

Metallic industrial piping

Part 2: Materials

National foreword

This British Standard is the UK implementation of EN 13480-2:2017+A8:2021. It supersedes BS EN 13480-2:2017+A7:2020, which is withdrawn.

The text of amendment 8:2021 to BS EN 13480-2:2017 is collated in its entirety at the end of this text. BSI's policy of providing consolidated content remains unchanged; however, in the interest of expediency, in this instance BSI have chosen to collate the relevant content at the end of this document.

The UK participation in its preparation was entrusted to Technical Committee PVE/10, Piping systems.

A list of organizations represented on this committee can be obtained on request to its committee manager.

This publication has been prepared under a mandate given to the European Standards Organizations by the European Commission and the European Free Trade Association. It is intended to support requirements of the EU legislation detailed in the European Foreword. A European Annex, usually Annex ZA or ZZ, describes how this publication relates to that EU legislation.

For the Great Britain market (England, Scotland and Wales), if UK Government has designated this publication for conformity with UKCA marking (or similar) legislation, it may contain an additional National Annex. Where such a National Annex exists, it shows the correlation between this publication and the relevant UK legislation. If there is no National Annex of this kind, the relevant Annex ZA or ZZ in the body of the European text will indicate the relationship to UK regulation applicable in Great Britain. References to EU legislation may need to be read in accordance with the UK designation and the applicable UK law. Further information on designated standards can be found at www.bsigroup.com/standardsandregulation.

For the Northern Ireland market, UK law will continue to implement relevant EU law subject to periodic confirmation. Therefore Annex ZA/ZZ in the European text, and references to EU legislation, are still valid for this market.

UK Government is responsible for legislation. For information on legislation and policies relating to that legislation, consult the relevant pages of www.gov.uk.

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Amendments/corrigenda issued since publication

Date	Text affected
31 December 2019	Implementation of CEN amendment A1:2018: see European foreword for details
31 December 2019	Implementation of CEN amendment A2:2018: see European foreword for details
31 December 2019	Implementation of CEN amendment A3:2018: see European foreword for details
30 September 2020	Implementation of CEN amendment A7:2020
31 March 2022	Implementation of CEN amendment 8:2021

English Version

Metallic industrial piping - Part 2: Materials

Tuyauteries industrielles métalliques - Partie 2 :
Matériaux

Metallische industrielle Rohrleitungen - Teil 2:
Werkstoffe

This amendment A7 modifies the European Standard EN 13480-2:2017; it was approved by CEN on 10 February 2020.

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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

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.

CEN members are the national standards bodies of 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 United Kingdom.



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Contents

Page

European foreword.....	3
1 Modification to Clause 2, Normative references.....	4
2 Modification to 4.2.1.1, General.....	4
3 Modification to 4.2.1.2, Lamellar tearing	4
4 Modification to Annex ZA, Relationship between this European Standard and the Essential Requirements of EU Directive 2014/68/EU aimed to be covered	4
5 Modification to Bibliography.....	4

European foreword

This document (EN 13480-2:2017/A7:2020) has been prepared by Technical Committee CEN/TC 267 “Industrial pipings 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 October 2020, and conflicting national standards shall be withdrawn at the latest by October 2020.

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

Amendments EN 13480-2:2017/prA4 to EN 13480-2:2017/prA6 are withdrawn from the work program of Technical Committee CEN/TC 267 “Industrial piping and pipelines” following CEN Rules related to the time limit for activating Preliminary Work Items.

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, see informative Annex ZA, which is an integral part of EN 13480-2:2017.

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 Clause 2, Normative references

Delete the following normative reference:

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

2 Modification to 4.2.1.1, General

Delete the heading "4.2.1.1 General".

Therefore, the paragraphs of 4.2.1.1 fall under 4.2.1 "Special properties".

The second indent shall read as follows:

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

3 Modification to 4.2.1.2, Lamellar tearing

Delete the whole sub-clause 4.2.1.2.

4 Modification to Annex ZA, Relationship between this European Standard and the Essential Requirements of EU Directive 2014/68/EU aimed to be covered

In Table ZA.1, reference to 4.2.1.1 shall be deleted and replaced by 4.2.1.

5 Modification to Bibliography

Delete the following reference:

[13] EN 1011-2:2001, *Welding - Recommendations for welding of metallic materials - Part 2: Arc welding of ferritic steels*

After this deletion, the sequence of numberings of references in the Bibliography shall be updated accordingly.

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 21 June 2017.

This European Standard was corrected and reissued by the CEN-CENELEC Management Centre on 26 June 2019.

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Contents

	Page
European foreword.....	4
1 Scope	6
2 Normative references	6
3 Terms and definitions, symbols and units	9
3.1 Terms and definitions	9
3.2 Symbols and units	10
4 Requirements for materials to be used for pressure containing parts in industrial piping.....	11
4.1 General.....	11
4.2 Special provisions	13
4.3 Technical delivery conditions	15
4.4 Marking.....	16
5 Requirements for materials to be used for non-pressure parts.....	16
Annex A (normative) Grouping system for steels for pressure equipment.....	17
Annex B (normative) Requirements for prevention of brittle fracture at low temperatures	19
B.1 General.....	19
B.2 Material selection and impact energy requirements.....	20
B.2.1 General.....	20
B.2.2 Method 1 – Code of practice.....	20
B.2.3 Method 2.....	29
B.2.4 Method 3 — Fracture mechanics analysis.....	41
B.3 General test requirements.....	42
B.3.1 General.....	42
B.3.2 Sub-sized specimens	43
B.4 Welds	44
B.4.1 General.....	44
B.4.2 Welding procedure qualification	44
B.4.3 Production test plates	44
B.5 Materials for use at elevated temperatures	44
B.5.1 General.....	44
B.5.2 Materials.....	45
B.5.3 Welding procedure qualification and production test plates.....	45
B.5.4 Start up and shut down procedure	45
B.5.5 Pressure test.....	45
Annex C (normative) Provisional technical delivery conditions for clad products for pressure purposes	53
C.1 Introduction	53
C.2 Requirements for the base material	53
C.3 Requirements for the cladding material	53

C.4	Qualification of the cladding procedure.....	54
C.5	Production tests	55
Annex D	(informative) European steels for pressure purposes	57
D.1	European Standards for steels and steel components for pressure purposes.....	57
D.2	European standardised steels grouped according to product forms	58
Annex E	(normative) Special provisions for materials and components	a
E.1	General.....	a
E.2	Mechanical properties and technical delivery conditions for fasteners in accordance with EN ISO 3506-1 and/or EN ISO 3506-2	a
E.2.1	Mechanical properties for austenitic bolts in accordance with EN ISO 3506-1.....	a
E.2.2	Delivery conditions for austenitic bolts.....	b
Annex Y	(informative) History of EN 13480-2.....	81
Y.1	Differences between EN 13480-2:2012 and EN 13480-2:2017.....	81
Y.2	List of corrected pages of Issue 2 (2019-06)	81
Annex ZA	(informative) Relationship between this European Standard and the Essential Requirements of EU Directive 2014/68/EU aimed to be covered	82
Bibliography		83

European foreword

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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 inter-dependant. 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://www.unm.fr> (en13480@unm.fr). 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 13480-2:2012. This new edition incorporates the Amendments which have been approved previously by CEN members, and the corrected pages up to Issue 5 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 13480:2017 each year, consolidating these Amendments and including other identified corrections. Issue 2 (2019-06) consolidates Amendments EN 13480-2:2017/A1:2018, EN 13480-2:2017/A2:2018 and EN 13480-2:2017/A3:2018; it includes the corrected pages listed in Annex Y.

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1 Scope

This document specifies the requirements for steel products used for industrial piping and supports.

For some metallic materials other than steel, such as spheroidal graphite cast iron, aluminium, nickel, copper, titanium, requirements are or will be formulated in separate parts of this document.

For metallic materials which are not covered by a harmonized material standard and are not likely to be in near future, specific rules are given in this part or the above cited parts of this document.

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 1515-4:2009, *Flanges and their joints — Bolting — Part 4: Selection of bolting for equipment subject to the Pressure Equipment Directive 97/23/EC*

EN 1591-1:2013, *Flanges and their joints — Design rules for gasketed circular flange connections — Part 1: Calculation*

EN 1591-2:2008, *Flanges and their joints — Design rules for gasketed circular flange connections — Part 2: Gasket parameters*

CEN/TS 1591-3:2007, *Flanges and their joints — Design rules for gasketed circular flange connections — Part 3: Calculation method for metal to metal contact type flanged joint*

EN 1591-4:2013, *Flanges and their joints — Part 4: Qualification of personnel competency in the assembly of the bolted connections of critical service pressurized systems*

CEN/TR 1591-5:2012, *Flanges and their joints — Design rules for gasketed circular flange connections — Part 5: Calculation method for full face gasketed joints*

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 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 10269:2013, *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 13445-2:2014, *Unfired pressure vessels — Part 2: Materials*

EN 13445-3:2014, *Unfired pressure vessels — Part 3: Design*

EN 13445-4:2014, *Unfired pressure vessels — Part 4: Fabrication*

EN 13445-5:2014, *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 13480-1:2017, *Metallic industrial piping — Part 1: General*

EN 13480-3:2017, *Metallic industrial piping — Part 3: Design and calculation*

EN 13480-4:2017, *Metallic industrial piping — Part 4: Fabrication and installation*

EN 13480-5:2017, *Metallic industrial piping — Part 5: Inspection and testing*

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

EN ISO 898-1:2013, *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 898-1:2013)*

EN ISO 898-2:2012, *Mechanical properties of fasteners — Part 2: Nuts with specified proof load values — Coarse thread (ISO 898-2:2012)*

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 13445-4:2014, *Unfired pressure vessels — Part 4: Fabrication*

EN 13445-5:2014, *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 13480-1:2017, *Metallic industrial piping — Part 1: General*

EN 13480-3:2017, *Metallic industrial piping — Part 3: Design and calculation*

EN 13480-4:2017, *Metallic industrial piping — Part 4: Fabrication and installation*

EN 13480-5:2017, *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, *Welding — Guidelines for a metallic materials grouping system (ISO/TR 15608)*

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 3269:2000, *Fasteners — Acceptance inspection (ISO 3269:2000)*

EN ISO 3506-1:2009, *Mechanical properties of corrosion-resistant stainless steel fasteners — Part 1: Bolts, screws and studs (ISO 3506-1:2009)*

EN ISO 3506-2:2009, *Mechanical properties of corrosion-resistant stainless steel fasteners — Part 2: Nuts (ISO 3506-2:2009)*

EN ISO 16425:2002, *Fasteners — Quality assurance system (ISO 16426:2002)*

CEN ISO/TR 15608:2017, *Welding — Guidelines for a metallic materials grouping system (ISO/TR 15608:2013)*

3 Terms and definitions, symbols and units

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13480-1:2017, 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 13480-3:2017, 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 13480-1:2017 apply together with those given in Table 3.2-1.

Table 3.2-1 — 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/mm² = 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 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:

— $\geq 14 \%$ for the transverse direction; and

— $\geq 16 \%$ 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:

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

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 13480-3:2017, 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 13480-3:2017 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_R the values required in EN 13480-3:2017 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 include 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/mm². The minimum elongation after fracture of bar material shall be at least 14%.

Impact requirements for ferritic steels shall be in accordance with B.2.2-4.

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.

4.2.5 Lined piping

The pressure containing steel of lined industrial piping need not be suitable for the internal fluid if the lining provides leak tight containment during operation.

4.3 Technical delivery conditions

4.3.1 European Standards

The European Standards for plates, strips, bars, tubes, forgings, fittings and castings for pressure purposes shall be used.

NOTE 1 Table D.1-1 provides an informative summary of European Materials Standards for steels and steel components for pressure purposes.

NOTE 2 Table D.2-1 provides an informative summary regarding materials for pressure purposes specified in harmonised standards grouped according to product forms.

Special provisions due to fabrication and operation shall be taken into account, if appropriate.

4.3.2 European Approval for Materials (EAM)

A material specified in an EAM for piping system shall only be used within its range of application.

4.3.3 Particular Material Appraisals (PMA)

Materials other than those specified in 4.3.1 and 4.3.2 may also be used provided that they have been accepted by a particular material appraisal (PMA).

4.3.4 Clad products

Technical delivery conditions for clad products for pressure parts shall be in accordance with the requirements of Annex C.

NOTE 1 European Standards specifying technical delivery conditions for clad products for pressure purposes are not currently available.

NOTE 2 Examples of documents covering technical delivery condition for clad steels are given within the publications [2] to [4]

4.3.5 Technical delivery conditions for welding consumables

Technical delivery conditions for welding consumables used for the welding of pressure parts and attachments to pressure parts shall be in accordance with EN 10274:1999 and EN 13479-1:2004.

NOTE Equivalent national/international specifications are accepted which fulfil the same criteria with respect to the requirements for the Quality System and the requirements for manufacture, supply distribution, test methods and evaluation of consumables.

4.4 Marking

The marking of the products or delivery units shall ensure traceability between the product or delivery unit and the inspection documents.

For European standardized materials, the marking shall fulfil the requirements of the relevant standard. For materials not contained in a European standard the marking shall at least contain:

- the material specification (reference, material designation);
- the manufacturer's name or mark;
- the stamp of the inspection representative, if applicable.

For material supplied with specific inspection the marking shall include an identification which permits the correlation between the product or delivery unit and the relevant inspection document.

5 Requirements for materials to be used for non-pressure parts

For non-pressure parts, e.g. supporting lugs, skirts, baffles and similar parts welded to industrial piping, and for welding consumables, materials shall be used which are supplied to material specifications covering at least the requirements for the chemical composition and the tensile properties. These materials shall not limit the operating conditions of the material to which they are attached.

Requirements on materials used for pipe supports are defined in EN 13480-3.

Annex A (normative)

Grouping system for steels for pressure equipment

Steels shall be grouped as shown in Table A.1. The figures given in group 1 are referring to the ladle analysis of the materials. The figures given in group 4 to 10 are based on the element content used in the designation of the alloys.

Table A.1 — Grouping system for steels (extract from CEN ISO/TR 15608:2013)

Group	Sub-group	Type of steel
1		Steels with a specified minimum yield strength $ReH \leq 460 \text{ MPa}^a$ and with analysis in %: $C \leq 0,25$ $Si \leq 0,60$ $Mn \leq 1,80$ $Mo \leq 0,70^b$ $S \leq 0,045$ $P \leq 0,045$ $Cu \leq 0,40^b$ $Ni \leq 0,5^b$ $Cr \leq 0,3$ (0,4 for castings) ^b $Nb \leq 0,06$ $V \leq 0,10^b$ $Ti \leq 0,05$
	1.1	Steels with a specified minimum yield strength $Re \leq 275 \text{ MPa}$
	1.2	Steels with a specified minimum yield strength $275 \text{ MPa} < Re \leq 360 \text{ MPa}$
	1.3	Normalized fine grain steels with a specified minimum yield strength $Re > 360 \text{ MPa}$
	1.4	Steels with improved atmospheric corrosion resistance whose analysis may exceed the requirements for the single elements as indicated under 1
2		Thermomechanically treated fine grain steels and cast steels with a specified minimum yield strength $Re > 360 \text{ MPa}$
	2.1	Thermomechanically treated fine grain steels and cast steels with a specified minimum yield strength $360 \text{ MPa} < Re \leq 460 \text{ MPa}$
	2.2	Thermomechanically treated fine grain steels and cast steels with a specified minimum yield strength $Re > 460 \text{ MPa}$
3		Quenched and tempered steels and precipitation hardened steels except stainless steels with a specified minimum yield strength $Re > 360 \text{ MPa}$
	3.1	Quenched and tempered steels with a specified minimum yield strength $360 \text{ MPa} < Re \leq 690 \text{ MPa}$
	3.2	Quenched and tempered steels with a specified minimum yield strength $Re > 690 \text{ MPa}$
	3.3	Precipitation hardened steels except stainless steels

Table A.1 (concluded)

Group	Sub-group	Type of steel
4		Low vanadium alloyed Cr-Mo-(Ni) steels with $\text{Mo} \leq 0,7 \%$ and $\text{V} \leq 0,1 \%$
	4.1	Steels with $\text{Cr} \leq 0,3 \%$ and $\text{Ni} \leq 0,7 \%$
	4.2	Steels with $\text{Cr} \leq 0,7 \%$ and $\text{Ni} \leq 1,5 \%$
5		Cr-Mo steels free of vanadium with $\text{C} \leq 0,35 \%$
	5.1	Steels with $0,75 \% \leq \text{Cr} \leq 1,5 \%$ and $\text{Mo} \leq 0,7 \%$
	5.2	Steels with $1,5 \% < \text{Cr} \leq 3,5 \%$ and $0,7 < \text{Mo} \leq 1,2 \%$
	5.3	Steels with $3,5 \% < \text{Cr} \leq 7,0 \%$ and $0,4 < \text{Mo} \leq 0,7 \%$
	5.4	Steels with $7,0 \% < \text{Cr} \leq 10 \%$ and $0,7 < \text{Mo} \leq 1,2 \%$
6		High vanadium alloyed Cr-Mo-(Ni) steels
	6.1	Steels with $0,3 \% \leq \text{Cr} \leq 0,75 \%$, $\text{Mo} \leq 0,7 \%$ and $\text{V} \leq 0,35 \%$
	6.2	Steels with $0,75 \% < \text{Cr} \leq 3,5 \%$, $0,7 \% < \text{Mo} \leq 1,2 \%$ and $\text{V} \leq 0,35 \%$
	6.3	Steels with $3,5 \% < \text{Cr} \leq 7,0 \%$, $\text{Mo} \leq 0,7 \%$ and $0,45 \% \leq \text{V} \leq 0,55 \%$
	6.4	Steels with $7,0 \% < \text{Cr} \leq 12,5 \%$, $0,7 \% < \text{Mo} \leq 1,2 \%$ and $\text{V} \leq 0,35 \%$
7		Ferritic, martensitic or precipitation hardened stainless steels with $\text{C} \leq 0,35 \%$ and $10,5 \% \leq \text{Cr} \leq 30 \%$
	7.1	Ferritic stainless steels
	7.2	Martensitic stainless steels
	7.3	Precipitation hardened stainless steels
8		Austenitic steels, $\text{Ni} \leq 35 \%$
	8.1	Austenitic stainless steels with $\text{Cr} \leq 19 \%$
	8.2	Austenitic stainless steels with $\text{Cr} > 19 \%$
	8.3	Manganese austenitic stainless steels with $4 \% < \text{Mn} \leq 12 \%$
9		Nickel alloyed steels with $\text{Ni} \leq 10 \%$
	9.1	Nickel alloyed steels with $\text{Ni} \leq 3 \%$
	9.2	Nickel alloyed steels with $3 \% < \text{Ni} \leq 8 \%$
	9.3	Nickel alloyed steels with $8 \% < \text{Ni} \leq 10 \%$
10		Austenitic ferritic stainless steels (duplex)
	10.1	Austenitic ferritic stainless steels with $\text{Cr} \leq 24 \%$
	10.2	Austenitic ferritic stainless steels with $\text{Cr} > 24 \%$
^a In accordance with the specification of the steel product standards, R_{eH} may be replaced by $R_{p0,2}$ or $R_{t0,5}$. ^b A higher value is accepted provided that $\text{Cr} + \text{Mo} + \text{Ni} + \text{Cu} + \text{V} \leq 0,75 \%$.		

Annex B (normative)

Requirements for prevention of brittle fracture at low temperatures

B.1 General

This annex distinguishes between pressure equipment that has design temperature for normal operation higher or lower than 50 °C.

For pressure equipment with normal operation temperatures higher than 50 °C B.5 applies. If B.5 is not applicable, the following rules for lower normal operation temperatures shall be used.

For pressure equipment with design temperature equal to or less than 50 °C this annex specifies three alternative methods for establishing criteria for the prevention of low temperature brittle fracture¹⁾ of steels in the form of plate, strip, tubes, fittings, forgings, castings, flanges, fasteners and weldments used in pressure parts. In this case, the temperature for the design T_R shall be determined²⁾. The criteria are based on impact energy requirements at specified temperatures for the base material, heat affected zone (including the fusion line) and weld metals.

The three methods are:

Method 1 Code of Practice:

Technical requirements

- a) Technical requirements based on the choice of $T_R = T27J$ as specified in harmonised European Material Standards and on the assumption that it is possible to achieve these minimum properties after fabrication. Calculated from the principles of fracture mechanics used for method 2 for C and CMn steels with yield strength < 460 MPa and
- b) based on operating experience for Ni-alloyed steels with Ni $\geq$ 3 % up to 9 %, for austenitic steels and for bolts and nuts.

¹⁾ Including temperatures at pressure tests

²⁾ See EN 13480-2:2017, 3.1.3.

Method 2 Method developed from the principles of fracture mechanics and from operating experiences:

A more flexible approach than method 1 for derivation of technical requirements applicable to C, CMn and low alloy ferritic steels with a specified minimum yield strength $\leq 500 \text{ N/mm}^2$ and for austenitic-ferritic steels with a specified minimum yield strength $\leq 550 \text{ N/mm}^2$. This method can be applied for these steels to a wider range of thicknesses and temperatures than method 1 because T_R must not be equal to T_{27J} (see Figures B.2-1 to B.2-11). In addition for ferritic steels with max. 355 N/mm^2 in PWHT condition operation experience was considered for higher thicknesses.

Method 3 The application of a fracture mechanics analysis:

This general method is applicable to cases not covered by methods 1 or 2. This method may also be used to justify deviations from the requirements of method 1 or 2. Only general guidance is given on the use of this method which shall only be used in agreement with the parties concerned.

Each of the three methods may be used independently. It is only necessary to satisfy the requirement of any one method.

All applicable combinations of the temperatures T_M (minimum metal temperature) and T_S (temperature adjustment term) shall be considered and the lowest possible T_R -value (design reference temperature) shall be used for the determination of the required material impact test temperature.

NOTE For definitions of temperature terms see 3.1.1 to 3.1.4.

B.2 Material selection and impact energy requirements

B.2.1 General

The methods specified in B.2.2 (Method 1) or B.2.3 (Method 2) shall be used to determine the impact energy required to avoid brittle fracture. Alternatively, B.2.4 (Method 3) may be used to determine the required toughness. The method used shall be fully documented, in order to ensure that compliance can be verified.

Reference thickness for constructional details is defined in Table B.4-1.

B.2.2 Method 1 – Code of practice

B.2.2.1 General

Method 1 allows the selection of materials taken from harmonised European material standards with regard to prevention of brittle fracture. Table B.2-1 gives an overview to the following tables by steel type and product form.

The weld metal, the heat affected zone and other parts affected by manufacturing processes shall satisfy the same impact energy requirements as the guaranteed minimum properties for the base material at T_R given in the tables.

The tables B.2-2 to B.2-11 list design reference temperatures for maximum thickness at given strength levels represented by steels from harmonised European material standards with guaranteed minimum strength and impact properties. Where it is not possible to achieve these minimum properties after fabrication a tougher material shall be selected.

Table B.2-1 — Guide to material selection

Table	Material or product form ^a	Steel group	Clause
B.2-2	Plates and strips	Ferritic steels	B.2.2.2
B.2-3	Seamless and welded pipes		
B.2-4	Bars		
B.2-5	Forgings		
B.2-6	Ni alloyed steels ($1,5 < \text{Ni} \leq 5 \%$)	Ferritic steels	B.2.2.3
B.2-7	Ni-alloyed steel (9 % Ni)		
B.2-8	Bolts and nuts	Ferritic steels	B.2.2.4
B.2-9		Austenitic steels	
B.2-10			
B.2-11	Austenitic steel grades	Austenitic steels	B.2.2.5

^a For standardized fittings (Tees, Reducers, Elbows and Caps) T_R may be taken from Tables B.2-2 to B.2-6 as for the applied material or product form. The reference thickness e_B of the fitting shall be considered as equal to the reference thickness of the thicker of the mating pipes.

NOTE Requirements for austenitic-ferritic steels are only given in B.2.3 (Method 2).

Where test pieces of at least 5 mm wide cannot be obtained, the material need not be subject to impact testing. For pipes with nominal thickness lower than 6,3 mm no impact testing is required.

Values of the design reference temperature T_R shall be calculated from the metal temperature T_M using the values of the temperature adjustment T_S given in Table B.2-12.

B.2.2.2 Ferritic steels

Tables B.2-2 to B.2-5 list ferritic steels taken from harmonised European material standards with specified impact properties below -10°C .

The tabulated value of T_R is based on the impact test temperature T_{KV} for $KV = 27 \text{ J}$.