

Specification for

Aluminium and aluminium alloy ingots and castings for general engineering purposes

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The preparation of this British Standard was entrusted by the Non-ferrous Metals Standards Committee (NFM/-) to Technical Committee NFM/35, upon which the following bodies were represented:

- Aluminium Federation
- Aluminium Stockholders' Association
- Association of Light Alloy Refiners Limited
- Department of Trade and Industry (Minerals and Metals Division)
- Light Metal Founders' Association
- Magnesium Industry Council
- Royal Institute of British Architects
- Society of Motor Manufacturers and Traders Limited

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

- BNF Metals Technology Centre
- British Foundry Association
- British investment Casting Trade Association
- Institute of British Foundrymen

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Foreword

This British Standard has been prepared under the direction of the Non-ferrous Metals Standards Committee. It is the fourth revision of BS 1490, which was originally published in 1949 and subsequently revised in 1955, 1963 and 1970. It supersedes the 1970 edition, which is withdrawn.

In this revision, two of the alloys in the previous edition, LM10 and LM18, have been omitted. One new alloy, LM31, has been introduced and its requirements are based on those of DTD 5008 B. Slight changes have been made to the magnesium content permitted in LM4 and LM27 and in the copper content permitted in LM25 and LM9. Limits have been imposed on the permitted level of unnamed impurities in the alloys.

Requirements have been introduced for the frequency of analysis of ingots and for the frequency of tensile testing of castings, other than pressure die castings. Three additional mould designs for casting tensile test samples have been introduced, two of these being specifically for investment cast samples.

A new appendix B "Recommendations for optional supplementary inspection and tests for castings" is included, based on section 2 of the last edition, but completely revised to take account of current procedures and to relate to the similar appendix in BS 1400. The "Colour code for ingots" of the previous edition has been retained in this revision as appendix C and is unchanged apart from the inclusion of a colour code for the new alloy LM31. Section 3 of the last edition, which was a guide for the user to the selection of alloys for the manufacture of castings, has been completely revised and included as appendix D.

In previous editions of this standard, clauses have been included entitled "Inspection", "Independent test" and "Facilities for testing". As these clauses are contractual and not relevant to a product standard, they have been omitted from this revision.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 24, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This British Standard specifies requirements for the chemical compositions, mechanical properties and other characteristics for the following two types of product for general engineering purposes:

- a) aluminium and aluminium alloy ingots intended to be remelted for the production of castings; and
- b) aluminium and aluminium alloy castings.

Methods for verifying that ingots and castings comply with this British Standard are also specified.

NOTE 1 This standard is intended to apply to castings made by any metal casting process. However, in the case of mechanical properties, requirements are specified only for castings made by the sand casting, chill casting and investment casting processes.

NOTE 2 Information which purchasers are recommended to provide in any enquiry or order is given in appendix A. Recommendations for optional supplementary inspection and test procedures, that enable castings to be ordered according to particular inspection and test requirements appropriate to the application of the castings, are given in appendix B.

Appendix B also describes a system of inspection coding that enables the additional inspection and test procedures to be specified readily at the design stage, for quotation purposes and for order.

NOTE 3 The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this British Standard the following definitions apply.

2.1

ingot

a cast, unwrought product, in a form suitable for remelting

2.2

casting

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

2.3

sand casting

a casting formed in a sand mould

2.4

chill casting

a casting formed in a metal mould

2.5

gravity die casting

a chill casting in which the molten metal is introduced by gravity

2.6

low pressure die casting

a chill casting in which the molten metal is introduced by a low pressure feed

2.7

pressure die casting

a chill casting in which the molten metal is introduced under high pressure

2.8

investment casting

a casting formed from an expendable pattern which has been invested in a suitable mould material

2.9

cast (non-continuous melting)

the product of either one furnace melt, or a number of furnace melts where such are aggregated and mixed prior to sampling or pouring

2.10

cast (continuous melting)

in continuous melting for the production of castings, when the contents of a melting/holding furnace are supplemented from time to time by the addition of metal to maintain an adequate bulk of liquid metal, a cast is 500 kg or fraction thereof of metal poured

2.11

approved ingots

aluminium and aluminium alloy ingots which have been proved to comply with the appropriate material specification

2.12

approved scrap

that scrap which arises from a founder's own production from approved ingots, which is segregated and identifiable. It may include heavy fettling scrap but be free of all drosses and small particles such as sawings, grindings and chippings

2.13

ingot batch

a series of ingots cast from a single uniform melt

3 General requirements

Aluminium and aluminium alloy ingots shall comply with clause 4.

Aluminium and aluminium alloy castings shall comply with clause 5.

Inspection procedures and test methods for verifying that the ingots and castings comply with clauses 4 and 5 shall be as specified in clauses 6, 7 and 8.

NOTE Castings ordered to be subject to optional supplementary inspection and testing requirements (see appendix B) should also comply with the recommendations of that appendix.

The results obtained from chemical analysis and tensile tests shall be rounded to the last place of figures specified as limits, by the application of the rounding rules in accordance with BS 1957.

4 Specific requirements for ingots

4.1 Chemical composition

The chemical composition of ingots determined on samples taken in accordance with 6.2.1 shall be as given in Table 1 to Table 3 for the appropriate alloy.

4.2 Certificate of analysis

The supplier shall provide a certificate of analysis with each cast of ingots, showing it complies with the analytical requirements of this standard. The certificate shall indicate the full analysis of sample(s) representative of the cast.

4.3 Marking

Ingots shall be marked clearly and durably either:

- a) individually, with the manufacturer's mark, the material designation and the cast number; or
- b) in bundles, with each bundle marked with the manufacturer's mark, the material designation and the cast number.

Ingots shall be colour marked to identify the alloy in which they have been cast.

NOTE Appendix C lists suitable colour codes.

Table 1 — Chemical compositions of group A ingots and castings: general purpose alloys

Designation	LM2		LM4		LM6		LM20		LM24		LM25		LM27	
Nominal composition	Al-Si10Cu2		Al-Si5Cu3Mn0.5		Al-Si12		Al-Si12		Al-Si8Cu3.5		Al-Si7Mg0.5		Al-Si7Cu2Mn0.5	
Nearest alloy(s) in ISO 3522	—		Al-Si5Cu3		Al-Si12 Al-Si12CuFe		Al-Si12Cu Al-Si12Fe		Al-Si8Cu3Fe		Al-Si7Mg		Al-Si5Cu3	
Elements	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Aluminium	Remainder		Remainder		Remainder		Remainder		Remainder		Remainder		Remainder	
Copper	0.7	2.5	2.0	4.0	—	0.1	—	0.4	3.0	4.0	—	0.20	1.5	2.5
Magnesium	—	0.30	—	0.20	—	0.10	—	0.2	—	0.30	0.20	0.6	—	0.35
Silicon	9.0	11.5	4.0	6.0	10.0	13.0	10.0	13.0	7.5	9.5	6.5	7.5	6.0	8.0
Iron	—	1.0	—	0.8	—	0.6	—	1.0	—	1.3	—	0.5	—	0.8
Manganese	—	0.5	0.2	0.6	—	0.5	—	0.5	—	0.5	—	0.3	0.2	0.6
Nickel	—	0.5	—	0.3	—	0.1	—	0.1	—	0.5	—	0.1	—	0.3
Zinc	—	2.0	—	0.5	—	0.1	—	0.2	—	3.0	—	0.1	—	1.0
Lead	—	0.3	—	0.1	—	0.1	—	0.1	—	0.3	—	0.1	—	0.2
Tin	—	0.2	—	0.1	—	0.05	—	0.1	—	0.2	—	0.05	—	0.1
Titanium	—	0.2	—	0.2	—	0.2	—	0.2	—	0.2	—	0.2 ^a	—	0.2
Each other element ^b	—	—	—	0.05	—	0.05	—	0.05	—	—	—	0.05	—	0.05
Total other elements ^b	—	0.50	—	0.15	—	0.15	—	0.20	—	0.50	—	0.15	—	0.15

NOTE Specified impurities are shown in light type. Analysis is required to verify that the contents of the specified impurities are less than the limits given in this table, Analysis for other elements is made when their presence is suspected to be in excess of the “each other element” limit.

^a If titanium alone is used for grain refining, the amount present shall be not less than 0.05 %.

^b In cases when alloys are required in the modified condition, the level of any modifying element present is not limited by the specified maximum value for other elements.

Table 2 — Chemical compositions of group B ingots and castings: special purpose alloys

Designation	LM0		LM5		LM9		LM13		LM16		LM21		LM22	
Nominal composition	99.50 + % Al		Al-Mg5Mn0.5		Al-Si12 Mg0.5Mn0.5		Al-Si12Cu1Mg1		Al-Si5Cu1 Mg0.5		Al-Si6Cu4 Mn0.4Mg0.2		Al Si5Cu3 Mn0.4	
Nearest alloy(s) in ISO 3522			Al-Mg5Si1 Al-Mg6		Al-Si10Mg		Al-Si12Cu Al-Si12CuFe		Al-Si5Cu1Mg		Al-Si6Cu4		Al-Si5Cu3	
Elements	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Aluminium	99.50 ^a	—	Remainder		Remainder		Remainder		Remainder		Remainder		Remainder	
Copper	—	0.03	—	0.1	—	0.20	0.7	1.5	1.0	1.5	3.0	5.0	2.8	3.8
Magnesium	—	0.03	3.0	6.0	0.2	0.6	0.8	1.5	0.4	0.6	0.1	0.3	—	0.05
Silicon	—	0.30	—	0.3	10.0	13.0	10.0	13.0	4.5	5.5	5.0	7.0	4.0	6.0
Iron	—	0.40	—	0.6	—	0.6	—	1.0	—	0.6	—	1.0	—	0.6
Manganese	—	0.03	0.3	0.7	0.3	0.7	—	0.5	—	0.5	0.2	0.6	0.2	0.6
Nickel	—	0.03	—	0.1	—	0.1	—	1.5	—	0.25	—	0.3	—	0.15
Zinc	—	0.07	—	0.1	—	0.1	—	0.5	—	0.1	—	2.0	—	0.15
Lead	—	0.03	—	0.05	—	0.1	—	0.1	—	0.1	—	0.2	—	0.1
Tin	—	0.03	—	0.05	—	0.05	—	0.1	—	0.05	—	0.1	—	0.05
Titanium	—	—	—	0.2	—	0.2	—	0.2	—	0.2 ^b	—	0.2	—	0.2
Each other element ^c	—	—	—	0.05	—	0.05	—	0.05	—	0.05	—	0.05	—	0.05
Total other elements ^c	—	—	—	0.15	—	0.15	—	0.15	—	0.15	—	0.15	—	0.15
NOTE Specified impurities are shown in light type. Analysis is required to verify that the contents of the specified impurities are less than the limits given in this table. Analysis for other elements is made when their presence is suspected to be in excess of the “each other element” limit.														
^a The aluminium content shall be determined by difference, i.e. by subtracting the total of all other elements listed.														
^b If titanium alone is used for grain refining, the amount present shall be not less than 0.05 %.														
^c In cases when alloys are required in the modified condition, the level of any modifying element present is not limited by the specified maximum value for other elements.														

Table 3 — Chemical compositions of group C ingots and castings: special purpose alloys of limited application

Designation	LM12		LM26		LM28 ^a		LM29 ^a		LM30		LM31 ^b	
Nominal composition	Al-Cu10Mg0.3		Al-Si10Cu3Mg1		Al-Si 18Cu1.5 Mg1Ni1		Al-Si23Cu1 Mg1Ni1		Al-Si17 Cu4.5Mg0.5		Al-Zn5 Mg0.7Cr0.5Ti	
Nearest alloy in ISO 3522											Al-Zn5Mg	
Elements	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
	%	%	%	%	%	%	%	%	%	%	%	%
Aluminium	Remainder		Remainder		Remainder		Remainder		Remainder		Remainder	
Copper	9.0	11.0	2.0	4.0	1.3	1.8	0.8	1.3	4.0	5.0	—	0.1
Magnesium	0.2	0.4	0.5	1.5	0.8	1.5	0.8	1.3	0.4	0.7	0.5	0.75
Silicon	—	2.5	8.5	10.5	17	20	22	25	16	18	—	0.25
Iron	—	1.0	—	1.2	—	0.7	—	0.7	—	1.1	—	0.5
Manganese	—	0.6	—	0.5	—	0.6	—	0.6	—	0.3	—	0.1
Nickel	—	0.5	—	1.0	0.8	1.5	0.8	1.3	—	0.1	—	0.1
Zinc	—	0.8	—	1.0	—	0.2	—	0.2	—	0.2	4.8	5.7
Lead	—	0.1	—	0.2	—	0.1	—	0.1	—	0.1	—	0.05
Tin	—	0.1	—	0.1	—	0.1	—	0.1	—	0.1	—	0.05
Titanium	—	0.2	—	0.2	—	0.2	—	0.2	—	0.2	—	0.25 ^c
Chromium	—	—	—	—	—	0.6	—	0.6	—	—	0.4	0.6
Each other element ^e	—	0.05	—	0.05	—	0.10 ^d	—	0.10 ^d	—	0.10	—	0.05
Total other elements ^e	—	0.15	—	0.15	—	0.30	—	0.30	—	0.30	—	0.15

NOTE Specified impurities are shown in light type. Analysis is required to verify that the contents of the specified impurities are less than the limits given in this table. Analysis for other elements is made when their presence is suspected to be in excess of the “each other element” limit.

^a LM28 and LM29 are also subject to metallographic structure requirements (see 5.4).

^b LM31 castings in the “M” condition have to be naturally aged for 3 weeks before use, or before determination of mechanical properties.

^c If titanium alone is used for grain refining, the amount present shall be not less than 0.05 %.

^d Maximum cobalt content 0.5 %.

^e In cases when alloys are required in the modified condition, the level of any modifying element present is not limited by the specified maximum value for other elements.