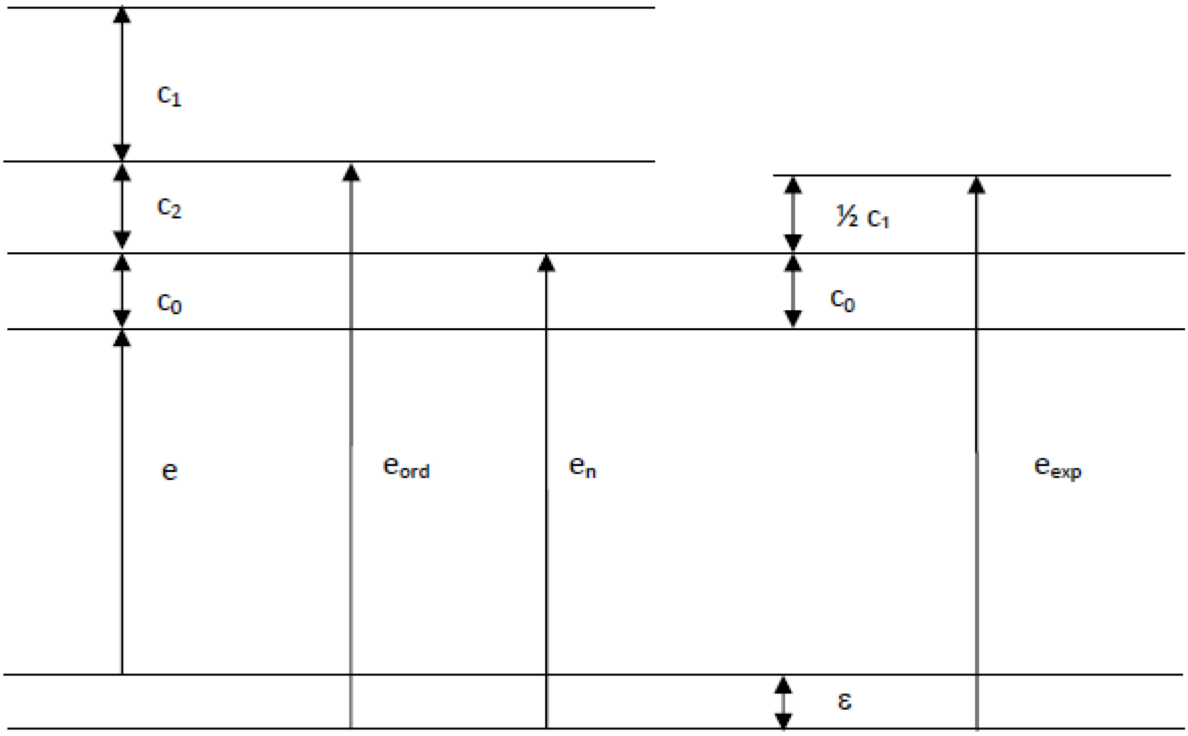
*In the key, below Figure 4.3-1, replace the explanation of $c_2$ with the following:*

$c_2$ is the thinning allowance for possible thinning during manufacturing process (e.g. due to bending, swaging, threading, grooving, etc);

*Replace the title of the Figure 4.3-1 as follows:*

**Figure 4.3-1 — Thickness (applicable to straight pipes as well as bends) when ordered with mean wall thickness**

*After Figure 4.3-1, add a new Figure 4.3-2 and the text below Figure 4.3-2 as follows:*






**key**

| | |
|---|---|
| $e$ | is the minimum required thickness without allowances and tolerances to withstand pressure, calculated by the appropriate equations given in this standard; |
| $c_0$ | is the corrosion or erosion allowance; |
| $c_1$ | positive tolerance given by the pipe supplier (e.g. see EN 10216-2:2013, Table 9 or Table 10) |
| $c_2$ | is the thinning allowance for possible thinning during manufacturing process (e.g. due to bending, swaging, threading, grooving, etc.); |
| $\varepsilon$ | is the additional thickness resulting from the selection of the ordered thickness $e_{ord}$; |
| $e_{ord}$ | is the ordered thickness (where $c_2$ is often equal to 0; e.g. straight pipe); |
| $e_n$ | is the nominal thickness (on drawings); |
| $e_{exp}$ | is the expected (mean) wall thickness |

**Figure 4.3-2 — Thickness (applicable to straight pipes as well as bends) when ordered with minimum wall thickness and plus-tolerances only**

Figure 4.3-1 shows the situation when pipes are ordered with mean wall thickness and +/- tolerances, e.g. see EN 10216-2:2013, Table 7 or Table 8.

For pipes, ordered with minimum wall thickness and plus-tolerances only, see EN 10216-2:2013, Table 9 or Table 10, the Figure 4.3-2 shall be used. In this case for the flexibility and stress calculation of piping the expected wall thickness $e_{exp} = e_{ord} + 1/2\ c_1 - c_2$ should be used instead of $e_n$ in the Formulae of Clause 12.

The analysis thickness $e_a$ shall be the lowest thickness after corrosion and shall be given by:

$$e_a = e + \varepsilon \quad (4.3\text{-}1)$$

or

$$e_a = e_{ord} - c_0 - c_1 - c_2 \quad (4.3\text{-}2)$$

when pipes are ordered with mean wall thickness, see Figure 4.3-1.

When pipes are ordered with minimum wall thickness and plus-tolerances, see Figure 4.3-2, the analysis thickness $e_a$ shall be:

$$e_a = e_{ord} - c_0 - c_2 \quad (4.3\text{-}3)”$$

*The sequence of the numbering of the equations shall be updated. The current Formula (4.3-3) shall be renumbered (4.3-4) and the current Formula (4.3-4) shall be renumbered (4.3-5).*

*At the end of subclause 4.3, the following NOTE shall be added:*

NOTE When pipes are ordered with minimum wall thickness and plus tolerance, see Figure 4.3–2, the value of the tolerance in Formula (4.3–4) needs to be set to $c_1 = 0$ or in Formula (4.3–5) $x = 0$.

## 6 Modification to 4.6

*In 4.6, replace the 2nd sentence of the 1st paragraph to read as follows:*

“This may be completed or replaced by a “design by analysis” as described in EN 13445-3, Annexes B and C, where applicable.”

*In 4.6, delete the following paragraph:*

“Clauses 6, 7, 8, 9, 10 and 11 describe the “design by rules” of piping components under static and cyclic loadings. The « design by rule » can be completed or replaced by a « design by analysis » as described in EN 13445-3, Annex B and Annex C, where applicable.”



## 7 Modification to 5.2.2

*At the end of the subclause 5.2.2.1, add the following sentence:*

“When different rupture elongation values for longitudinal and transverse directions are provided in the material standard, the lowest value shall be used.”

## 8 Modification to 5.2.2.2

*Replace subclause 5.2.2.2 with the following:*

For $A \geq 35$ %, the designer shall ensure that the stress under the proof test conditions, given in EN 13480-5, shall not exceed the greater of the following values:

— 95 % $R_{p1,0}$ at specified test temperature;

— 45 % $R_m$ at specified test temperature.

For $30 \leq A < 35$ %, the designer shall ensure that the stress under the proof test conditions, given in EN 13480-5, shall not exceed 95 % $R_{p1,0}$ at specified test temperature.

For $A < 30$ %, the designer shall ensure that the stress under the proof test conditions, given in EN 13480-5, shall not exceed 95 % $R_{eH}$ or 95 % $R_{p0,2}$ at specified test temperature.

## 9 Modification to 5.2.5.1

*Add the following sentence fter the first paragraph of 5.2.5.1:*

These steels shall be subjected to a positive material identification prior to use, to ensure weldability.

## 10 Modification to 5.3.1

*Replace subclause 5.3.1 with the following:*

For welds other than circumferential welds in welded pipes and fittings, the creep strength values of the weld shall be considered if ensured values are available. Otherwise the minimum of the creep strength values of either the base material or the filler material reduced by 20 % shall be taken into account.

For circumferential butt welds the necessity of the consideration of reduced creep strength values depends on the stress distribution in the cross section. Detailed stress analyses may be used.

## 11 Modification to 5.3.2.1

*Replace subclause 5.3.2.1 with the following:*

### 5.3.2.1 Design conditions

The design stress in the creep range $f_{cr}$ to be used for design under static loading shall be:

$$f_{cr} = \frac{S_{RTt}}{Sf_{cr}} \qquad (5.3.2\text{-}1)$$

where

$Sf_{cr}$ is a safety factor which depends on the design life time and shall be in accordance with Table 5.3.2-1.



**Table 5.3.2–1 — Safety factor as a function of mean creep rupture strength related to time**



| Design lifetime[a)] | Without surveillance of creep exhaustion[c)] | | With surveillance of creep exhaustion[c)] | |
|---|---|---|---|---|
| $t$ [h] | Mechanical property | $Sfcr$ | Mechanical property | $Sfcr$ |
| 10 000 ≤ $t$ ≤ 100 000 | $S_{RTt}$ | 1,5 | $S_{RTt}$ | 1,25 |
| 100 000 < $t$ < 200 000 | $S_{RTt}$ [d)] | 1,5[d)] | $S_{RTt}$ | 1,25 |
| $t$ = 200 000 | $S_{RTt}$ [d)] | 1,5[d)] | $S_{RT\,200\,000\,h}$<br>$S_{RT\,150\,000\,h}$ [b)]<br>$S_{RT\,100\,000\,h}$ [b)] | 1,25<br>1,35<br>1,5 |

[a)] If the design lifetime is not specified, the mean creep rupture strength at 200 000 h shall be used with the associated $Sf_{cr}$.

[b)] Only in cases where the 200 000 h values are not specified in the material standards, the mean creep rupture strength at 150 000 h or 100 000 h shall be used for a design lifetime of 200 000 h with the associated $Sf_{cr}$.

[c)] Surveillance by means of non-destructive testing and/or additional calculations of creep damage, $D_c$.

[d)] Allowed only if $\frac{S_{RT200000h}}{S_{RT100000h}} \geq 0{,}781$ to ensure that 60 % of theoretical creep damage are not exceeded at 200 000 h.

The creep rupture strength associated to the specified lifetime shall be interpolated based on a logarithmic time axis as well as a logarithmic stress axis (double logarithmic interpolation scheme).

## 12 Modification to 6.2.3.2

*Delete the existing subclause 6.2.3.2 "Alternative route", renumber the current subclause 6.2.3.3 "More accurate route" as 6.2.3.2 and modify Table 6.2.3-1 as follows:*

**Table 6.2.3–1 — Minimum pipe wall thickness before bending by induction**

| Radius | Normal route 6.2.3.1 |
|---|---|
| 10 $D_o$ | 1,02 $e$ |
| 8 $D_o$ | 1,03 $e$ |
| 6 $D_o$ | 1,04 $e$ |
| 5 $D_o$ | 1,04 $e$ |
| 4 $D_o$ | 1,05 $e$ |
| 3 $D_o$ | 1,06 $e$ |
| 2,5 $D_o$ | 1,08 $e$ |
| 2 $D_o$ | 1,10 $e$ |
| 1,5 $D_o$ | 1,15 $e$ |

## 13 Modification to 6.3.1



*Replace subclause 6.3.1 with the following:*

### 6.3.1 General



The following rules for mitre bends (see Figure 6.3.2-1) shall only be used if the following conditions are met:

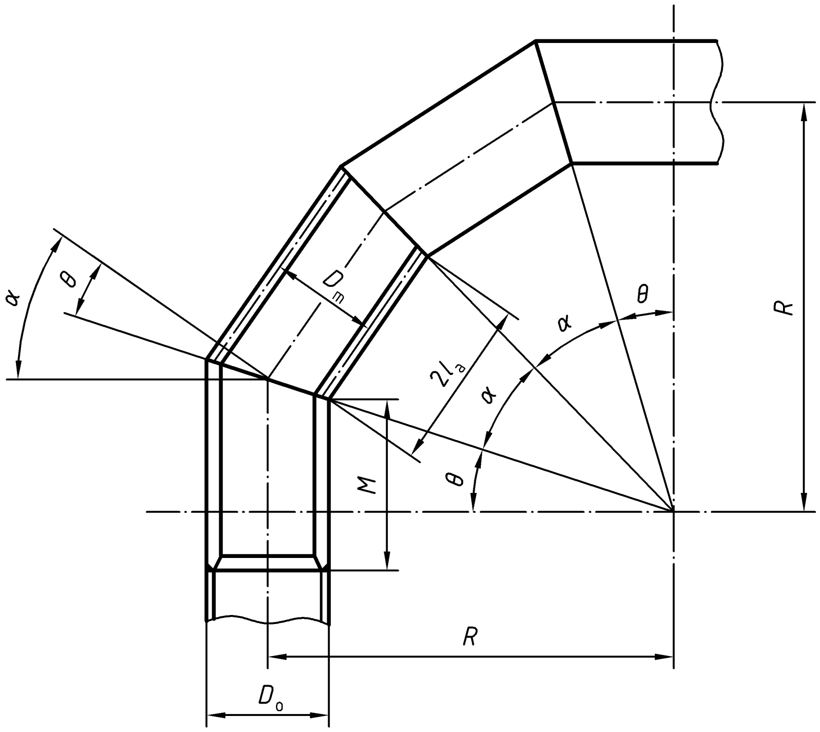
A mitre bend with an angle of change in direction at a single joint greater than 22,5 ° (see angle $\alpha$ in Figure 6.3.2-1) shall not be used under cyclic loadings (>7 000 cycles).

In addition, for time dependent design stress, consideration of high temperature cycling should be given.

For an angle of change in direction of 3 ° or less at a single joint, the calculation method given in 6.1 may be used.

## 14 Modification to 6.3.2

*Replace Figure 6.3.2-1 with the following:*




NOTE α = 2 θ



**Figure 6.3.2–1 — Scheme for a mitre bend**

## 15 Modification to 6.4.1



*Replace the first indent in subclause 6.4.1 with the following:*

— cones for which the half angle at the apex of the cone is greater than 60°;

## 16 Modification to 6.4.4

*Replace Formula (6.4.4-1) with the following:*

$$“e_{con} = \frac{p_c D_i}{2f z - p_c} \frac{1}{\cos\alpha} \quad (6.4.4\text{-}1)”$$

*Replace Formula (6.4.4-2) with the following:*

$$“e_{con} = \frac{p_c D_e}{2f z + p_c} \frac{1}{\cos\alpha} \quad (6.4.4\text{-}2)$$

where

$D_i$ and $D_e$ are the inner or outer diameter respectively at the point under consideration.”

*Replace Formula (6.4.4-3) with the following:*

“For a given geometry:

$$P_{max} = \frac{2 f z e_{con} \cos\alpha}{D_m} \quad (6.4.4\text{-}3)$$

where

$D_m$ is the mean diameter at the point under consideration."

*Replace Formula (6.4.4-7) with the following:*

"where

$$D_K = D_c - e_1 - 2r_i(1-\cos\alpha) - l_2 \sin\alpha \quad (6.4.4\text{-}7)$$

For $r_i$ see Figure 6.4.2-2."

## 17 Modification to 6.4.6.2

*Replace Figure 6.4.6-1 with the following:*

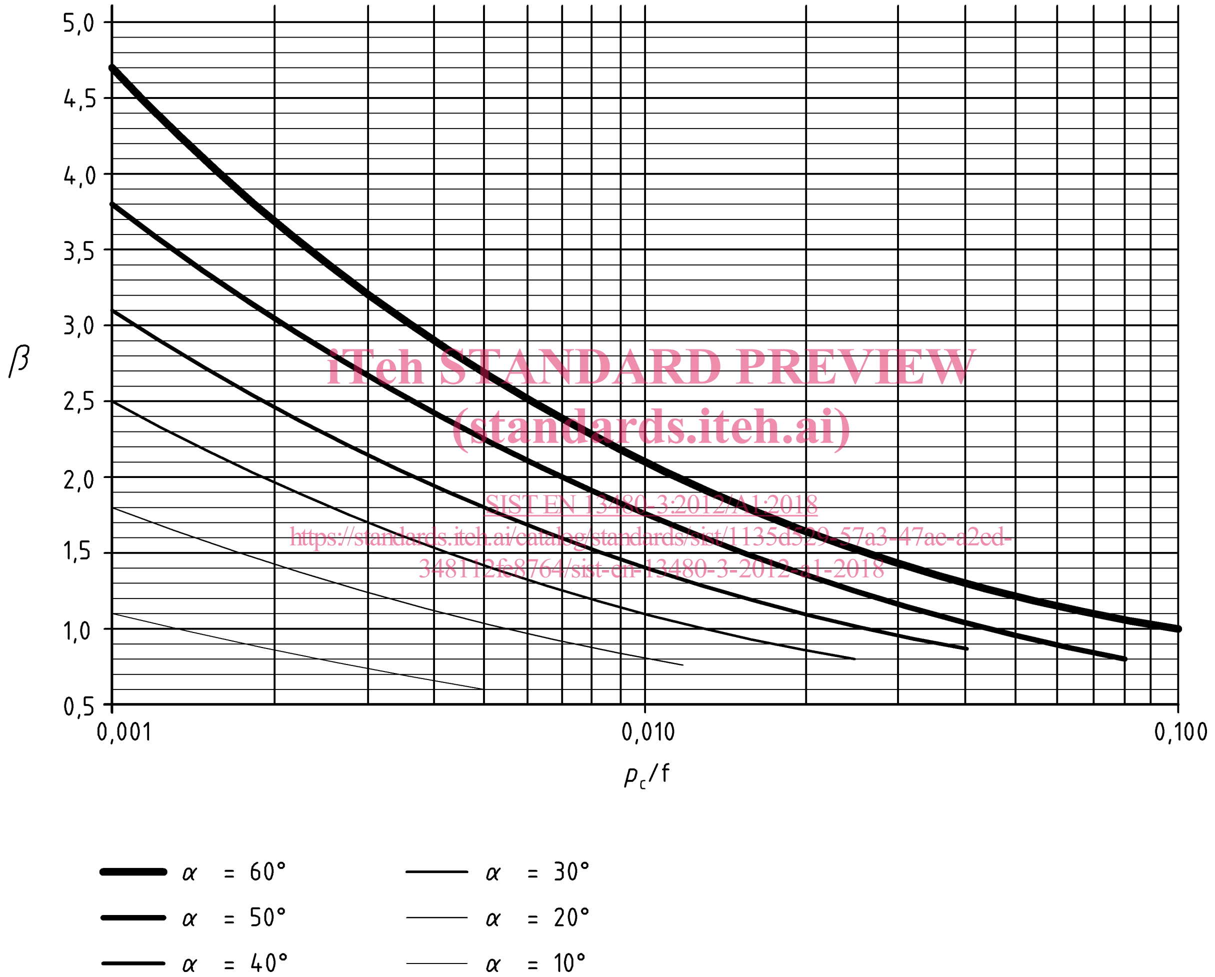





**Figure 6.4.6-1 — Values of coefficient *β* for cone/cylinder intersection without knuckle**

## 18 Modification to 6.4.6.3

*In indent a), replace Formula (6.4.6-3) with the following:*

a) apply Formula (6.4.6-3) to cylinder;

$$P_{max} = \frac{2 f z e_a}{D_c} \quad (6.4.6\text{-}3)$$

## 19 Modification to 6.4.7.3

*In indent f), replace Formula (6.4.7-5) with the following:*

$$P_{\max} = \frac{2f\,\gamma\,e_{\mathrm{j}}}{\beta\,D_{\mathrm{c}}} \quad (6.4.7\text{-}5)$$

## 20 Modification to 6.4.8.3

*Replace Formula (6.4.8-6) with the following:*

$$P_{\max} = \frac{2\,f\,z\,e_{1a}}{D_c\,\beta_H} \quad (6.4.8\text{-}6)$$

## 21 Modification to 6.6.1

*Replace the second paragraph of Clause 6.6.1 with the following:*

If there is a specific requirement on tightness for the flange connection, this shall be calculated in accordance with EN 1591-1 and EN 1591-2. Recommended gaskets are specified in Annex P.

*Replace the second sentence of the fourth paragraph of Clause 6.6.1 with the following:*

The selection of bolting shall comply with Annex D and EN 1515-4.



*At the end of Clause 6.6.1, add a fifth paragraph as follows:*

Annex P gives information on applicability of gaskets (pressure, temperature, chemical compatibility, etc.).



## 22 Modification to 6.6.2

*Replace Table 6.6.2-1 with the following:*

**Table 6.6.2–1 — Additional symbols for the purposes of 6.6**

| Symbol | Description | Unit |
|---|---|---|
| $P_{\mathrm{eq}}$ | Equivalent design pressure | MPa (N/mm²) |
| $P$ | Internal calculation pressure | MPa (N/mm²) |
| $F$ | Pulling axial force (to be a positive value in equation) | N |
| $M$ | External bending moment | N mm |
| $G$ | Diameter of gasket load reaction | mm |
| $C$ | Diameter of bolt circle | mm |

## 23 Modification to 6.6.3

*In indent b), replace Formula (6.6.2-1) with the following:*

$$P_{eq} = P + \frac{4F}{\pi G^2} + \frac{16|M|}{\pi C G^2} \quad (6.6.2\text{-}1)$$

*Below the Formula (6.6.2-1), delete the following sentence:*

“where: