



SLOVENSKI STANDARD SIST EN 1706:2020+A1:2021

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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

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EUROPEAN STANDARD

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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 European Standard was approved by CEN on 2 March 2020 and includes Amendment 1 approved by CEN on 1 July 2021.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 1706:2020+A1:2021) has been prepared by Technical Committee CEN/TC 132 “Aluminium and aluminium alloys”, 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of an identical text or by endorsement, at the latest by February 2022, and conflicting national standards shall be withdrawn at the latest by February 2022.

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.

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This document supersedes A1 EN 1706:2020 A1.

A1 *deleted text* A1

This document includes Amendment 1 approved by CEN on 7 June 2021.

The start and finish of text introduced or altered by amendment is indicated in the text by tags A1 A1.

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.

A1 Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website. A1

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.

EN 1706:2020+A1:2021 (E)**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 ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method (ISO 6506-1)*

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

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 <https://www.iso.org/obp/ui>

3.1

casting

product at or near finished shape, formed by solidification of the metal in a mould or a die

[SOURCE: EN 12258-1:2012, 2.5.1]

3.2

sand casting

casting produced by pouring molten metal into a sand mould and allowing it to solidify

[SOURCE: EN 12258-1:2012, 2.5.2]

3.3

permanent mould casting

casting produced by introducing molten metal by gravity or low pressure into a mould constructed of durable material, typically iron or steel, and allowing it to solidify

Note 1 to entry: Permanent mould casting where the metal solidifies in a metal mould under low pressure (typically less than 1 bar above atmospheric pressure) is also referred to as "low pressure die casting".

Note 2 to entry: Permanent mould casting, which is made using an expendable core such as sand, is often (mainly in the USA) termed "semi-permanent mould casting".

[SOURCE: EN 12258-1:2012, 2.5.3]

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".

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)

EN 1706:2020+A1:2021 (E)**3.6****investment casting**

precision casting formed by a three step process comprising:

- a) fabrication of a ceramic mould around a wax or thermoplastic pattern with a refractory slurry that sets at room temperature;
- b) removal of the pattern through the use of heat;
- c) pouring of metal into this mould and allowing it to solidify.

[SOURCE: EN 12258-1:2012, 2.5.6]

3.7**fluidity**

ability of a liquid metal to flow (into a mould)

[SOURCE: EN 12258-1:2012, 4.5.23]

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**

absence of leakage at a specified pressure

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[SOURCE: EN 12258-1:2012, 4.3.27]

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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 ordering document can be an order of the purchaser confirmed by the supplier or a quotation of the supplier confirmed by the purchaser.

[SOURCE: EN 12258-1:2012, 3.11.10]

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 alloy castings, solution heat treatment involves quenching from elevated temperatures and distortion can 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.

5.5 Designations to be included in drawings

The complete designation of the casting shall be included in 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.

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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 castings 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.

The chemical analysis of elements for which specific limits are given in Table 1 shall be carried out. By agreement between supplier and purchaser other elements may be determined. 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 limits shall be inserted, in alphabetical order with respect to their chemical symbols after titanium, or be specified in footnotes.

6.2 Samples for chemical analysis

When a chemical analysis is carried out by spark emission spectrometry, samples shall be taken from the melt at the time the castings are made and shall be cast into a metallic die.

If chemical 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 content of certain elements such as sodium, strontium and magnesium, is normally reduced by the remelting, and chemical analysis of such elements should be made directly on the casting.

For sampling the use of EN 14361 is recommended. For chemical analysis the use of EN 14242 and EN 14726 is recommended.

Table 1 — Chemical composition of aluminium castings

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 (0,10 to 0,30)	—	—	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
AlSi10Mg	EN AC-43000 ⁱ	EN AC-Al Si10Mg	9,0 to 11,0	0,55 (0,40)	0,05 ^k (0,03)	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

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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	
	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	0,20 to 0,45 (0,25 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 ⁱ	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 ⁱ	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 ⁱ	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