SLOVENSKI STANDARD
SIST EN 13480-3:2018/A2:2020

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Kovinski industrijski cevovodi - 3. del: Konstruiranje in izračun - Dopolnilo A2

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 13480-3:2017/A2:2020

ICS:

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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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Metallic industrial piping - Part 3: Design and calculation

Tuyauteries industrielles métalliques - Partie 3 : Conception et calcul

Metallische industrielle Rohrleitungen - Teil 3: Konstruktion und Berechnung

This amendment A2 modifies the European Standard EN 13480-3:2017; it was approved by CEN on 12 July 2020.

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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
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (EN 13480-3:2017/A2:2020) 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of an identical text or by endorsement, at the latest by February 2021, and conflicting national standards shall be withdrawn at the latest by February 2021.

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 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 13480-3:2017.

This document includes the text of the amendment itself. The amended/corrected pages of EN 13480-3:2017 will be published as Issue 4 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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Modification to 3.2, "*Symbols and units*"

Table 3.2-1 shall be completed with the line e_c to be placed after e_n:

e_c	corroded thickness (see Figure 4.3–1 and Figure 4.3–2)	mm

2 Modification to 4.2, "*Loadings*"

The second sentence of subclause 4.2.4.6 shall read as follows:

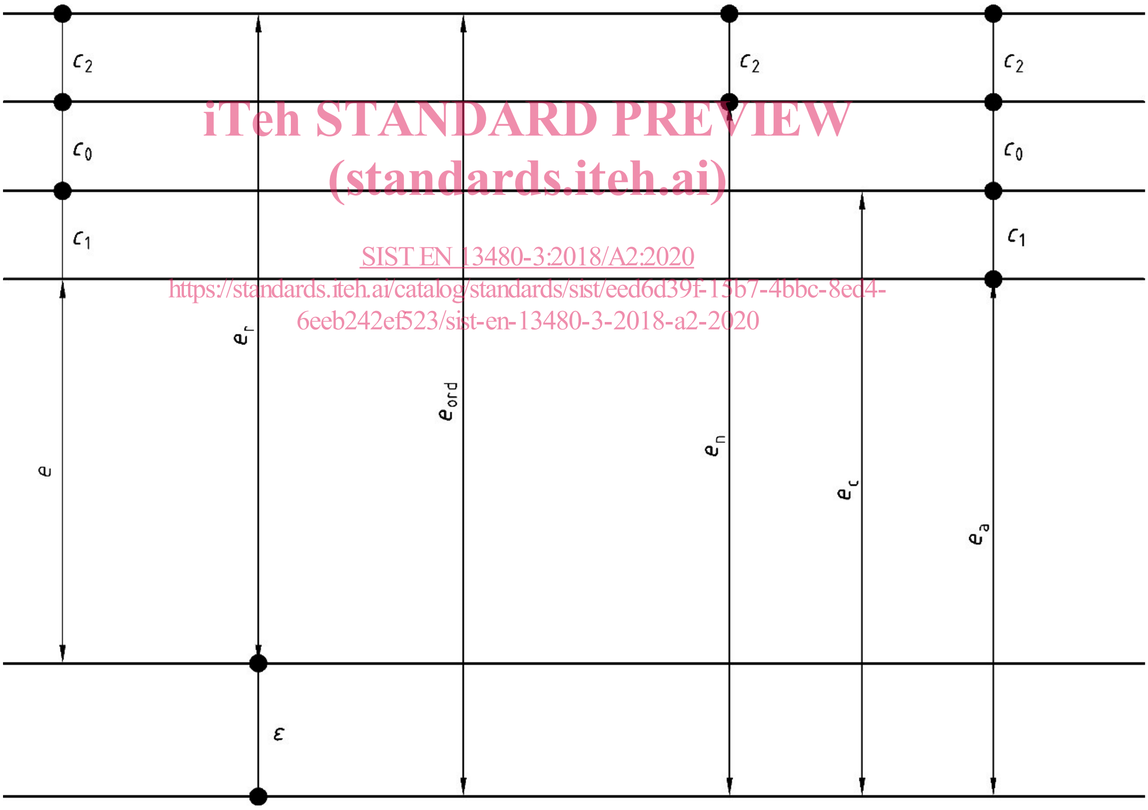
"The specification shall give details relating to the characteristics of the seismic conditions (design basis earthquake and/or safe shut-down earthquake) to be taken into account."

The last indent of 4.2.5.2.1 shall read as follows:

"— seismic conditions (Design Basis Earthquake)."

3 Modification to 4.3, "*Thickness*"

The new Figure 4.3-1 shall read as follows:

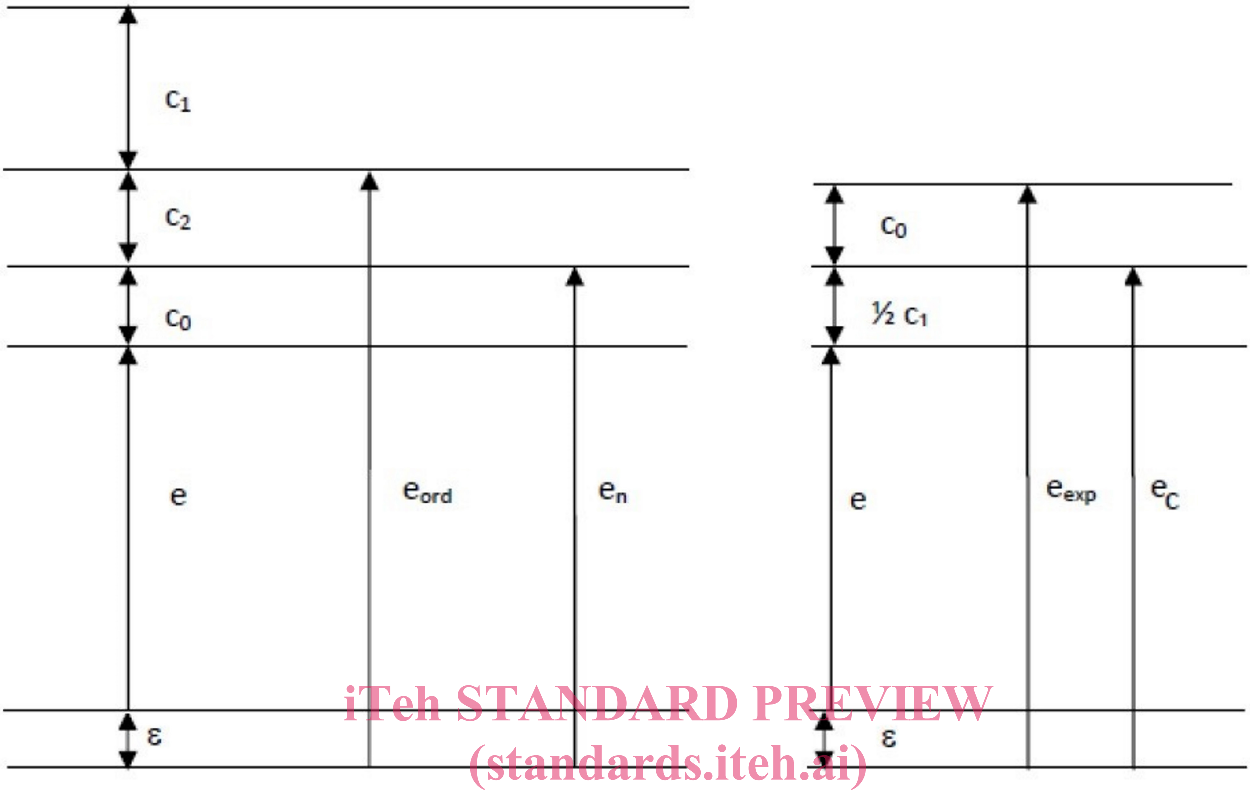


The key of Figure 4.3-1 shall be updated with the following correction and addition:

c_2 is the thinning allowance for possible thinning during manufacturing process;

e_c is the wall thickness after corrosion or erosion used for flexibility analysis in Clause 12;

The new Figure 4.3-2 shall read as follows:



The key of Figure 4.3-2 shall be updated with the following correction and addition:

c_2 is the thinning allowance for possible thinning during manufacturing process;

e_c is the wall thickness after corrosion or erosion used for flexibility analysis in chapter 12;

4 Modification to 12.2.4.2, "*Overstrained behaviour*"

The first indent shall read as follows:

— Where there is large deflection at the connecting point between two pipes with significantly different cross section;

5 Modification to 12.2.10.3, "*Basic assumptions and requirements*"

The last paragraph of subclause 12.2.10.3.1 shall read as follows:

When friction forces are significant, they shall be considered in the piping design.

6 Modification to 12.3, "*Flexibility analysis*"

The revised Clause 12.3.1 shall read as follows:

"12.3.1 General

The following determination and limitation of stresses shall be used to ensure the safe operation of the piping.

The Formulae (12.3.2-1) and (12.3.3-1) deal with the longitudinal stresses due to design and operating loadings, and the Formulae (12.3.4-1) and (12.3.4-2) with the stress range due to such loadings that gives rise to deformation of the total system.

In Formula (12.3.5-1), one-third of the stress resulting from thermal expansion and alternating loadings are taken into consideration with respect to the material behaviour in the creep rupture stress range, assuming that two-thirds will be relieved by relaxation.

Formula (12.3.6-1) ensures that in the event of a single non-repeated load, no strain occurs which can adversely affect the material.

The forces and moments shall be determined for nominal thickness of the pipe e_n.

The longitudinal stresses for primary loads shall be determined based on the corroded thickness e_c.

The longitudinal stresses for thermal expansion and alternating loads shall be determined based on nominal thickness e_n.

NOTE Wall thickness reductions, allowed by the technical conditions of delivery for seamless and welded pipes are covered by the stress limits.

The stress intensification factors, i, i_i, i_o, are given in Tables H-1 to H-3 and are calculated based on nominal wall e_n.

The sectional modulus of the nominal pipe is: $Z = \frac{\pi(d_o^4 - d_i^4)}{32 d_o}$

Unless specified otherwise, it is assumed that corrosion happens on the inside of the pipe so that the inner diameter after corrosion is $d_i = d_o - 2e_c$

and the sectional modulus of the corroded pipe is: $Z_c = \frac{\pi(d_o^4 - (d_o - 2e_c)^4)}{32 d_o}$

Using the alternative equations given in 12.3.2 to 12.3.6 with the corresponding stress intensification factors in Table H-3, allow a more detailed determination of the stresses by considering independently in-plane and out-of-plane moments .

For the general and the alternative route, the stress intensity factors, *i*, including the reduction factor 0,75, if defined, shall be greater than or equal to 1,0 (0,75 *i* ≥ 1,0). If a value less than 1 is obtained then the value 1,0 shall be used.

If considerable corrosion/erosion is expected, it is taken into account in the flexibility analysis as follows. In the Formulae (12.3.2-1), (12.3.2-2), (12.3.3-1), (12.3.3-2) and (12.3.4-2), using the sectional modulus based on the corroded pipe.

Optionally the corrosion may be disregarded during flexibility design, if provisions are taken in order that corrosion is detected during inspection. In this case Z and e_n shall be used instead of Z_c and e_c in these equations."

For most piping systems, the axial forces in the pipe are dominated by the internal pressure reaction force. In special cases, such as buried pipes or pipes which are otherwise restrained in axial direction, the axial stresses from external loads may be significant. In these cases, the axial force Q in Formulae 12.3.2 to 12.3.6 allows taking into account these effects.

7 Modification to 12.3.2, "*Stress due to sustained loads*"

The revised Clause 12.3.2 shall read as follows:

"**12.3.2 Stress due to sustained loads**

The sum of primary stresses σ_1, due to calculation pressure, p_c, and the resultant moment, M_A, from weight and other sustained mechanical loads shall satisfy the following equation:

$$\sigma_1 = \frac{i_{QA} Q_{xA}}{A_c} + \frac{0{,}75\ i\ M_A}{Z_c} \leq f_f \qquad (12.3.2\text{-}1)$$

where

M_A is the resultant moment from the sustained mechanical loads which shall be determined by using the most unfavourable combination of the following loads:

— piping dead weight including insulation, internals and attachments;

— weight of fluid;

— internal pressure forces due to unrelieved axial expansion joints etc.

$$Q_{xA} = \max\left(\left|Q_{xS}\right|, \left|\frac{p_c \pi d_i^2}{4} + Q_{xS}\right|\right)$$

Q_{xS} is the axial force from the sustained mechanical loads

d_i is the inner diameter of the corroded pipe

$A_c = \frac{\pi}{4}(d_o^2 - d_i^2)$ is the cross section of the pipe (reduced by the corrosion allowances)

i_{QA} is the stress intensification factor for axial forces for sustained loads. Unless more precise information is available i_{QA} = 1,0

i is the stress intensification factor from Table H.1

f_f is the design stress for flexibility analysis in N/mm^2 (MPa) with $f_f = \min\left(f; f_{cr}\right)$.

or alternatively using the stress intensification factors from Table H.3:

$$\sigma_1 = \sqrt{\left[\frac{i_{QA} Q_{xA}}{A_c} + \frac{\sqrt{(0{,}75\ i_i\ M_{iA})^2 + (0{,}75\ i_o\ M_{oA})^2}}{Z_c}\right]^2 + \left[\frac{i_t M_{tA}}{Z_c}\right]^2} \leq f_f \qquad (12.3.2\text{-}2)$$

where

M_{iA} is the in-plane moment from the sustained mechanical loads

M_{oA} is the out-of-plane moment from the sustained mechanical loads

M_{tA} is the torsional moment from the sustained mechanical loads

i_t is the stress intensification factor for torsional moments. Unless more precise information is available $i_t = 1,0$

For the consideration of pressure test loads in Formula (12.3.2-1), the calculation pressure p_c shall be replaced by the test pressure p_{test} (see EN 13480-5). In addition, the design stress f_f shall be replaced by a value of 95 % R_{eH} at test temperature."

8 Modification to 12.3.3, "*Stress due to sustained and occasional or exceptional loads*"

The revised Clause 12.3.3 shall read as follows:

"**12.3.3 Stress due to sustained and occasional or exceptional loads**

The sum of primary stresses, σ_2, due to internal pressure, p_c, resultant moment, M_A, from weight and other sustained mechanical loads and resultant moment, M_B, from occasional or exceptional loads shall satisfy the following equation:

$$\sigma_2 = \frac{i_{QA} Q_x}{A_c} + \frac{0{,}75\ i\ M_A}{Z_c} + \frac{0{,}75\ i\ M_B}{Z_c} \leq k\ f_f \qquad (12.3.3\text{-}1)$$

where

M_B is the resultant moment from the occasional or exceptional loads which shall be determined by using the most unfavourable combination of the following loads:

— wind loads ($T \leq T_B/10$);

— snow loads;

— dynamic loads from switching operations ($T \leq T_B/100$);

— seismic loads ($T \leq T_B/100$);

Q_x is the axial force from the sustained and occasional or exceptional loads

The axial force shall include the most unfavourable combination of the following loads:

— pressure effect (acting or not);

— sustained loads Q_{xA} (acting all the time);

— occasional or exceptional loads Q_{xB} (acting or not, reversing or not).

for reversing loads:

$$Q_x = \max\left(\left|Q_{xA}\right| + \left|Q_{xB}\right|, \left|\frac{p_c\ \pi d_i^{\,2}}{4} + Q_{xA}\right| + \left|Q_{xB}\right| \right) \qquad (12.3.3\text{-}2)$$

for non-reversing loads:

$$Q_x = \max\left(\left|Q_{xA}\right|, \left|Q_{xA} + Q_{xB}\right|, \left|\frac{p_c \ \pi \, d_i^{\,2}}{4} + Q_{xA}\right|, \left|\frac{p_c \ \pi \, d_i^{\,2}}{4} + Q_{xA} + Q_{xB}\right|\right) \quad (12.3.3\text{-}3)$$

f_f is the design stress for flexibility analysis in N/mm² (MPa) with $f_f = \min\left(f; f_{cr}\right)$.

k = 1 if the occasional load is acting for more than 10 % in any 24 h operating period, e.g. normal snow, normal wind;

k = 1,15 if the occasional load is acting for less than 10 % in any 24 h operating period;

k = 1,2 if the occasional load is acting for less than 1 % in any 24 h operating period, e.g. dynamic loadings due to valve closing/opening, operational basis earthquake;

k = 1,3 for exceptional loads with very low probability e.g. very heavy snow/wind (i.e. 1,75 times normal);

k = 1,8 for safe shut-down earthquake;

p_c is the maximum calculation pressure occurring at the considered loading condition, the calculation pressure shall be taken as a minimum.

or alternatively using the stress intensification factors from Table H.3:

$$\sigma_2 = \sqrt{\left(\frac{i_{QA} Q_x}{A_c} + \frac{\sqrt{\left[0{,}75 \ i_i \ \left(M_{iA} + M_{iB}\right)\right]^2 + \left[0{,}75 \ i_o \ \left(M_{oA} + M_{oB}\right)\right]^2}}{Z_c}\right)^2 + \left(\frac{i_t M_{tA} + i_t M_{tB}}{Z_c}\right)^2} \le k \cdot f_f \quad (12.3.3\text{-}4)$$

where

M_B is the moment from occasional or exceptional loads with the components:

M_{iB} is the in-plane moment from occasional or exceptional loads

M_{oB} is the out-of-plane moment from occasional or exceptional loads

M_{tB} is the torsional moment from occasional or exceptional loads

For reversing loads both signs of M_B shall be considered.

The effects of anchor displacements due to earthquake may be excluded if they are included in Formula (12.3.4–1).

Unless specified otherwise, the following agreements apply:

a) the action time T corresponds to the bracketed values referring to the total operating time T_B;

b) snow and wind loads are not applied simultaneously;

c) loadings with $T \le T_B/100$ are not applied simultaneously";.