
Kovinski industrijski cevovodi - 8. del: Dodatne zahteve za cevovode iz aluminija in aluminijevih zlitin

Metallic industrial piping - Part 8: Additional requirements for aluminium and aluminium alloy piping

Metallische industrielle Rohrleitungen - Teil 8: Zusatzanforderungen an Rohrleitungen aus Aluminium und Aluminiumlegierungen

Tuyauteries industrielles métalliques - Partie 8: Exigences complémentaires relatives aux tuyauteries en aluminium et alliages d'aluminium

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Foreword

This document (EN 13480-8:2007) 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of an identical text or by endorsement, at the latest by September 2007, and conflicting national standards shall be withdrawn at the latest by September 2007.

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 97/23/EC.

For relationship with EU Directive 97/23/EC, see informative Annex ZA, which is an integral part of this document.

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, 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 and United Kingdom.

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1 Scope

This Part of this European Standard specifies requirements for industrial piping systems made of aluminium and aluminium alloys in addition to the general requirements for industrial piping according to the series of standards EN 13480 and CEN/TR 13480-7.

2 Normative references

The following referenced documents are indispensable for the application 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 485-3, *Aluminium and aluminium alloys — Sheet, strip and plate — Part 3: Tolerances on dimensions and form for hot-rolled products*

EN 485-4, *Aluminium and aluminium alloys - Sheet, strip and plate - Part 4: Tolerances on shape and dimensions for cold-rolled products*

EN 571-1:1997, *Non-destructive testing — Penetrant testing — Part 1: General principles*

EN 573-3:2003, *Aluminium and aluminium alloys — Chemical composition and form of wrought products — Part 3: Chemical composition*

EN 583 (all parts), *Non-destructive testing - Ultrasonic examination*

EN 895:1995, *Destructive tests on welds in metallic materials — Transverse tensile test*

EN 910:1996, *Destructive tests on welds in metallic materials — Bend tests*

EN 970:1997, *Non-destructive examination of fusion welds — Visual examination*

EN 1289:1998, *Non-destructive examination of welds - Penetrant testing of welds - Acceptance levels*

EN 1321:1996, *Destructive tests on welds in metallic materials - Macroscopic and microscopic examination of welds*

EN 1435:1997, *Non-destructive examination of welds - Radiographic examination of welded joints*

EN 1712:1997, *Non-destructive examination of welds - Ultrasonic examination of welded joints - Acceptance levels*

EN 1714:1997, *Non-destructive examination of welds - Ultrasonic examination of welded joints*

EN 1779, *Non-destructive testing - Leak testing - Criteria for method and technique selection*

EN 10002 (all parts), *Metallic materials - Tensile testing*

EN 10045-1, *Metallic materials - Charpy impact test - Part 1: Test method*

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

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EN 10246 (all parts), *Non-destructive testing of steel tubes*

EN 12392:2000, *Aluminium and aluminium alloys — Wrought products — Special requirements for products intended for the production of pressure equipment*

EN 13445-4:2002, *Unfired pressure vessels — Part 4: Fabrication*

EN 13445-8, *Unfired pressure vessels — Part 8: Additional requirements for pressure vessels of aluminium and aluminium alloys*

EN 13480-1:2002, *Metallic industrial piping — Part 1: General*

EN 13480-2:2002, *Metallic industrial piping — Part 2: Materials*

EN 13480-3:2002, *Metallic industrial piping — Part 3: Design and calculation*

EN 13480-4:2002, *Metallic industrial piping — Part 4: Fabrication and installation*

EN 13480-5:2002, *Metallic industrial piping — Part 5: Inspection and testing*

CEN/TR 13480-7, *Metallic industrial piping — Part 7: Guidance on the use of conformity assessment procedures*

EN ISO 3834-2:2005, *Quality requirements for fusion welding of metallic materials - Part 2: Comprehensive quality requirements (ISO 3834-2:2005)*

EN ISO 3834-3:2005, *Quality requirements for fusion welding of metallic materials - Part 3: Standard quality requirements (ISO 3834-3:2005)*

EN ISO 4063:2000, *Welding and allied processes — Nomenclature of processes and reference numbers (ISO 4063:1998)*

EN ISO 7438, *Metallic materials - Bend test (ISO 7438:2005)*

EN ISO 9606-2, *Qualification test of welders — Fusion welding — Part 2: Aluminium and aluminium alloys (ISO 9606-2:2004)*

EN ISO 10042:2005, *Welding - Arc-welded joints in aluminium and its alloys - Quality levels for imperfections (ISO 10042:2005)*

CEN ISO/TR 15608:2005, *Welding - Guidelines for a metallic materials grouping system (ISO/TR 15608:2005)*

EN ISO 15614-2:2005, *Specification and qualification of welding procedures for metallic materials - Welding procedure test - Part 2: Arc welding of aluminium and its alloys (ISO 15614-2:2005)*

3 Terms, definitions, symbols and units

For the purposes of this document, the terms, definitions, symbols and units of EN 13480:2002 Parts 1 to 5 apply.

4 General requirements

The general requirements of EN 13480-1 shall apply.

5 Materials

5.1 General

The requirements of EN 13480-2 shall apply with the following additions/exclusions:

5.2 Material grouping system

Annex A of EN 13480-2:2002 is not applicable for aluminium and aluminium alloys. The allowable materials for industrial piping of aluminium and aluminium alloys shall be according to Table 5.2-1.

Any product form available in EN 12392:2000 for a material in this table at an acceptable temper is acceptable for construction to this European Standard. Other materials not defined here may be used by agreement by the parties concerned (see 4.3 of EN 13480-2:2002) if they meet the requirements of 5.2 and 5.3 of this standard and a Particular Material Appraisal is produced (see EN 764-4).

Table 5.2-1 — Grouping system based on CEN ISO/TR 15608:2005 and allowable materials of construction based on EN 12392:2000 using the EN AW numbers according to EN 573-3

Group	Sub group	Type of aluminium and aluminium alloys	Designation		
			EN AW number	Chemical symbol	Temper
21		Pure aluminium with $\leq 1\%$ impurities or alloy content	EN AW – 1050A	EN AW–Al 99,5	O, H111, H112
			EN AW – 1070A	EN AW–Al 99,7	O, H111, H112
			EN AW – 1080A	EN AW–Al 99,8(A)	O, H111, H112
22	Non heat treatable alloys				
	22.1	Aluminium-manganese alloys	EN AW – 3003	EN AW–Al Mn1Cu	O, H111, H112
			EN AW – 3103	EN AW–Al Mn1	O, H111, H112
			EN AW – 3105	EN AW–Al Mn0,5Mg0,5	O, H111
	22.2	Aluminium-magnesium alloys with Mg $\leq 1,5\%$	EN AW – 5005	EN AW–Al Mg1(B)	O, H111, H112
			EN AW – 5005A	EN AW–Al Mg1(C)	O, H111, H112
			EN AW – 5050	EN AW–Al Mg1,5 (C)	O, H111
22.3	Aluminium-magnesium alloys with $1,5\% < \text{Mg} \leq 3,5\%$	EN AW – 5049	EN AW–Al Mg2Mn0,8	O, H111, H112	
		EN AW – 5052	EN AW–Al Mg2,5	O, H111, H112	
		EN AW – 5154A	EN AW–Al Mg3,5(A)	O, H111, H112	
		EN AW – 5251	EN AW–Al Mg2	O, H111, H112	
		EN AW – 5454	EN AW–Al Mg3Mn(A)	O, H111, H112	
		EN AW – 5754	EN AW–Al Mg3	O, H111, H112	
22.4	Aluminium-magnesium alloys with Mg $> 3,5\%$	EN AW – 5083	EN AW–Al Mg4,5Mn0,7	O, H111, H112	
		EN AW – 5086	EN AW–Al Mg4	O, H111	
23	Heat treatable alloys				
	23.1	Aluminium-magnesium-silicon alloys	EN AW 6060 EN AW 6061	EN AW–Al MgSi EN AW–Al Mg1SiCu	T4 ^a T4 ^b , T6 ^c
^a for seamless pipes and profiles only ^b for seamless pipes and flanges only ^c for flanges only					

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Aluminium and aluminium alloys used for parts of industrial piping that are subjected to cold forming shall have a specified minimum elongation after fracture measured on a gauge length

$$L_o = 5,65\sqrt{S_o}$$

that is ≥ 14 % in the longitudinal or transverse direction as defined by the material specification.

Aluminium and aluminium alloys used for parts of industrial piping that are not subjected to cold forming (e.g. straight flanges and nozzles) shall have a specified minimum elongation after fracture measured on a gauge length

$$L_o = 5,65\sqrt{S_o}$$

that is ≥ 10 % in the longitudinal or transverse direction as defined by the material specification.

5.4 Chemical composition

The chemical composition shall be in accordance with the material specification. All materials shall have a maximum lead content of 150 $\mu\text{g/g}$.

NOTE 5.1.3 of EN 12392:2000 recommends a maximum hydrogen level of 0,2 ml per 100 g aluminium, measured in the liquid metal during casting for parts to be welded.

5.5 Lamellar tearing

Specific requirements to avoid lamellar tearing for industrial piping of aluminium and aluminium alloys are not applicable.

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NOTE Specific requirements apply to steel (see EN 1011-2) whereas in EN 1011-4 no requirement is given because lamellar tearing is not a recognized phenomenon.

5.6 Design temperature and properties

NOTE See also 4.2.2 of EN 13480-2:2002.

The 2nd paragraph of 4.2.2.1 of EN 13480-2:2002 is not applicable for aluminium and aluminium alloys.

The maximum design temperature shall not exceed that defined in Table 1 of EN 12392:2000 as the maximum working temperature. For material of group 22.4 the maximum design temperature is 75 °C (200 °C for non-corrosive service).

The mechanical properties used for design shall be taken from the tabulated values in EN 12392 at room temperature for $R_{m/20}$ / $R_{e/20}$ and at the highest design temperature for $R_{e/t}$.

For welded parts and heat treated parts after forming only the values equivalent to the O temper shall be used for design when 6 000 series flanges, etc. are welded. These values are not quoted in EN 12392 and so the tabulated values for f shown in Table 6.2-2 shall be used for design. The weld area shall be based on the O temper but the flange strength away from the weld ($2t$) may be based on the actual temper (T4 or T6).

For aluminium and aluminium alloys values of 0,2 % proof stress (or 1 % proof stress for material group 21-1 000 series aluminium) for temperatures above 20 °C shall be established by linear interpolation between two adjacent values in EN 12392 except that for alloys 5083 and 5086 the respective value at 50 °C may be used for 65 °C.

For material of group 22.4: For short periods, higher temperatures are permitted (e.g. when defrosting refrigerating plant) up to 150 °C are permissible provided that the pressure is reduced to half the working pressure for a period up to 8 h and to atmospheric pressure for a period up to 24 h.

5.7 Prevention of brittle fracture

Annex B of EN 13480-2:2002 is not applicable. All materials of Table 5.2-1 are suitable for any minimum metal temperature without impact testing.

NOTE See also EN 1252-1 and 8.4 of EN 12392:2000.

5.8 Specific requirements for fasteners made of aluminium and aluminium alloys

Threads of bolts and studs shall be rolled. Regarding prevention of brittle fracture for materials of fasteners 5.6 of this standard applies.

NOTE 1 Other manufacturing techniques may be agreed by the parties involved. In this case, special considerations regarding the application and testing requirements may be necessary. Such requirements are not addressed by this standard.

NOTE 2 Materials other than aluminium and aluminium alloys may be used for bolting for piping constructions according to this European Standard. The designer should give special consideration to these different bolting materials.

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5.9 Lined piping <https://standards.iteh.ai/catalog/standards/sist/54e69cae-d0ab-472b-b72f-d621d24c5721/sist-en-13480-8-2007>

Specific requirements for lined piping are not applicable for aluminium and aluminium alloys.

5.10 Clad products

Specific requirements for clad products are not applicable for aluminium and aluminium alloys.

5.11 Technical delivery conditions for welding consumables

The requirements of 4.3.5 of EN 13480-2:2002 shall apply.

6 Design

6.1 General

The requirements of EN 13480-3 shall apply with the following additions/exclusions.

6.2 Time-independent nominal design stress

The design stresses for aluminium and aluminium alloys materials shall be in accordance with the Table 6.2-1.

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Table 6.2-1 — Design stresses for aluminium and aluminium alloy material

Group according to Table 5.2-1	Design stresses at design condition	Design stresses at test condition
21	$f = [R_{p1,0,t} / 1.5]$	$f_{\text{test}} = [R_{p1,0,20} / 1.05]$
22	$f = \min ([R_{p0,2,t} / 1.5] \text{ or } [R_{m,20} / 2.4])$	$f_{\text{test}} = [R_{p0,2,20} / 1.05]$
23	$f = \min ([R_{p0,2,t} / 1.5] \text{ or } [R_{m,20} / 3])$	$f_{\text{test}} = [R_{p0,2,20} / 1.05]$

Table 6.2-2 — Allowable design strength values for 6 000 series aluminium alloys in the welded condition (see 5.6)

Material designation to EN 12392	Value of f for design temperature (°C) not exceeding					
	50	75	100	125 ^a	150	175 ^a
EN AW 6060	40	40	40	38	-	-
EN AW 6061	55	55	55	54	51	43

^a For maximum design temperature see 5.6. Values for 125 °C (EN AW 6060) and 175 °C (EN AW 6061) shall be used for interpolation only.

NOTE Data are derived from EN 13445-8.

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6.3 Straight pipes

In general, straight pipes shall be designed in accordance with 6.1 of EN 13480-3:2002.

For $D_0/D_i > 1,2$ Equation 6.3-1 may be used. In this case pipes shall be seamless or tested in accordance with 8.4.3 and 8.6 of this European Standard for $z = 1,0$ and the maximum allowable pressure p_a shall be determined as follows:

$$p_a = \left[\frac{2}{\sqrt{3}} \times R_{p0,2,t} \times \ln \left(\frac{D_0}{D_i} \right) \right] \times \frac{1}{1,5} \quad (6.3-1)$$

For material group 21 $R_{p1,0,t}$ shall be used instead of $R_{p0,2,t}$.

6.4 Pipe bends and elbows

The standard method for calculation of bends and elbows for aluminium and aluminium alloys shall be the method described in B.4.1.3 of EN 13480-3:2002, Annex B.

NOTE 1 This clause should not be understood as to prohibit the other methods given in EN 13480-3, but to reflect the actual situation at the bend manufacturers.

NOTE 2 Also see 6.2.3 and Annex B, Equation B4.1-11 of EN 13480-3:2002.

6.5 Mitre bends

6.3 of EN 13480-3:2002 may be used for the design of mitre bends for aluminium and aluminium alloys.

Alternatively the method described in Equations 6.5-1 to 6.5-4 may also be used for multiple mitre bends for aluminium and aluminium alloys according to Figure 6.5-1 with a maximum angle Θ of 22,5°. The pressure limit given in EN 13480-3:2002, 6.3.1 is not applicable for this method.