SLOVENSKI STANDARD
SIST EN 13480-2:2012

01-oktober-2012

Nadomešča:
SIST EN 13480-2:2002
SIST EN 13480-2:2002/A1:2011
SIST EN 13480-2:2002/A2:2011

Kovinski industrijski cevovodi - 2. del: Materiali

Metallic industrial piping - Part 2: Materials

Metallische industrielle Rohrleitungen - Teil 2: Werkstoffe

Tuyauteries industrielles métalliques - Partie 2: Matériaux

Ta slovenski standard je istoveten z: **EN 13480-2:2012**

ICS:

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

SIST EN 13480-2:2012 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 13480-2

June 2012

ICS 23.040.01

Supersedes EN 13480-2:2002

English Version

Metallic industrial piping - Part 2: Materials

Tuyauteries industrielles métalliques - Partie 2: Matériaux

Metallische industrielle Rohrleitungen - Teil 2: Werkstoffe

This European Standard was approved by CEN on 8 May 2012.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (EN 13480-2:2012) 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of an identical text or by endorsement, at the latest by December 2012, and conflicting national standards shall be withdrawn at the latest by December 2012.

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 EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

This European Standard EN 13480 for metallic industrial piping consists of eight interdependent and not dissociable Parts which are:

— *Part 1: General;*

— *Part 2: Materials;*

— *Part 3: Design and calculation;*

— *Part 4: Fabrication and installation;*

— *Part 5: Inspection and testing;*

— *Part 6: Additional requirements for buried piping;*

— CEN/TR 13480-7*: Guidance on the use of conformity assessment procedures;*

— *Part 8: Additional requirements for aluminium and aluminium alloy piping.*

Although these Parts may be obtained separately, it should be recognised that the Parts are interdependent. As such the manufacture of metallic industrial piping requires the application of all the relevant Parts in order for the requirements of the Standard to be satisfactorily fulfilled.

This European Standard will be maintained by a Maintenance MHD working group whose scope of working is limited to corrections and interpretations related to EN 13480.

The contact to submit queries can be found at http://portailgroupe.afnor.fr/public_espacenormalisation/CENTC267WG8/index.htm. A form for submitting questions can be downloaded from the link to the MHD website. After subject experts have agreed an answer, the answer will be communicated to the questioner. Corrected pages will be given specific issue number and issued by CEN according to CEN Rules. Interpretation sheets will be posted on the website of the MHD.

This document supersedes EN 13480-2:2002+A1:2010+A2:2010. This new edition incorporates the Amendments/the corrigenda which have been approved previously by CEN members, the corrected pages up to Issue 17 without any further technical change. Annex Y provides details of significant technical changes between this European Standard and the previous edition.

Amendments to this new edition may be issued from time to time and then used immediately as alternatives to rules contained herein. It is intended to deliver a new Issue of EN 13480:2012 each year, consolidating these Amendments and including other identified corrections.

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, Croatia, 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, Turkey and the United Kingdom.

1 Scope

This Part of this European Standard specifies the requirements for materials (including metallic clad materials) for industrial piping and supports covered by EN 13480-1 manufactured from of metallic materials. It is currently limited to steels with sufficient ductility. This Part of this European Standard is not applicable to materials in the creep range.

NOTE Other materials will be added later by amendments.

It specifies the requirements for the selection, inspection, testing and marking of metallic materials for the fabrication of industrial piping.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 764-3:2002, *Pressure equipment — Terminology Part 3: Definition of parties involved*

EN 1092-1:2007, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 1: Steel flanges*

EN 10028-1:2007+A1:2009+AC:2009, *Flat products made of steels for pressure purposes — Part 1: General requirements*

EN 10028-2:2009, *Flat products made of steels for pressure purposes — Part 2: Non-alloy and alloy steels with specified elevated temperature properties*

EN 10028-3:2009, *Flat products made of steels for pressure purposes — Part 3: Weldable fine grain steels, normalized*

EN 10028-4:2009, *Flat products made of steels for pressure purposes — Part 4: Nickel alloyed steels with specified low temperature properties*

EN 10028-5:2009, *Flat products made of steels for pressure purposes — Part 5: Weldable fine grain steels, thermomechanically rolled*

EN 10028-6:2009, *Flat products made of steels for pressure purposes — Part 6: Weldable fine grain steels, quenched and tempered*

EN 10028-7:2007, *Flat products made of steels for pressure purposes — Part 7: Stainless steels*

EN 10164:2004, *Steel products with improved deformation properties perpendicular to the surface of the product — Technical delivery conditions*

EN 10204:2004, *Metallic products — Types of inspection documents*

EN 10213:2007, *Steel castings for pressure purposes*

EN 10216-1:2002+A1:2004, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 1: Non-alloy steel tubes with specified room temperature properties*

EN 10216-2:2002+A2:2007, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties*

EN 10216-3:2002+A1:2004, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 3: Alloy fine grain steel tubes*

EN 10216-4:2002+A1:2004, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 4: Non-alloy and alloy steel tubes with specified low temperature properties*

EN 10216-5:2004, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 5: Stainless steel tubes*

EN 10217-1:2002+A1:2005, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 1: Non-alloy steel tubes with specified room temperature properties*

EN 10217-2:2002+A1:2005, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 2: Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties*

EN 10217-3:2002+A1:2005, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 3: Alloy fine grain steel tubes*

EN 10217-4:2002+A1:2005, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 4: Electric welded non-alloy steel tubes with specified low temperature properties*

EN 10217-5:2002+A1:2005, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 5: Submerged arc welded non-alloy and alloy steel tubes with specified elevated temperature properties*

EN 10217-6:2002+A1:2005, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 6: Submerged arc welded non-alloy steel tubes with specified low temperature properties*

EN 10217-7:2005, *Welded steel tubes for pressure purposes — Technical delivery conditions – Part 7: Stainless steel tubes*

EN 10222-1:1998+A1:2002, *Steel forgings for pressure purposes — Part 1: General requirements for open die forgings*

EN 10222-2:2000, *Steel forgings for pressure purposes — Part 2: Ferritic and martensitic steels with specified elevated temperature properties*

EN 10222-3:1998, *Steel forgings for pressure purposes — Part 3: Nickel steels with specified low temperature properties*

EN 10222-4:1998+A1:2001, *Steel forgings for pressure purposes — Part 4: Weldable fine grain steels with high proof strength*

EN 10222-5:2000, *Steel forgings for pressure purposes — Part 5: Martensitic, austenitic and austenitic-ferritic stainless steels*

EN 10253-2:2007, *Butt-welding pipe fittings — Part 2: Non alloy and ferritic alloy steel with specific inspection requirements*

EN 10269:1999+A1:2006, *Steels and nickel alloys for fasteners with specified elevated and/or low temperature properties*

EN 10272:2007, *Stainless steel bars for pressure purposes*

EN 10273:2007, *Hot rolled weldable steel bars for pressure purposes with specified elevated temperature properties*

EN 12074:1999, *Welding consumables — Quality requirements for manufacture, supply and distribution of consumables for welding and allied processes*

EN 13445-4:2009, *Unfired pressure vessels — Part 4: Fabrication*

EN 13445-5:2009, *Unfired pressure vessels — Part 5: Inspection and testing*

EN 13479:2004, *Welding consumables — General product standard for filler metals and fluxes for fusion welding of metallic materials*

EN 13480-1:2012, *Metallic industrial piping — Part 1: General*

EN 13480-3:2012, *Metallic industrial piping — Part 3: Design and calculation*

EN 13480-4:2012, *Metallic industrial piping — Part 4: Fabrication and installation*

EN 13480-5:2012, *Metallic industrial piping — Part 5: Inspection and testing*

EN 20898-2:1993, *Mechanical properties of fasteners — Part 2: Nuts with specified proof load values — Coarse thread*

EN ISO 148-1:2010, *Metallic materials — Charpy pendulum impact test — Part 1: Test method (ISO 148-1:2009)*

EN ISO 898-1:2009, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs with specified property classes — Coarse thread and fine pitch thread (ISO 898-1:2009)*

EN ISO 2566-1:1999, *Steel — Conversion of elongation values — Part 1: Carbon and low alloy steels (ISO 2566-1:1984).*

EN ISO 2566-2:1999, *Steel — Conversion of elongation values — Part 2: Austenitic steels (ISO 2566-2:1984)*

EN ISO 3506-1:1997, *Mechanical properties of corrosion-resistant stainless steel fasteners — Part 1: Bolts, screws and studs (ISO 3506-1:1997)*

EN ISO 3506-2:1997, *Mechanical properties of corrosion-resistant stainless steel fasteners — Part 2: Nuts (ISO 3506-2:1997)*

CEN ISO/TR 15608:2000, *Welding — Guidelines for a metallic materials grouping system (ISO/TR 15608:2000)*

3 Terms and definitions, symbols and untis

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13480-1:2012, EN 764-3:2002 and the following definitions apply.

3.1.1
minimum metal temperature T_M
lowest temperature determined for any of the following conditions:

— normal operations;

— start up and shut down procedures;

— possible process upsets, such as flashings of fluid, which have an atmospheric boiling point below 0 °C;

— during pressure or leak testing.

Note to entry See also 3.1.2 and 3.1.3.

3.1.2
temperature adjustment term T_S
temperature relevant to the calculation of the design reference temperature T_R and dependent on the calculated tensile membrane stress at the appropriate minimum metal temperature

Note 1 to entry Values for temperature adjustment term T_S are given in Table B.2-12.

Note 2 to entry For tensile membrane stress reference is made to EN 13480-3:2012, clause 12.

3.1.3
design reference temperature T_R
temperature used for determining the impact energy requirements and determined by adding the temperature adjustment T_S to the minimum metal temperature T_M

$$T_R = T_M + T_S$$

3.1.4
impact test temperature T_{KV}
temperature at which the required resistance to impact energy is achieved

Note to entry See B.2.

3.1.5
impact energy KV
energy absorbed by a sample of material when subjected to a Charpy-V-notch impact test in accordance with EN ISO 148-1:2010

3.1.6
reference thickness e_B
thickness of a component to be used to relate the design reference temperature T_R of the component with its required impact test temperature T_{KV}

Note 1 to entry See Tables B.2-2 to B.2-7 and Figures B.2-1 to B.2-11.

Note 2 to entry The reference thickness e_B, defined in Table B.4-1, is based on the nominal thickness (including corrosion allowance). For butt welded components e_B is the nominal wall thickness of the component at the edge of the weld preparation.

3.2 Symbols and units

For the purposes of this Part of this European Standard, the symbols and units of EN 13480-1:2012 apply together with those given in Table 3.2-1.

Table 1 — Symbols and units

Symbol	Characteristic	Unit
a_K	Form factor	–
b	width	mm
C	constant	–
e_B	reference thickness	mm
G	shear modulus	N/mm^2 (MPa)
HB	Brinell hardness	–
HV	Vickers hardness	–
h	maximum permissible reinforcement of weld	mm
KV	Impact rupture energy	J
L_o	length (gauge length)	mm
P	pressure	bar
P_{LM}	parameter according to Larson-Miller	–
R_e	yield strength	N/mm^2 (MPa)
$R_{m\,T\,t}$	creep rupture strength for T in h at temperature t	N/mm^2 (MPa)
S_0	original cross section area	mm^2
T_M	minimum metal temperature	°C
T_{KV}	material impact test temperature	°C
T_R	design reference temperature	°C
T_S	temperature adjustment term	°C
α	linear expansion coefficient	K^{-1}
ε	strain	%
NOTE 1 N/mm^2 = 1 MPa		

4 Requirements for materials to be used for pressure containing parts in industrial piping

4.1 General

4.1.1 Materials to be used for pressure containing parts in industrial piping shall meet the general requirements of 4.1 and the special provisions of 4.2 if applicable. Materials for pressure containing parts shall be ordered complying with the technical delivery conditions in 4.3.

Marking of materials for pressure containing parts shall be performed in accordance with 4.4.

Materials shall be selected in accordance with Annex A.

Materials shall be selected to be compatible with anticipated fabrication steps and to be suitable for the internal fluid and external environment. Both normal operating conditions and transient conditions occurring during fabrication, transport, testing, commissioning and decommissioning shall be taken into account when specifying the materials.

NOTE 1 The requirements of 4.1 and 4.2 should also be fulfilled when technical delivery conditions are developed for European Standards for materials , European Approval of Materials or Particular Material Appraisals.

NOTE 2 When technical delivery conditions for pressure-containing parts are developed, the structure and requirements of EN 764-4:2002 should be met. Exceptions should be technically justified.

The materials shall be grouped in accordance with CEN ISO/TR 15608:2000 to relate manufacturing and inspection requirements to generic material types.

NOTE 3 Materials have been allocated into these groups in accordance with their chemical composition and properties in relation to manufacture and heat treatment after welding.

4.1.2 Materials for pressure containing parts compliant with the requirements of this European Standard shall be certified on the basis of EN 10204:2004.

NOTE The certification should be in accordance with EN 764-5:2002.

4.1.3 The products shall be free from surface and internal defects which might impair their usability.

4.1.4 The specified minimum elongation of the steel after fracture shall be:

— ≥ 14 % for the transverse direction; and

— ≥ 16 % for the longitudinal direction, or where this is the less critical direction, the transverse direction;

when measured on a gauge length, L_0, calculated as follows:

$$L_0 = 5{,}65\sqrt{S_0} \qquad (4.1\text{-}1)$$

where

S_0 is the original cross sectional area within the gauge length in order to fulfil formula 4.1-1.

However, lower elongation values than specified in 4.1 (e. g. for fasteners or castings) may also be applied, provided that appropriate measures shall be taken by the parties concerned to compensate for these lower values and that compliance with the specific requirements is verifiable.

NOTE Examples of appropriate measures:

— application of higher safety factors in design;

— performance of appropriate burst tests to demonstrate ductile material behaviour.

4.1.5 When measured on a gauge length other than that stated in 4.1.4, the minimum elongation after fracture shall be determined by converting the elongation given in 4.1.4 in accordance with:

— EN ISO 2566-1:1999 for carbon and low alloy steels;

— EN ISO 2566-2:1999 for austenitic steels.

4.1.6 Steels shall have a specified minimum impact energy measured on a Charpy V-notch impact test specimen (EN ISO 148-1:2010) as follows:

— ≥ 27 J for ferritic and 1,5 % to 5 % Ni alloyed steels;

— ≥ 40 J for steels of material groups 8, 9.3 and 10,

at a test temperature in accordance with Annex B, but not higher than 20 °C. The other requirements of Annex B shall also apply.

4.1.7 The chemical composition of steels intended for welding or forming shall not exceed the values given in Table 4.1-1. Exceptions shall be technically justified.

Table 4.1-1 — Maximum carbon, phosphorus and sulphur content for steel intended for welding or forming

Material group (according to Table A.1)	Maximum content of cast analysis		
	% C	% P	% S
Steels (1 to 6 and 9)	0,23 [a]	0,035	0,025
Ferritic stainless steels (7.1)	0,08	0,040	0,015
Martensitic stainless steels (7.2)	0,06	0,040	0,015
Austenitic stainless steels (8.1)	0,08	0,045	0,015 [b]
Austenitic stainless steels (8.2)	0,10	0,035	0,015
Austenitic-ferritic stainless steels (10)	0,030	0,035	0,015

[a] Maximum content of product analysis 0,25 %.
[b] For products to be machined a controlled sulphur content of 0,015 % to 0,030 % is permitted by agreement provided the resistance to corrosion is satisfied for the intended purpose.

4.2 Special provisions

4.2.1 Special properties

4.2.1.1 General

Where the behaviour of a material can be affected by manufacturing processes or operating conditions, to an extent that would adversely affect the safety or service life of the piping system, this shall be taken into consideration when specifying the material.

Adverse effects can arise from:

— manufacturing processes: e.g. degree of cold forming, heat treatment;

— operating conditions: e.g. hydrogen embrittlement, corrosion, scaling, ageing behaviour after cold forming.

4.2.1.2 Lamellar tearing

Where lamellar tearing due to the joint design and loading needs to be addressed (see EN 13480-3:2012, 7.2.3.3), steels shall be used which have improved deformation properties perpendicular to the surface shall be specified and verified in accordance with EN 10164:2004.

NOTE For guidance see EN 1011-2:2001.

4.2.2 Design temperature above 20 °C

4.2.2.1 A material shall only be used for pressure parts within the range of temperatures for which the material properties required by EN 13480-3:2012 are defined in the technical specification for the material. If the technical delivery condition does not contain the specific material values required for the design temperature t_s the values required in EN 13480-3:2012 for the design shall be determined by linear interpolation between the two adjacent values. Values shall not be rounded up.

For other than austenitic and austenitic-ferritic stainless steels, the specified value of R_{eH} ($R_{p0,2}$) at room temperature may be used for temperatures less than or equal to 50 °C. Interpolation for design temperatures between 50 °C and 100 °C shall be performed with the values of R_{eH} at room temperature and at 100 °C, and using 20 °C as the starting point for interpolation. Above 100 °C linear interpolation shall be performed between the tabulated values given in the appropriate material standards.

In the case of creep rupture strength values or strength values for plastic strain in a given time, linear interpolation shall be permissible only if the difference between the two temperatures serving as starting points for the interpolation is equal to or less than 10 °C.

4.2.2.2 Materials in the creep range shall not be used unless the creep rupture strength values or strength values for plastic strain needed for design are specified in the base material specification. The manufacturer of the piping system installation shall be assured by the material supplier that the material supplied is capable of complying with specified properties (within the normal scatter band) by a statement that the manufacturing processes have remained equivalent to those for the steel for which the test results were obtained.

4.2.3 Prevention of brittle fracture

The requirements given in Annex B shall apply.

4.2.4 Specific requirements for fasteners

Fasteners includes bolts, studs and nuts.

Free cutting steel shall not be used. Fasteners made of carbon steel or low alloyed ferritic steel with > 3,5 % nickel shall not be used above 300 °C.

The specified minimum tensile strength of bar material of ferritic and martensitic steel for bolts shall not exceed 1 000 N/mm^2. The minimum elongation after fracture of bar material shall be at least 14%.

Impact requirements for ferritic steels shall be in accordance with Table B.2.-9.

Bolt material with a design temperature below –160 °C shall be impact tested at –196 °C.

Hydrogen embrittlement, fatigue or relaxation properties shall be taken into account where appropriate.

NOTE Detailed requirements on the surface condition and internal soundness of the bar can be necessary for some applications.