SLOVENSKI STANDARD
SIST EN 13480-3:2018/oprA2:2019

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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/prA2**

ICS:

23.040.10	Železne in jeklene cevi	Iron and steel pipes
77.140.75	Jeklene cevi in cevni profili za posebne namene	Steel pipes and tubes for specific use

SIST EN 13480-3:2018/oprA2:2019 **en,fr,de**

EUROPEAN STANDARD

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English Version

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 draft amendment is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 267.

This draft amendment A2, if approved, will modify the European Standard EN 13480-3:2017. 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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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Contents

European foreword

This document (EN 13480-3:2017/prA2:2019) has been prepared by Technical Committee CEN/TC 267 “Industrial piping and pipelines”, the secretariat of which is held by AFNOR.

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 this document.

This document includes the text of the amendment itself. The amended/corrected pages of EN 13480-3:2017 will be published as Issue 2 of the European Standard.

1 Modification to 3.2, *Symbols and units*

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

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

“.

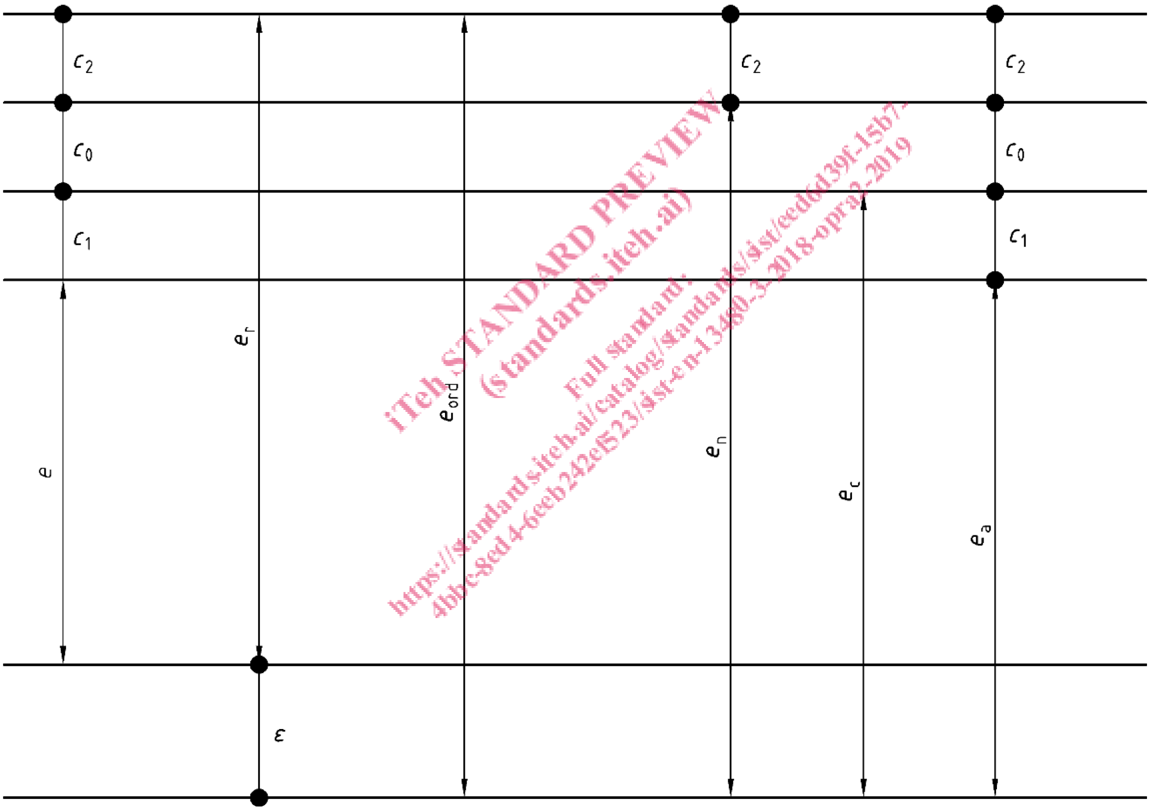
2 Modification to 4.2, *Loadings*

The last indent of 4.2.5.2.1 shall read as follows:

“— seismic conditions (Operational Basis Earthquake).”.

3 Modification to 4.3, *Thickness*

The new Figure 4.3-1 shall read as follows: “



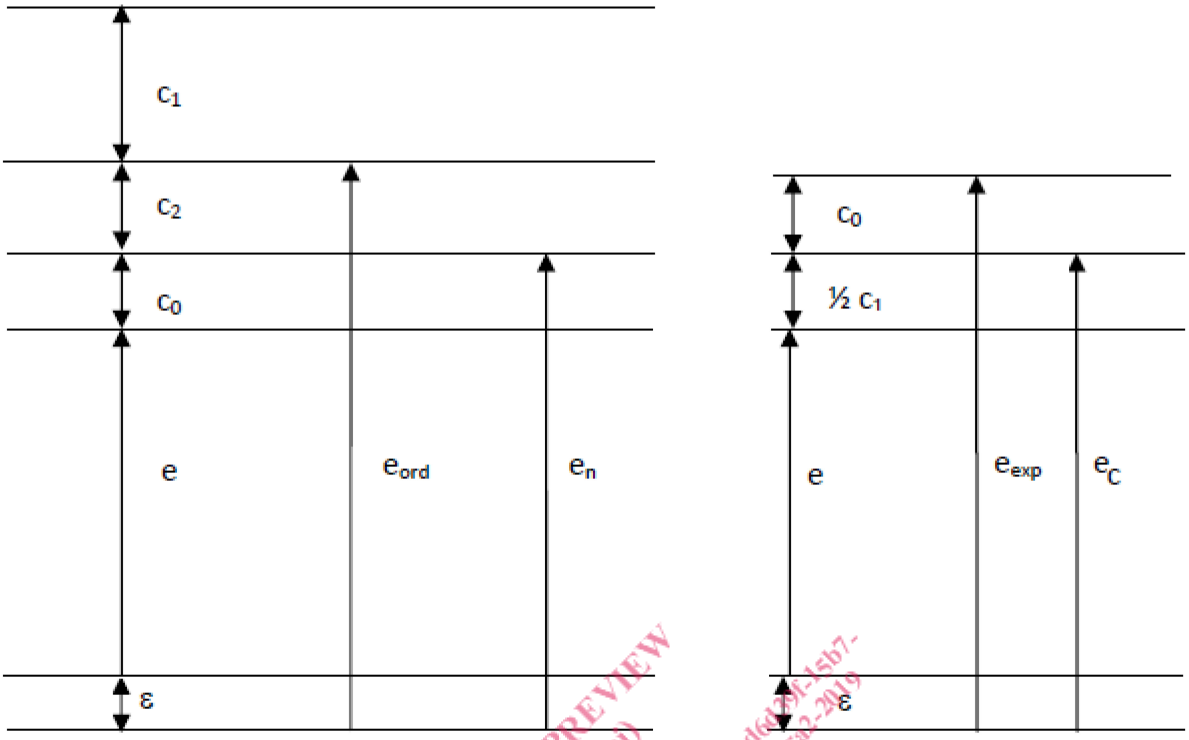
“.

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 Clause 12”;.

4 Modification to 12.2.4.2, *Overstrained behaviour*

The first indent shall read as follows: “

— highly stressed small size pipe runs in series with longer and relatively flexible pipe runs”;.

5 Modification to 12.2.10.3, *Basic assumptions and requirements*

The last paragraph of sub-clause 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 sub-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: $Z = \dfrac{\pi(d_o^4 - d_i^4)}{32 d_o}$

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: $Z_c = \dfrac{\pi(d_o^4 - (d_o - 2e_c)^4)}{32 d_o}$

As an alternative route to equations given in 12.3.2 to 12.3.6, a more detailed determination of the stresses by separating in-plane and out-of-plane moments can be performed, using the corresponding stress intensification factors in Table H-3.

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.

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 ($0{,}75\, i \geq 1{,}0$). 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.".

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

The revised sub-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:

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

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.

$$Q_{xA} = \max\left(\left|Q_{xS}\right|, \left|\frac{p_{\mathrm{c}} \pi d_{\mathrm{i}}^{2}}{4} + Q_{xS}\right|\right)$$

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

d_{i} is the inner diameter of the corroded pipe;

$\mathrm{A_c} = \frac{\pi}{4}(d_{\mathrm{o}}^{2} - d_{\mathrm{i}}^{2})$ 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 $i_{\mathrm{QA}} = 1{,}0$;

i is the stress intensification factor from Table H.1;

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

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

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

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 $i_{\mathrm{t}} = 1{,}0$.

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 sub-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:

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

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 ($T \le T_B/10$);
- snow loads;
- dynamic loads from switching operations ($T \le T_B/100$);
- seismic loads ($T \le T_B/100$);

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

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;