



SLOVENSKI STANDARD
oSIST prEN 1706:2019
01-april-2019

Aluminij in aluminijeve zlitine - Ulitki - Kemična sestava in mehanske lastnosti

Aluminium and aluminium alloys - Castings - Chemical composition and mechanical properties

Aluminium und Aluminiumlegierungen - Gussstücke - Chemische Zusammensetzung und mechanische Eigenschaften

Aluminium et alliages d'aluminium - Pièces moulées - Composition chimique et propriétés mécaniques

<https://standards.iteh.ai/catalog/standards/sist/3741a9b7-8c91-4bb5-a6c7-ced43d53cdc0/sist-en-1706-2020>

Ta slovenski standard je istoveten z: prEN 1706

ICS:

77.150.10 Aluminijski izdelki Aluminium products

oSIST prEN 1706:2019

en,fr,de

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

DRAFT
prEN 1706

February 2019

ICS 77.150.10

Will supersede EN 1706:2010

English Version

Aluminium and aluminium alloys - Castings - Chemical composition and mechanical properties

Aluminium et alliages d'aluminium - Pièces moulées -
Composition chimique et propriétés mécaniques

Aluminium und Aluminiumlegierungen - Gussstücke -
Chemische Zusammensetzung und mechanische
Eigenschaften

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 132.

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

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European foreword

This document (prEN 1706:2019) has been prepared by Technical Committee CEN/TC 132 “Aluminium and aluminium alloys”, the secretariat of which is held by AFNOR.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 1706:2010.

CEN/TC 132 affirms it is its policy that in the case when a patentee refuses to grant licences on standardized standard products under reasonable and not discriminatory conditions, then this product shall be removed from the corresponding standard.

Within its programme of work, Technical Committee CEN/TC 132 entrusted CEN/TC 132/WG 23 “Revision of EN 1676 and EN 1706” to revise EN 1706:2010.

In comparison with EN 1706:2010, the following significant changes were made:

- a) Normative reference EN 10002-1 was replaced by EN ISO 6892-1;
- b) In Table 1, the following alloys were deleted:
 - 1) EN AC-21200 [EN AC-Al Cu4MnMg];
 - 2) EN AC-43000 [EN AC-Al Si10Mg(a)];
- c) In Table 1, the following new alloys were added:
 - 1) EN AC-42300 [EN AC-Al Si7(Mg)];
 - 2) EN AC-42400 [EN AC-Al Si7MnMg];
 - 3) EN AC-44600 [EN AC-Al Si10Mn];
 - 4) EN AC-45600 [EN AC-Al Si7Cu1Mg0,6];
 - 5) EN AC-47200 [EN AC-Al Si12(Fe)];
 - 6) EN AC-48200 [EN AC-Al Si15Cu3Mg(Fe)];
- d) In Table 1, the maximum limit for lead was reduced to 0,29 %;
- e) In Table 1, footnotes “k” to “m” were added;
- f) In Table 2, the following alloys were deleted:
 - 1) EN AC-21200 [EN AC-Al Cu5MnMg];
 - 2) EN AC-43000 [EN AC-Al Si10Mg(a)];
- g) In Table 2, the following new alloys were added:
 - 1) EN AC-42300 [EN AC-Al Si7(Mg)];

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- 2) EN AC-45600 [EN AC-Al Si7Cu1Mg0,6];
- 3) EN AC-48200 [EN AC-Al Si15Cu3Mg(Fe)];
- h) In Table 2, the following changes to already existing alloys were made:
- 1) Addition of T64-values for EN AC-42100 [EN AC-Al Si7Mg0,3];
 - 2) Hardness value for EN AC-71100 [EN AC-Al Zn10Si8Mg];
- i) In Table 2, footnote “a” was added;
- j) In Table 3, the following alloys were deleted:
- 1) EN AC-21200 [EN AC-Al Cu5MnMg];
 - 2) EN AC-43000 [EN AC-Al Si10Mg(a)];
- k) In Table 3, the following new alloys were added:
- 1) EN AC-42300 [EN AC-Al Si7(Mg)];
 - 2) EN AC-45600 [EN AC-Al Si7Cu1Mg0,6];
- l) In Table 3, the following changes to already existing alloys were made:
- 1) Addition of T64- and T6-values for EN AC-46200 [EN AC-Al Si8Cu3];
 - 2) Hardness value for EN AC-71100 [EN AC-Al Zn10Si8Mg];
- m) In Table A.1, the following alloy was deleted:
- 1) EN AC-46200 [EN AC-Al Si8Cu3];
- n) In Table A.1, the following new alloys were added:
- 1) EN AC-42400 [EN AC-Al Si7MnMg];
 - 2) EN AC-44600 [EN AC-Al Si10Mn];
 - 3) EN AC-48200 [EN AC-Al Si15Cu3Mg(Fe)];
- o) In Table A.1 the following changes to already existing alloys were made:
- 1) Tensile strength value for EN AC-43500 [EN AC-Al Si10MnMg];
 - 2) Addition of T5-values for EN AC-46000 [EN AC-Al Si9Cu3(Fe)];
 - 3) Including of EN AC-71100 [EN AC-Al Zn10Si8Mg];
- p) A new Annex B was added and the former Annex B renamed to Annex C;
- q) In Table C.1, the same alloys as in Table 1 were added or deleted respectively. The suitability for some casting methods was revised for some alloys as well as some rankings of properties. Footnote “j” was modified and footnote “l” was added;
- r) The former Annex C was renamed to Annex D and Table D.1 was completely revised.

1 Scope

This document specifies the chemical composition limits for aluminium casting alloys and mechanical properties of separately cast test pieces for these alloys.

Annex C is included as a guide to the selection of alloys for a specific use or process.

This document is intended to be used in conjunction with EN 576, EN 1559-1, EN 1559-4, EN 1676 and EN ISO 8062-3.

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 576, *Aluminium and aluminium alloys — Unalloyed aluminium ingots for remelting — Specifications*

EN 1559-1, *Founding — Technical conditions of delivery — Part 1: General*

EN 1559-4, *Founding — Technical conditions of delivery — Part 4: Additional requirements for aluminium alloy castings*

EN 1780-1, *Aluminium and aluminium alloys — Designation of alloyed aluminium ingots for remelting, master alloys and castings — Part 1: Numerical designation system*

EN 1780-2, *Aluminium and aluminium alloys — Designation of alloyed aluminium ingots for remelting, master alloys and castings — Part 2: Chemical symbol based designation system*

EN 1780-3, *Aluminium and aluminium alloys — Designation of alloyed aluminium ingots for remelting, master alloys and castings — Part 3: Writing rules for chemical composition*

EN ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature (ISO 6892-1)*

EN 12258-1:2012, *Aluminium and aluminium alloys — Terms and definitions — Part 1: General terms*

EN ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method (ISO 6506-1)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12258-1:2012 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 casting

process in which molten metal is poured into a mould and solidified

[SOURCE: EN 12258-1:2012, 4.1.1]

prEN 1706:2019 (E)**3.2****sand casting**

process in which molten metal is poured into a sand mould and solidified (at atmospheric pressure)

[SOURCE: EN 12258-1:2012, 4.1.8]

3.3**permanent mould casting****chill casting**

process in which molten metal is poured into a permanent metal mould and solidified (at atmospheric pressure)

[SOURCE: EN 12258-1:2012, 4.1.9]

3.4**low pressure die casting**

process in which molten metal is poured into a metal mould and solidified under low pressure (typically 7 kPa above atmospheric pressure)

Note 1 to entry: This process can also be used with a sand mould, being called "low pressure sand casting".

[SOURCE: EN 12258-1:2012, 4.1.11]

3.5**high pressure die casting**

process in which molten metal is poured into a permanent metal mould and solidified under high pressure (typically 7 MPa)

[SOURCE: EN 12258-1:2012, 4.1.10]

3.6**investment casting**

two step process comprising:

- a) fabrication of a ceramic mould around a wax or thermoplastic pattern which is lost during this process;
- b) pouring of metal into this mould

[SOURCE: EN 12258-1:2012, 4.1.12]

3.7**fluidity**

ability of an alloy to make thin wall castings and reproduce fine details

3.8**hot tearing**

tendency for a crack to form in a casting due to the development of internal stress during solidification

3.9**pressure tightness**

tendency not to leak on pressure testing

3.10**order document**

document or set of documents to which supplier and purchaser agreed at the time of ordering

Note 1 to entry: An order document may be an order of the purchaser confirmed by the supplier or a quotation of the supplier confirmed by the purchaser.

4 Ordering information

The order document shall include a reference to this document. It shall include all the ordering information as required in EN 1559-1 and EN 1559-4.

5 Designation systems**5.1 Numerical designation system**

The numerical designation system shall be in accordance with EN 1780-1.

5.2 Chemical symbol based designation system

The chemical symbol based designation system shall be in accordance with EN 1780-2.

For unalloyed grades, the designation shall be in accordance with EN 576.

5.3 Temper designations

The following abbreviations shall be used as temper designations for the conditions of heat treatment, referred in Tables 2, 3 and 4 and Table A.1:

- F as cast;
- O annealed;
- T1 controlled cooling from casting and naturally aged;
- T4 solution heat treated and naturally aged where applicable;
- T5 controlled cooling from casting and artificially aged or over-aged;
- T6 solution heat treated and fully artificially aged;
- T64 solution heat treated and artificially under-aged;
- T7 solution heat treated and artificially over-aged (stabilized).

NOTE For aluminium casting alloys, solution heat treatment involves quenching from elevated temperatures and distortion could occur.

5.4 Casting process designations

The following abbreviations shall be used as designations for the different casting processes:

- S sand casting;
- K chill or permanent mould casting;
- D high pressure die casting;
- L investment casting.

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5.5 Designations to appear on drawings

The complete designation of the casting shall appear on the drawings being part of the order information. This designation includes:

- the number of this document;
- the alloy designation;
- the casting process designation;
- the temper designation.

EXAMPLE EN 1706 AC-42000-K-T6 is the complete designation of the alloy EN AC-42000, chill cast solution heat treated and fully artificially aged.

6 Chemical composition

6.1 General

Chemical composition shall be expressed in accordance with the writing rules given in EN 1780-3. The chemical composition of aluminium casting alloys shall be in conformity with the limits specified in Table 1.

NOTE Table 1 also includes the chemical compositions of ingots used to produce castings. These are shown in brackets where they differ from the casting limits and are taken from EN 1676.

When specified, analysis of elements for which specific limits are given in Table 1 shall be carried out. Analysis for other elements shall be carried out only when agreed between supplier and purchaser. This particularly applies to modifying or refining elements such as sodium, strontium, antimony and phosphorus. Alloying elements and impurities shall be expressed in the following sequence: silicon, iron, copper, manganese, magnesium, chromium, nickel, zinc, lead, tin, titanium, other elements each/total, aluminium.

Additional specified elements with specific limit shall be inserted, in alphabetical order with respect to their chemical symbols after titanium, or be specified in footnotes.

6.2 Samples for analysis

When samples are required for analysis by emission spectrometry, they shall be taken from the melt at the time the castings are made and shall be cast into a metallic die.

If analysis by emission spectrometry is carried out on a casting, it is recommended that a part of the casting is remelted and cast into a metallic die to minimize the unavoidable segregation effect. The level of certain elements such as sodium, strontium and magnesium, is normally reduced by the remelting, and analysis for such elements should be made directly on the casting.

For sampling and analysis, the use of existing rules or standards is recommended until a suitable European Standard is published.

Table 1 — Chemical compositions of alloyed ingots

Expressed in percentage by mass

Alloy Group	Alloy designation		Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Pb _m	Sn	Ti ^h	Others ^{a,g}		Aluminium
	Numerical	Chemical symbols												Each	Total	
Al ^d	—	Al 99,6E	0,10	0,30	0,01	0,007	0,02	0,005	—	0,04	—	—	-	0,03 ^e	—	99,60 min.
	—	Al 99,7E	0,07	0,20	0,01	0,005	0,02	0,004	—	0,04	—	—	-	0,03 ^f	—	99,70 min.
AlCu	EN AC-21000	EN AC-Al Cu4MgTi	0,20 (0,15)	0,35 (0,30)	4,2 to 5,0	0,10	0,15 to 0,35 (0,20 to 0,35)	—	0,05	0,10	0,05	0,05	0,15 to 0,30 (0,15 to 0,25)	0,03	0,10	Remainder
	EN AC-21100	EN AC-Al Cu4Ti	0,18 (0,15)	0,19 (0,15)	4,2 to 5,2	0,55	—	—	—	0,07	—	—	0,15 to 0,30 (0,15 to 0,25)	0,03	0,10	Remainder
AlSiMgTi	EN AC-41000 ⁱ	EN AC-Al Si2MgTi	1,6 to 2,4	0,60 (0,50)	0,10 (0,08)	0,30 to 0,50	0,45 to 0,65 (0,50 to 0,65)	—	0,05	0,10	0,05	0,05	0,05 to 0,20 (0,07 to 0,15)	0,05	0,15	Remainder
AlSi7Mg	EN AC-42000 ⁱ	EN AC-Al Si7Mg	6,5 to 7,5	0,55 (0,45)	0,20 (0,15)	0,35	0,20 to 0,65 (0,25 to 0,65)	—	0,15	0,15	0,15	0,05	0,25 ^j (0,20)	0,05	0,15	Remainder
	EN AC-42100 ⁱ	EN AC-Al Si7Mg0,3	6,5 to 7,5	0,19 (0,15)	0,05 (0,03)	0,10	0,25 to 0,45 (0,30 to 0,45)	—	—	0,07	—	—	0,25 ^j (0,18)	0,03	0,10	Remainder
	EN AC-42200 ⁱ	EN AC-Al Si7Mg0,6	6,5 to 7,5	0,19 (0,15)	0,05 (0,03)	0,10	0,45 to 0,70 (0,50 to 0,70)	—	—	0,07	—	—	0,25 ^j (0,18)	0,03	0,10	Remainder
	EN AC-42300 ⁱ	EN AC-Al Si7(Mg)	6,5 to 7,5	0,19 (0,15)	0,05 (0,03)	0,10	0,10 to 0,25	—	—	0,07	—	—	0,25 ^j (0,18)	0,03	0,10	Remainder
	EN AC-42400 ^{i?}	EN AC-Al Si7MnMg ^c	6,5 to 8,5	0,25 (0,20)	0,05 (0,03)	0,35 to 0,75	0,10 to 0,45 (0,15 to 0,45)	—	—	0,03	—	—	0,20 (0,15)	0,05	0,15	Remainder

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Alloy Group	Alloy designation		Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Pb _m	Sn	Ti ^h	Others ^{a,g}		Aluminium
	Numerical	Chemical symbols												Each	Total	
AlSi10Mg	EN AC-43100 ⁱ	EN AC-Al Si10Mg(b)	9,0 to 11,0	0,55 (0,45)	0,10 ^k (0,08)	0,45	0,20 to 0,45 (0,25 to 0,45)	—	0,05	0,10	0,05	0,05	0,15	0,05	0,15	Remainder
	EN AC-43200	EN AC-Al Si10Mg(Cu)	9,0 to 11,0	0,65 (0,55)	0,35 (0,30)	0,55	0,20 to 0,45 (0,25 to 0,45)	—	0,15	0,35	0,10	—	0,20 (0,15)	0,05	0,15	Remainder
	EN AC-43300 ⁱ	EN AC-Al Si9Mg	9,0 to 10,0	0,19 (0,15)	0,05 (0,03)	0,10	0,25 to 0,45 (0,30 to 0,45)	—	—	0,07	—	—	0,15	0,03	0,10	Remainder
	EN AC-43400 ⁱ	EN AC-Al Si10Mg(Fe)	9,0 to 11,0	1,0 (0,45 to 0,9)	0,10 (0,08)	0,55	0,20 to 0,50 (0,25 to 0,50)	—	0,15	0,15	0,15	0,05	0,20 (0,15)	0,05	0,15	Remainder
	EN AC-43500 ⁱ	EN AC-Al Si10MnMg ^c	9,0 to 11,5	0,25 (0,20)	0,05 (0,03)	0,40 to 0,80	0,10 to 0,60 (0,15 to 0,60)	—	—	0,07	—	—	0,20 (0,15)	0,05	0,15	Remainder
AlSi	EN AC-44000 ⁱ	EN AC-Al Si11	10,0 to 11,8	0,19 (0,15)	0,05 (0,03)	0,10	0,45	—	—	0,07	—	—	0,15	0,03	0,10	Remainder
	EN AC-44100 ⁱ	EN AC-Al Si12(b)	10,5 to 13,5	0,65 (0,55)	0,15 (0,10)	0,55	0,10	—	0,10	0,15	0,10	—	0,20 (0,15)	0,05	0,15	Remainder
	EN AC-44200 ⁱ	EN AC-Al Si12(a)	10,5 to 13,5	0,55 (0,40)	0,05 (0,03)	0,35	—	—	—	0,10	—	—	0,15	0,05	0,15	Remainder
	EN AC-44300	EN AC-Al Si12(Fe)(a)	10,5 to 13,5	1,0 (0,45 to 0,9)	0,10 (0,08)	0,55	—	—	—	0,15	—	—	0,15	0,05	0,25	Remainder
	EN AC-44400 ⁱ	EN AC-Al Si9	8,0 to 11,0	0,65 (0,55)	0,10 (0,08)	0,50	0,10	—	0,05	0,15	0,05	0,05	0,15	0,05	0,15	Remainder
	EN AC-44500	EN AC-Al Si12(Fe)(b)	10,5 to 13,5	1,0 (0,45 to 0,9)	0,20 (0,18)	0,55	0,40	—	—	0,30	—	—	0,15	0,05	0,25	Remainder
	EN AC-44600	EN AC-Al Si10Mn	9,5 to 11,5	0,10 to 0,25 (0,10 to 0,20)	0,03	0,30 to 0,75	0,15	—	—	0,03	—	—	0,20 (0,15)	0,05	0,15	Remainder