SIST

SLOVENSKI STANDARD
SIST EN 13480-3:2002/A1:2005

01-november-2005

Kovinski industrijski cevovodi – 3. del: Konstruiranje in izračun

Metallic industrial piping - Part 3: Design and calculation

Industrielle metallische Rohrleitungen - Teil 3: Konstruktion und Berechnung

Tuyauteries industrielles métalliques - Partie 3: Conception et calcul

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Ta slovenski standard je istoveten z: EN 13480-3:2002/A1:2005

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ICS:

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

Industrielle metallische Rohrleitungen - Teil 3: Konstruktion und Berechnung

This amendment A1 modifies the European Standard EN 13480-3:2002; it was approved by CEN on 20 July 2005.

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Foreword

This European Standard (EN 13480-3:2002/A1:2005) has been prepared by Technical Committee CEN/TC 267 “Industrial piping and pipelines”, the secretariat of which is held by AFNOR.

This Amendment to the European Standard EN 13480-3:2002 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2006, and conflicting national standards shall be withdrawn at the latest by February 2006.

This European Standard 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 this European Standard.

This European Standard contains changes in 8.1 of EN 13480-3:2002, the Annex O (normative) to be added in EN 13480-3:2002, and the Annex ZA updated to replace the current Annex ZA in EN 13480-3:2002.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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8 Openings and branch connections

8.1 General

Replace 8.1 by:

This subclause shall apply to cylindrical shells, conical shells, spherical shells and dished ends having circular, elliptical or obround openings, provided that the assumptions and conditions specified in Clause 8 are satisfied.

For the purposes of Clause 8, the word “shell” shall apply to run pipes and headers in addition to shells.

NOTE 1 Forces and/or moments due to loadings other than internal pressure are not considered in this design method.

NOTE 2 Another route for design openings based on the area replacement method is also given, with its required safety margins, in ASME B 31.3.

An alternative method for the calculation of openings is given in Annex O (normative).

This new procedure is based on limit analysis and shakedown analysis and allows the connection to be designed as well as the reinforcement where necessary, and is particularly suitable for large openings.

As for clauses 6, 7, 8, 9 and 11, the requirements of Annex O shall apply for loads of predominantly non-cyclic nature.

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This method applies to connections that are self reinforced and also to those where reinforcing pads are used.

Oblique branch connections are also covered.

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In addition, significant moments due to loadings other than internal pressure, as bending or torsion moments, can be considered by this new design method.

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Annex O
(normative)

Alternative method for checking branch connections

O.1 Scope

This annex specifies a method for checking branch connections subjected to internal pressure and to moments (Figure O.1). Where external loads cannot be neglected, this method may be used in place of the method of EN 13480-3:2002, 8.1. The rules of this annex shall apply for temperatures below the creep range and for the following branch connections:

— connection of cylinders with intersecting axes;

— ratio of branch pipe to run pipe diameter within the range 0,1 to 1, 0,1 and 1 included;

— ratio of branch pipe to run pipe thickness within the range 0,2 to 1.5, 0,2 and 1,5 included;

— ratio of run pipe mean diameter to run pipe thickness within the range 10 to 125, 10 and 125 included;

— branch pipe self-reinforced or with complete encirclement pad (width = d_m / 2);

— angle φ_b between branch pipe and run pipe axes within the range 45° to 90°, 45° and 90° included;

— maximum thickness of reinforcing saddle = 1,5 times nominal thickness.

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NOTE The current developments included in this annex do not deal with forged tees, considering the eventual reduction of thickness that could occur at the branch location (e.g. hot drawn tees).

O.2 Symbols

For the purposes of Annex O, the symbols given below shall apply in addition to those given in Table 8.2-1 and in Table 3.2-1.

D_m	Mean diameter of the run pipe
d_m	Mean diameter of the branch pipe
e_s	Analysis thickness of the run pipe
e_b	Analysis thickness of the branch pipe
φ_b	Angle between the branch pipe axis and the run pipe axis (φ_b = 90° – φ)
p_c	Internal pressure
pln_s	Limit pressure for the run pipe, in the absence of branch pipe
pln_b	Limit pressure for the branch pipe considered separately

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p_{max} Maximum permitted internal pressure when applied alone

Mfp_s Total bending moment acting on the run pipe and causing a rotation in the plane containing the run pipe and the branch pipe

Mfp_b Total bending moment acting on the branch pipe and causing a rotation in the plane containing the run pipe and the branch pipe

Mfh_s total bending moment acting on the run pipe and causing a rotation out of the plane containing the run pipe and the branch pipe

Mfh_b total bending moment acting on the branch pipe and causing a rotation out of the plane containing the run pipe and the branch pipe

Mt_s Torsional moment acting on the run pipe

Mt_b Torsional moment acting on the branch pipe

$Mfln_s$ Limit bending moment for the run pipe in the absence of branch pipe. This load is the nominal limit bending load corresponding to Mfp_s and Mfh_s

$Mtln_s$ Limit torsion moment for the run pipe in the absence of branch pipe

$Mfln_b$ Limit bending moment for the branch pipe considered separately. This load is the limit nominal bending load corresponding to Mfp_s and Mfh_s

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$Mtln_b$ Limit torsional moment for the branch pipe considered separately

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$Mflp_s$ Limit moment for the run pipe fitted with a branch pipe, corresponding to the loading Mfp_s

$Mflh_s$ Limit moment for the run pipe fitted with a branch pipe, corresponding to the loading Mfh_s

$Mflp_b$ Limit moment for the branch line in the branch connection, corresponding to the loading Mfp_b

$Mflh_b$ Limit moment for the branch line in the branch connection, corresponding to the loading Mfh_b

Mtl_s Limit moment for the run pipe fitted with a branch pipe, corresponding to the loading Mt_s

Mtl_b Limit moment for the branch line in the branch connection, corresponding to the loading Mt_b

$Mfh_{b,max}$, $Mfp_{b,max}$, $Mt_{b,max}$, $Mfh_{s,max}$, $Mfp_{s,max}$, $Mt_{s,max}$ Maximum allowable value for each of the external loads when each load is applied alone

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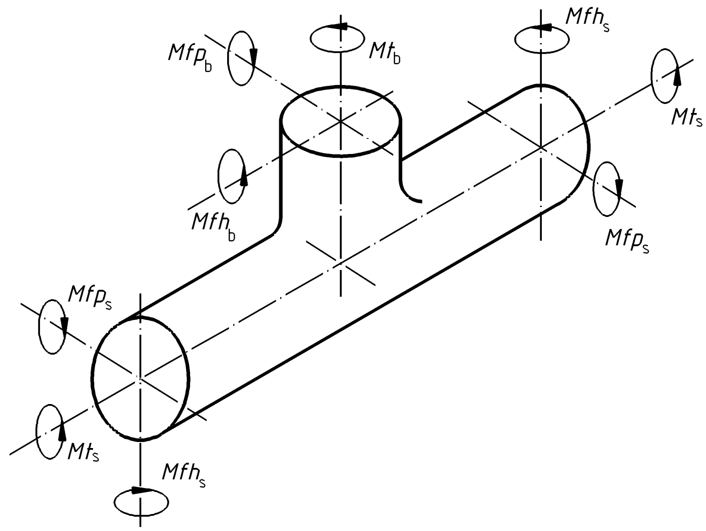

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Figure O.1-1 – Location of moments

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O.3 Design and checking of the branch connection

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O.3.1 Limit value for the load due to pressure only for straight pipes without opening

$$pln_s = \frac{2}{\sqrt{3}} R_{p\,0,2\,t} \ln\left(\frac{D_m + e_s}{D_m - e_s}\right) \quad \text{(O.3.1-1)}$$

$$pln_b = \frac{2}{\sqrt{3}} R_{p\,0,2\,t} \ln\left(\frac{d_m + e_b}{d_m - e_b}\right) \quad \text{(O.3.1-2)}$$

O.3.2 Determination of the minimum thicknesses under loading due to pressure only

a) Weakening coefficient for the loading due to pressure only.

The Graphs O.3.2-1 to O.3.2-6 and Table O.3.2-1 make it possible to determine the weakening coefficient c as a function of e_b / e_s, d_m / D_m and d_m / e_s.

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b) Minimum thicknesses of the run pipe and branch line.

The minimum thicknesses of the run pipe and of the branch line shall be determined from the following equations:

$$e_s = \frac{1}{c} \frac{p_c \, D_i}{2 \, f \, z - p_c} (\sin \varphi_b)^{-\left(\frac{3}{2}\right)} \tag{O.3.2-1}$$

$$e_s = \frac{1}{c} \frac{p_c \, D_m}{2 \, f \, z} (\sin \varphi_b)^{-\left(\frac{3}{2}\right)} \tag{O.3.2-2}$$

$$e_s = \frac{1}{c} \frac{p_c \, D_e}{2 \, f \, z + p_c} (\sin \varphi_b)^{-\left(\frac{3}{2}\right)} \tag{O.3.2-3}$$

$$e_b = \frac{1}{c} \frac{p_c \, d_i}{2 \, f \, z - p_c} (\sin \varphi_b)^{-\left(\frac{3}{2}\right)} \tag{O.3.2-4}$$

$$e_b = \frac{1}{c} \frac{p_c \, d_m}{2 \, f \, z + p_c} (\sin \varphi_b)^{-\left(\frac{3}{2}\right)} \tag{O.3.2-5}$$

$$e_b = \frac{1}{c} \frac{p_c \, d_e}{2 \, f \, z + p_c} (\sin \varphi_b)^{-\left(\frac{3}{2}\right)} \tag{O.3.2-6}$$

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O.3.3 Checking of the thicknesses selected for the combination of pressure loading and loadings due to external loads

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a) Limit values for the various external loadings applied separately.

For the various external loads applied separately, the limit values are given by the following formulae:

$$Mfln_s = R_{p\,0{,}2\,t} \frac{(D_m + e_s)^3}{6} \left(1 - \left(1 - \frac{2 \, e_s}{D_m + e_s}\right)^3\right) \tag{O.3.3-1}$$

$$Mfln_b = R_{p\,0{,}2\,t} \frac{(d_m + e_b)^3}{6} \left(1 - \left(1 - \frac{2 \, e_b}{d_m + e_b}\right)^3\right) \tag{O.3.3-2}$$

$$Mtln_s = \frac{2}{\sqrt{3}} R_{p\,0{,}2\,t} \left(\frac{\pi \, D_m^2}{4}\right) e_s \tag{O.3.3-3}$$

$$Mtln_b = \frac{2}{\sqrt{3}} R_{p\,0{,}2\,t} \left(\frac{\pi \, d_m^2}{4}\right) e_b \tag{O.3.3-4}$$

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b) Weakening coefficients for the various external loads applied separately.

The Graphs O.3.2-7 to O.3.2-42 and Table O.3.2-2 make it possible to determine the weakening coefficients as a function of e_b / e_s, d_m / D_m and d_m / e_s.

$$cfh_b = \frac{Mflh_b}{Mfln_b} \quad (O.3.3\text{-}5)$$

$$cfp_b = \frac{Mflp_b}{Mfln_b} \quad (O.3.3\text{-}6)$$

$$ct_b = \frac{Mtl_b}{Mtln_b} \quad (O.3.3\text{-}7)$$

$$cfh_s = \frac{Mflh_s}{Mfln_s} \quad (O.3.3\text{-}8)$$

$$cfp_s = \frac{Mflp_s}{Mfln_s} \quad (O.3.3\text{-}9)$$

$$ct_s = \frac{Mtl_s}{Mtln_s} \quad (O.3.3\text{-}10)$$

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c) Maximum allowable loads if they are applied separately.

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$$Mfh_{b,max} = 0,5\ Mflh_b \quad (O.3.3\text{-}11)$$

$$Mfp_{b,max} = 0,5\ Mflp_b \quad (O.3.3\text{-}12)$$

$$Mt_{b,max} = 0,5\ Mtl_b \quad (O.3.3\text{-}13)$$

$$Mfh_{s,max} = 0,5\ Mflh_s \quad (O.3.3\text{-}14)$$

$$Mfp_{s,max} = 0,5\ Mflp_s \quad (O.3.3\text{-}15)$$

$$Mt_{s,max} = 0,5\ Mtl_s \quad (O.3.3\text{-}16)$$

$$p_{max} = \frac{\sqrt{3}}{3} MIN[z\ MIN(pln_s\ ;\ pln_b)\ ;\ c\ \mathrm{MIN}(pln_s\ ;\ pln_b)(\sin \varphi_b)^{\frac{3}{2}}] \quad (O.3.3\text{-}17)$$

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d) Checking of the admissibility of the applied loads.

$$\frac{Mfh_{b}}{Mfh_{b,max}} \leq 1 \qquad \text{(O.3.3-18)}$$

$$\frac{Mfp_{b}}{Mfp_{b,max}} \leq 1 \qquad \text{(O.3.3-19)}$$

$$\frac{Mt_{b}}{Mt_{b,max}} \leq 1 \qquad \text{(O.3.3-20)}$$

$$\frac{Mfh_{s}}{Mfh_{s,max}} \leq 1 \qquad \text{(O.3.3-21)}$$

$$\frac{Mfp_{s}}{Mfp_{s,max}} \leq 1 \qquad \text{(O.3.3-22)}$$

$$\frac{Mt_{s}}{Mt_{s,max}} \leq 1 \qquad \text{(O.3.3-23)}$$

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$$\frac{p_{c}}{p_{max}} \leq 1 \qquad \text{(O.3.3-24)}$$

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$$\sqrt{\left(\frac{Mfh_{b}}{Mfh_{b,max}}\right)^{2}+\left(\frac{Mfp_{b}}{Mfp_{b,max}}\right)^{2}+\left(\frac{Mt_{b}}{Mt_{b,max}}\right)^{2}+\left(\frac{Mfh_{s}}{Mfh_{s,max}}\right)^{2}+\left(\frac{Mfp_{s}}{Mfp_{s,max}}\right)^{2}+\left(\frac{Mt_{s}}{Mt_{s,max}}\right)^{2}+\left(\frac{p_{c}}{p_{max}}\right)^{2}} \leq 1 \qquad \text{(O.3.3-25)}$$

If those criteria are not met, dimensions shall be modified and calculations repeated.

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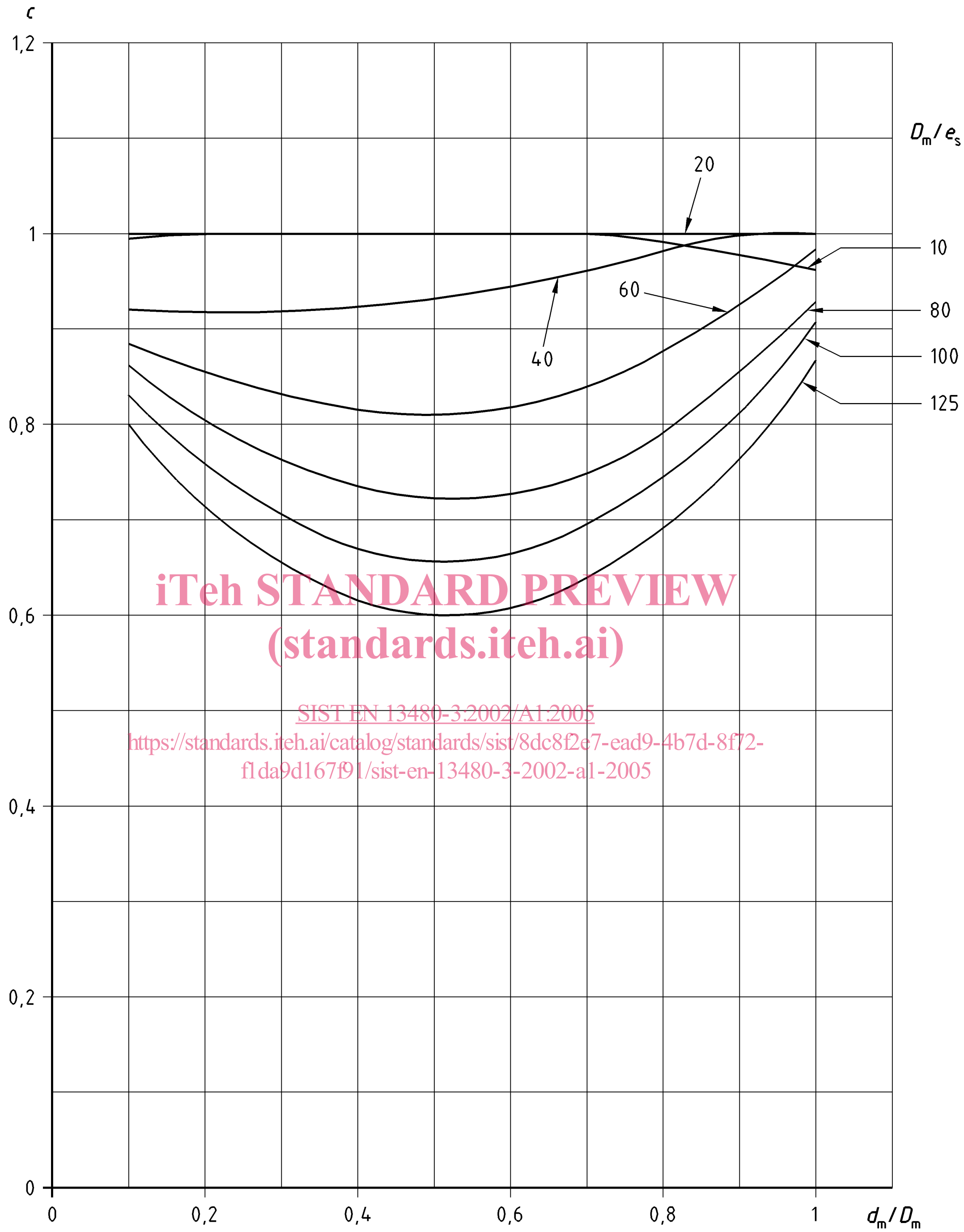

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Figure O.3.2-1 – Coefficient c for e_b / e_s = 0,2

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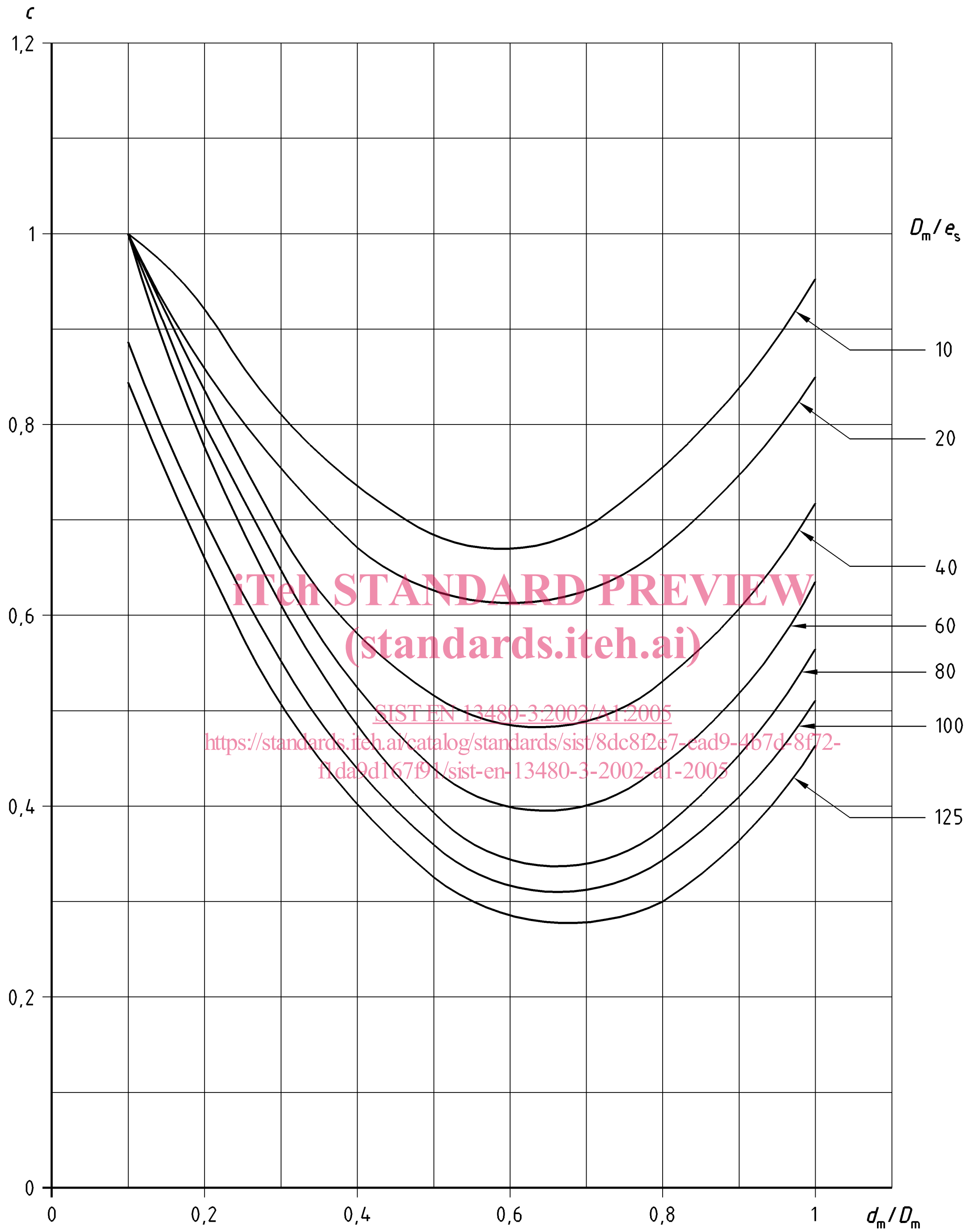

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Figure O.3.2-2 – Coefficient c for e_b / e_s = 0,5

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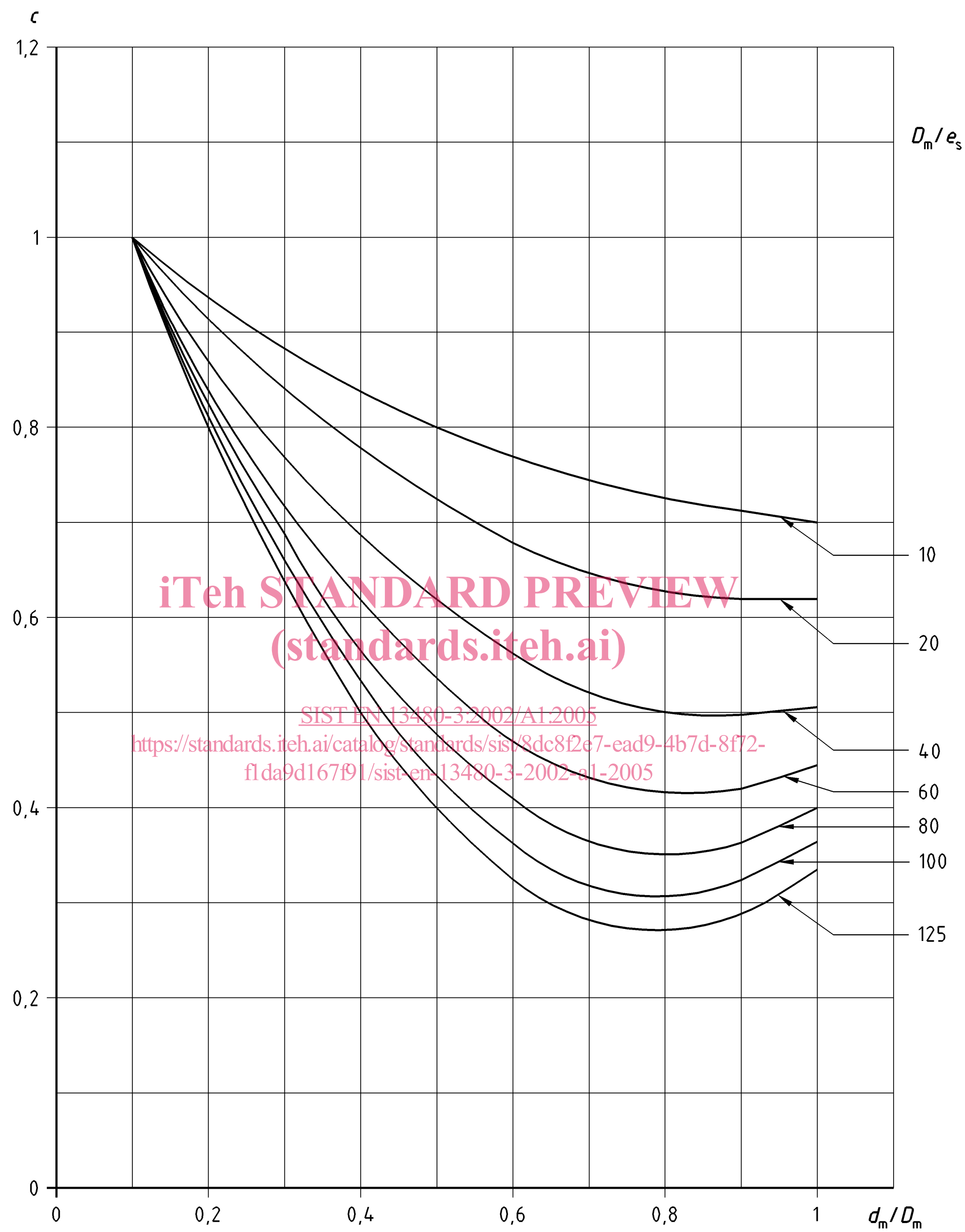

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Figure O.3.2-3 – Coefficient c for e_b / e_s = 0,8