
International Standard



3522

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Cast aluminium alloys — Chemical composition and mechanical properties

Alliages d'aluminium moulés — Composition chimique et caractéristiques mécaniques

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Descriptors : aluminium alloys, casting, chemical composition, mechanical properties.

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been authorized has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 3522 was developed by Technical Committee ISO/TC 79, *Light metals and their alloys*, and was circulated to the member bodies in February 1982.

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It has been approved by the member bodies of the following countries :

Austria	India	South Africa, Rep. of
China	Japan	Spain
Czechoslovakia	Mexico	Sweden
France	Netherlands	Switzerland
Germany, F.R.	Poland	USSR
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The member bodies of the following countries expressed disapproval of the document on technical grounds :

Australia
Canada
United Kingdom
USA

This second edition cancels and replaces the first edition (i.e. ISO 3522-1981).

Cast aluminium alloys — Chemical composition and mechanical properties

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1 Scope and field of application

ISO 2107, *Light metals and their alloys — Temper designations.*

This International Standard specifies

ISO 3522:1984

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ISO 2378, *Aluminium alloy chill castings — Reference test bar.*

- the chemical composition of cast aluminium alloys;
- minimum values for the mechanical properties of sand-cast or permanent mould-cast reference test pieces cast separately from the casting.

ISO 2379, *Aluminium alloy sand castings — Reference test bar.*

ISO 2379, *Aluminium alloy sand castings — Reference test bar.*

ISO 6892, *Metallic materials — Tensile testing.*¹⁾

NOTE — General conditions for the control and delivery of cast aluminium alloys will form the subject of a future International Standard. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements.

2 References

ISO 2092, *Light metals and their alloys — Code of designation based on chemical symbols.*

3 Chemical composition

Methods of analysis shall be at the discretion of the supplier.

In case of dispute over composition, another analysis shall be carried out in accordance with existing International Standards and the results obtained by these methods shall be accepted.

1) At present at the stage of draft.

3.1 Sand cast and permanent mould alloys

Table 1 – Chemical composition of sand cast and permanent mould alloys. %

Alloys	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Pb	Sn	Be	Ti	Al
Al-Cu4 Ni2 Mg2 min. max.	— 0,7	— 0,7	3,5 4,5	— 0,6	1,2 1,8	— 0,2	1,7 2,3	— 0,1	— 0,05	— 0,05	— —	— 0,2	The remainder
Al-Cu4 Mg Ti min. max.	— 0,30	— 0,35	4,2 5,0	— 0,10	0,15 0,35	— —	— 0,05	— 0,10	— 0,05	— 0,05	— —	0,05 0,35	
Al-Cu4 Ti min. max.	— 0,25	— 0,25	4,0 5,0	— 0,10	— 0,05	— —	— 0,10	— 0,2	— 0,05	— 0,05	— —	0,05 0,30	
Al-Si5 min. max.	4,5 6,0	— 0,8	— 0,10	— 0,5	— 0,1	— —	— 0,1	— 0,1	— 0,1	— 0,1	— —	— 0,20	The remainder
Al-Si5 Mg min. max.	3,5 ¹⁾ 6,0	— 0,6	— 0,1	— 0,6	0,5 0,9	— —	— 0,1	— 0,1	— 0,1	— 0,05	— —	— 0,2	
Al-Si5 Cu1 Mg min. max.	4,5 5,5	— 0,6	1,0 1,5	— 0,5	0,4 0,6	— —	— 0,3	— 0,5	— 0,1	— 0,1	— —	— 0,2	
Al-Si5 Cu3 min. max.	4,0 6,0	— 0,8	2,0 4,0	0,2 0,6	— 0,15	— —	— 0,3	— 0,5	— 0,1	— 0,05	— —	— 0,2	
Al-Si6 Cu4 min. max.	5,0 7,0	— 1,0	3,0 5,0	0,2 0,6	— 0,3	— —	— 0,3	— 2,0	— 0,2	— 0,1	— —	— 0,2	
Al-Si7 Mg (Fe) min. max.	6,5 7,5	— 0,5	— 0,20	— 0,6	0,20 0,4	— —	— 0,05	— 0,3	— 0,05	— 0,05	— —	— 0,20	
Al-Si10 Mg min. max.	9,0 11,0	— 0,60	— 0,10	— 0,6	0,15 0,40	— —	— 0,05	— 0,1	— 0,05	— 0,05	— —	— 0,20	
Al-Si12 min. max.	11,0 13,5	— 0,70	— 0,10	— 0,5	— 0,10	— —	— 0,1	— 0,1	— 0,1	— 0,05	— —	— 0,20	
Al-Si12 Cu min. max.	11,0 13,5	— 0,90	— 1,2	— 0,5	— 0,3	— —	— 0,30	— 0,5	— 0,20	— 0,1	— —	— 0,2	
Al-Mg3 min. max.	— 0,5	— 0,5	— 0,10	— 0,6	2,5 4,5	— 0,1	— 0,05	— 0,2	— 0,05	— 0,05	— —	— 0,2	
Al-Mg3 Si2 min. max.	0,9 2,2	— 0,5	— 0,10	— 0,6	2,5 4,5	— 0,4	— 0,05	— 0,2	— 0,05	— 0,05	— —	— 0,2	
Al-Mg5 Si1 min. max.	0,5 1,5	— 0,5	— 0,10	— 0,5	4,0 6,0	— —	— 0,05	— 0,2	— 0,05	— 0,05	— —	— 0,2	
Al-Mg6 min. max.	— 0,50	— 0,5	— 0,10	— 0,6	4,5 7,0	— 0,5	— 0,05	— 0,2	— 0,05	— 0,05	— —	— 0,2	
Al-Mg10 min. max.	— 0,30	— 0,3	— 0,10	— 0,15	9,5 11,0	— —	— 0,10	— 0,10	— 0,05	— 0,05	— 0,05	— 0,15	
Al-Zn5 Mg min. max.	— 0,3	— 0,8	— 0,35	— 0,4	0,5 0,70	0,15 0,60	— 0,05	4,5 6,0	— 0,05	— 0,05	— —	0,10 0,30	The remainder

1) For anodizing, the silicon content should be between 3,5 % and 4,5 %.

NOTE — If the purchaser's requirements or product specifications necessitate limits for the contents of elements other than those specified in this table, these shall be agreed upon in the order.

3.2 Pressure die cast alloys

Table 2 – Chemical composition of pressure die cast alloys, %

Alloys	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Pb	Sn	Be	Ti	Al
Al-Si5 Fe	min.	4,5	—	—	—	—	—	—	—	—	—	—	The remainder
	max.	6,0	1,3	0,10	0,5	0,1	—	0,1	0,1	0,1	—	0,20	
Al-Si6 Cu4 Fe	min.	5,0	—	3,0	0,2	—	—	—	—	—	—	—	
	max.	7,0	1,3	5,0	0,6	0,3	—	0,3	2,0	0,2	0,1	—	
Al-Si8 Cu3 Fe	min.	7,5	—	2,5	—	—	—	—	—	—	—	—	
	max.	9,5	1,3	4,0	0,6	0,3	—	0,5	1,2	0,3	0,2	—	0,2
Al-Si12 Fe	min.	11,0	—	—	—	—	—	—	—	—	—	—	
	max.	13,5	1,3	0,10	0,5	0,10	—	0,1	0,1	0,1	0,05	—	0,20
Al-Si12 Cu Fe	min.	11,0	—	—	—	—	—	—	—	—	—	—	
	max.	13,5	1,3	1,2	0,5	0,3	—	0,30	0,5	0,20	0,1	—	0,2

NOTE — If the purchaser's requirements or product specifications necessitate limits for the contents of elements other than those specified in this table, these shall be agreed upon in the order.

3.3 High purity alloy

Table 3 – Chemical composition of high purity alloy, %

Alloy	Si	Fe	Cu	Mn	Mg	Ni	Zn	Ti	Others ¹⁾	
									Each	Total
Al-Si7 Mg	min.	6,5	—	—	—	—	—	—	—	—
	max.	7,5	0,20	0,10	0,10	0,25 0,45	0,05	0,10	0,20	0,05

1) Does not apply to modifying or refining elements.

4 Mechanical properties

ISO 3522:1984

Table 4 – Minimum mechanical properties of aluminium alloy sand-cast reference test pieces

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4.1 Sand-cast alloys

Mechanical tests shall be carried out in conformity with ISO 6892 using sand-cast reference test pieces prepared in accordance with ISO 2379.

The minimum mechanical properties are given in table 4.

Alloys	Temper ¹⁾	Tensile strength	Elongation
		R_m N/mm ²	A %
Al-Cu4 Ni2 Mg2	O	150	—
Al-Cu4 Ni2 Mg2	TF	220	—
Al-Cu4 Mg Ti	TB	290	4
Al-Cu4 Ti	TF	280	4
Al-Si5	M	120	2
Al-Si5 Mg	TF	230	1
Al-Si5 Cu1 Mg	TF	220	1
Al-Si5 Cu3	M	140	1
Al-Si6 Cu4	M	140	—
Al-Si7 Mg (Fe)	M	140	2
Al-Si7 Mg (Fe)	TF	210	1
Al-Si10 Mg	M	150	2
Al-Si10 Mg	TF	220	1
Al-Si12	M	150	3
Al-Si12 Cu	M	150	1
Al-Mg3	M	150	5
Al-Mg6	M	160	2
Al-Mg10	TB	260	8
Al-Zn5 Mg	TA	200	3

1) In accordance with ISO 2107, i.e.

M = As manufactured.

TF = Solution heat treated and precipitation treated.

TA = Cooled from an elevated temperature shaping process and naturally aged.

TB = Solution heat treated and naturally aged.

O = Annealed.

4.2 Permanent mould-cast alloys

Mechanical tests shall be carried out in conformity with ISO 6892 using permanent mould-cast reference test pieces prepared in accordance with ISO 2378.

The minimum mechanical properties are given in table 5.

Table 5 — Minimum mechanical properties of aluminium alloy permanent mould-cast reference test pieces

Alloys	Temper	Tensile strength	Elongation
		R_m N/mm ²	A %
Al-Cu4 Ni2 Mg2	TF	260	—
Al-Cu4 Mg Ti	TB	330	8
Al-Cu4 Ti	TF	310	9
Al-Si5 Mg	M	160	2
Al-Si5 Mg	TF	240	1
Al-Si5 Cu1 Mg	M	160	—
Al-Si5 Cu1 Mg	TF	290	—
Al-Si5 Cu3	M	150	1
Al-Si6 Cu4	M	150	1
Al-Si7 Mg (Fe)	M	150	3
Al-Si7 Mg (Fe)	TF	230	2
Al-Si10 Mg	M	170	3
Al-Si10 Mg	TF	240	1.5
Al-Si13	M	170	3
Al-Mg3	M	150	5
Al-Mg5 Si1	M	170	2
Al-Mg6	M	170	3
Al-Zn5 Mg	TA	210	3

4.3 High purity alloy

Mechanical tests shall be carried out in conformity with ISO 6892 using sand-cast reference test pieces prepared in accordance with ISO 2379 or permanent mould-cast reference test pieces prepared in accordance with ISO 2378.

The minimum mechanical properties are given in table 6.

Table 6 — Minimum mechanical properties of high purity alloy Al-Si7 Mg

Type of casting	Temper ¹⁾	R_m	$R_{p0,2}$	A_5	HB
		N/mm ²	N/mm ²	%	
Sand casting	TF	230	180	2	75
Permanent mould casting	TF	250	190	5	80

1) TF = Solution heat treated and precipitation treated.

5 Rules for rounding

In interpreting the results of chemical analyses, the number representing the result of the determination of an element content shall be rounded to the same number of decimal places as the corresponding number in this International Standard.

The following rule shall be applied for rounding such values :

- a) When the figure immediately after the last figure to be retained is lower than 5, the last figure to be retained remains unchanged.
- b) When the figure immediately after the last figure to be retained is greater than or equal to 5, and is followed by at least one figure other than zero, the last figure to be retained is increased by one.
- c) When the figure immediately after the last figure to be retained is equal to 5 and is followed by zeros only, the last figure to be retained remains unchanged if even and is increased by one if odd.

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