



SLOVENSKI STANDARD
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Kovinski industrijski cevovodi - 9. del: Dodatne zahteve za cevovode iz niklja in nikeljevih zlitin

Metallic industrial piping - Part 9: Additional requirements for nickel and nickel alloys piping

Metallische industrielle Rohrleitungen - Teil 9: Zusatzanforderungen an Rohrleitungen aus Nickel und Nickellegierungen

Tuyauteries industrielles métalliques - Partie 9 : Exigences complémentaires relatives aux tuyauteries en nickel et alliages de nickel

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Metallic industrial piping - Part 9: Additional requirements for nickel and nickel alloys piping

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

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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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

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prEN 13480-9:2018 (E)**European foreword**

This document (prEN 13480-9:2018) 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 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, *Metallic industrial piping*, consists of nine 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;*
- *Part 7: Guidance on the use of conformity assessment procedures [CEN/TR];*
- *Part 8: Additional requirements for aluminium and aluminium alloy piping;*
- *Part 9: Additional requirements for nickel and nickel alloys piping.*

Although these parts may be obtained separately, 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 European 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 the EN 13480 series.

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.

1 Scope

This document specifies requirements for metallic industrial piping and their parts made of nickel and nickel alloys (see 3.1) in addition to the general requirements for metallic industrial piping under EN 13480-1:2017, EN 13480-2:2017, EN 13480-3:2017, EN 13480-4:2017 and EN 13480-5:2017.

NOTE Cast materials are not included in this version. Details regarding cast materials will be subject to an amendment to or a revision of this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 764-5:2014, *Pressure equipment – Part 5: Inspection documentation of metallic materials and compliance with the material specification*

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

EN 13480-1:2017, *Metallic industrial piping – Part 1: General*

EN 13480-2:2017, *Metallic industrial piping – Part 2: Materials*

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

EN ISO 9606-4:1999, *Approval testing of welders - Fusion welding – Part 4: Nickel and nickel alloys (ISO 9606-4:1999)*

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

3 Terms and definitions

For the purposes of this document, the terms, definitions, symbols and units given in EN 13480-1:2017, EN 13480-2:2017, EN 13480-3:2017, EN 13480-4:2017 and EN 13480-5:2017 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1

nickel alloys

alloys which contain a minimum of 30 % nickel and contain more nickel than iron

4 General requirements

The general requirements of EN 13480-1:2017 shall apply.

prEN 13480-9:2018 (E)**5 Materials****5.1 General**

The general requirements of EN 13480-2:2017 shall apply with the following additions/exclusions in 5.2-5.5.

NOTE There are presently no European Standards specifically for nickel or nickel alloys for pressure purposes.

This document is therefore limited to:

- 1) Harmonized standards as listed in Table A.2;
- 2) Nickel and nickel alloys having EMAs as listed in Table A.3;

These commonly used materials are suitable for, and may be employed in, the design and manufacture of piping according to this document.

- 3) Materials for which the manufacturer produces a Particular Materials Appraisal (PMA).

These may be used only when they meet the requirements in Subclauses 5.1 to 5.5 of this document.

5.2 Material grouping system

EN 13480-2:2017, Annex A is not applicable to metallic industrial piping of nickel and nickel alloys and is replaced by Annex A of this document.

The grouping system for nickel and its alloys as given in CEN/ISO TR 15608:2013 is shown in Table A.1 of this document.

Only material having a minimum elongation after fracture greater than 25 % shall be used for construction of metallic industrial piping.

Materials which have mechanical properties enhanced by precipitation hardening are excluded from this document, unless they are to be used for bolting applications.

5.3 Material documentation

Materials for pressure bearing parts compliant with the requirements of this document shall be accompanied by inspection documentation in accordance with EN 10204:2004.

The type of inspection document shall be in accordance with EN 764-5:2014 and include a declaration of compliance to the material specification.

5.4 Prevention of brittle fracture

There are no general requirements for nickel and nickel alloys at temperatures down to $-196\text{ }^{\circ}\text{C}$. However, the specific requirements of individual EAMs/PMAs shall be taken into account.

5.5 Lamellar tearing

Failure by lamellar tearing is not normally a defect of nickel and nickel alloys.

6 Design**6.1 General**

All the design methods included in EN 13480-3:2017 shall apply, with the following amendments, given in 6.2 – 6.5.

6.2 Time-independent nominal design stress

The design stress for nickel and nickel alloy materials entering service without any subsequent heat treatment shall be evaluated in accordance with Table 1.

If any material is subjected to subsequent heat treatment (for example, in the manufacture of dished ends) representative material test coupons shall be heat treated with the components and subjected to the same mechanical tests as used to certify the material at the manufacturer's works. The nominal design stress shall then be calculated in accordance with Table 1 using the values from this test. If this design stress is lower than that used in the original calculations, the design of that component and any other related components shall be repeated using the nominal design stress derived from the properties of the heat treated material.

For designs using nickel and nickel alloys attention is drawn to the effect of heat treatment on the materials, and care should therefore be taken when determining the thickness of the materials that will receive subsequent heat treatments during fabrication.

Table 1 — Maximum allowed values of the nominal design stress for nickel and nickel alloy materials for pressure parts

Minimum specified elongation after fracture (A) (%)	Design stress for normal operating load cases (MPa)	Design stress for testing and exceptional load cases (MPa)
A > 35	$f_d = \min \left(\frac{R_{p1,0/T}}{1,2}; \frac{R_m/T}{3} \right)$	$f_{test} = \left(\frac{R_{p1,0/T_{test}}}{1,05} \right)$
30 < A ≤ 35	$f_d = \left(\frac{R_{p1,0/T}}{1,5} \right)$	$f_{test} = \left(\frac{R_{p1,0/T_{test}}}{1,05} \right)$
A ≤ 30	$f_d = \min \left(\frac{R_{p0,2/T}}{1,5}; \frac{R_m/20}{2,4} \right)$	$f_{test} = \left(\frac{R_{p0,2/T_{test}}}{1,05} \right)$

6.3 Creep design

Where sufficient material data are available, creep design may be applied to nickel and nickel alloys using the formulae and approach of EN 13480-3:2017.

6.4 Piping under external pressure

The requirements for austenitic steels in EN 13480-3:2017, 9.2.2 shall apply to nickel and nickel alloys.

6.5 Fatigue design

For loads up to 1 000 equivalent full pressure cycles no fatigue analysis is required.

Above 1 000 cycles the requirements of EN 13445-3:2014, Clause 17 shall apply with the following modifications:

The application of EN 13445-3:2014, Clause 17 (see EN 13445-3:2014, 17.4.4) to nickel and nickel alloys shall be limited to temperatures not exceeding 450 °C.

The correction factor to account for the influence of temperature on fatigue resistance (see EN 13445-3:2014, 17.6.2.2) is:

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For $T^* \geq 100$ °C:

$$C_t = 1,0164 - 1,4 \times 10^{-4} T^* - 2,4 \times 10^{-7} (T^*)^2$$

The requirements of EN 13445-3:2014, Clause 18 shall apply with the following modifications:

The application of EN 13445-3:2014, Clause 18 (see EN 13445-3:2014, 18.4.3) to nickel and nickel alloys shall be limited to temperatures not exceeding 450 °C.

The correction factor to account for the influence of temperature on fatigue resistance, f_{T^*} (see EN 13445-3:2014, 18.10.6.2) is given by:

$$f_{T^*} = 1,0164 - 1,4 \times 10^{-4} T^* - 2,4 \times 10^{-7} (T^*)^2$$

7 Fabrication**7.1 General**

EN 13480-4:2017 shall apply, with the following amendments, given in 7.2–7.13.

NOTE Not all welding processes are suitable for all nickel alloys.

Welding consumables may be selected from EN ISO 14172, EN ISO 12153 and EN ISO 18274.

7.2 Qualification of welding procedure specifications (WPQR)

The requirements of EN 13480-4:2017, 9.3 shall apply with the following modifications:

- a) EN 13480-2:2017, Annex B shall not apply.
- b) Impact testing is not normally required for metallic industrial piping of nickel and nickel alloys at temperatures down to -196 °C except for alloys in group 47.
- c) For nickel alloys in group 47 when the design temperature is below -105 °C, impact testing shall be carried out at -196 °C on the weld metal and heat affected zone of the WPQR.

7.3 Qualification of welders and welding operators

The requirements in EN 13480-4:2017, 9.1.1 shall apply with the following modifications:

Replace reference to EN 287-1 and EN ISO 9606-1 with EN ISO 9606-4:1999.

7.4 Joint preparation

In addition to the requirements of EN 13480-4:2017, 9.7, the following shall apply for metallic industrial piping of nickel and its alloys:

- a) the edges plates, pipes and fittings that have been thermally cut shall be dressed back by machining or grinding for a minimum distance of 1,5 mm to remove damaged material;

NOTE Nickel and nickel alloys are not subject to hardening by thermal cutting.

- b) for plates less than 20 mm thickness cold shearing is permissible, provided that the cut edges are dressed back mechanically by not less than 1,5 mm to permit a satisfactory examination of the edges prior to welding;
- c) plates less than 10 mm thick, which are cold sheared, need not be dressed prior to welding.

- d) coated parts shall be free of coating products for a minimum distance of 50 mm from the edge of the weld preparation, in order that the coating does not interfere with the welding process, and to safeguard the coating itself;
- e) cutting fluids and similar shall be removed before welding or heat treatment;
- f) after welding, the welded areas shall be cleaned, and any residues, slag, spatter, etc. shall be removed.

7.5 Preheat

Preheating is not normally necessary for nickel and nickel alloys.

When the metal temperature is less than 5 °C, heat should be applied to a maximum temperature of 75 °C to remove condensation.

7.6 Forming procedures

7.6.1 Cold forming

Cold forming of nickel and nickel alloy materials shall be carried out at temperatures below 300 °C. It is preferable that nickel and nickel alloys are cold formed whenever possible.

7.6.2 Hot forming

Hot forming of nickel and nickel alloy materials shall be carried out in accordance with the manufacturer's recommendations such that grain boundary liquation and overheating is avoided.

The material shall be heated uniformly without flame impingement.

Most fuels may be used provided that detrimental impurities, such as sulphur, are kept at low levels.

Nickel and nickel alloys shall be cleaned before heating.

Embrittlement by low melting point metals such as sulphur, phosphorus, lead, zinc and their alloys can occur from marking materials, die lubricants, pickling liquids, and any waste products encountered during the manufacturing process. Care should be taken to avoid contact with any foreign substances which may be taken into the surface of the material at elevated temperatures.

7.7 Heat treatment after forming

7.7.1 General

Heat treatment after hot or cold forming shall be carried out in accordance with the requirements of 7.7.2, 7.7.3 or 7.7.4.

7.7.2 Heat treatment of flat products after cold forming

The requirements of EN 13480-4:2017, 7.2.1 are not applicable for metallic industrial piping made of nickel and nickel alloys.

Heat treatment of flat products after cold forming shall be carried out in accordance with the material manufacturer's recommendations, when required by Table 2.