BRITISH STANDARD AEROSPACE SERIES

BS 2L 77: 1971
(Superseding BS L 77)

Specification for

Forging stock and forgings of aluminium-copper-magnesium-silicon-manganese alloy —

(Solution treated and precipitation treated)
(Cu 4.4, Mg 0.5, Si 0.7, Mn 0.8)

Confirmed January 2011

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 3 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.

This British Standard, having been approved by the Aerospace Industry Standards Committee, was published under the authority of the Executive Board of the Institution on 31 August 1971

The following BSI references relate to the work on this standard:
Committee reference ACE/24
Draft for comment 69/23023

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Amendments issued since publication

Amd. No.	Date of issue	Comments

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NOTE Other forms of material of similar composition are covered by British Standards as listed in Appendix A.

1 Inspection and testing procedure

This British Standard shall be used in conjunction with the relevant sections of BS L 100 as follows:

Cast billets and slabs for hot working	Sections 1 and 2
Extruded bars and sections for forging	Sections 1 and 3
Hot-rolled plate for forging	Sections 1 and 13
Forgings	Sections 1 and 7

2 Quality of material

The material shall be made from aluminium and alloying constituents, with or without approved scrap, at the discretion of the manufacturer.

3 Chemical composition

The chemical composition of the material shall be:

Element	%	
	min.	max.
Copper	**3.9**	**5.0**
Magnesium	**0.20**	**0.8**
Silicon	**0.50**	**0.90**
Iron	—	0.5
Manganese	**0.40**	**1.2**
Nickel[a]	—	0.2
Zinc[a]	—	0.2
Lead[a]	—	0.05
Tin[a]	—	0.05
Titanium plus Zirconium[a]	—	0.2
Chromium[a]	—	0.10
Aluminium	—	**The remainder**

[a] Subject to the discretion of the Inspecting Authority, determination of these elements need be made on a small proportion only of the samples analysed.

4 Condition

4.1 Forging stock. Cast billets and slabs for hot working and extruded bars, sections and hot-rolled plate for forging shall be supplied non-heat treated.

4.2 Forgings. Unless otherwise agreed between the manufacturer and the purchaser and stated on the order, forgings shall be supplied solution treated and precipitation treated.

5 Heat treatment

The forgings shall be heat treated as follows:

1) Solution treat by heating at a temperature of 500 ± 5 °C and quenching in water at a temperature not less than 40 °C not more than 70 °C, unless otherwise agreed by the parent design firm and the manufacturer.

NOTE If a water quenching temperature below 40 °C is used, high residual stress and cracking may result, particularly in large and/or complicated forgings. For these reasons it is desirable to quench in water at as high a temperature as practicable.
If a water quenching temperature above 70 °C is agreed, the level of the mechanical properties in the forging may be lower than that normally expected and the use of the AX or BX testing procedure is recommended. Quenching above 70 °C may also increase the susceptibility of the material to intercrystalline corrosion.

2) Precipitation treat by heating uniformly for the requisite period at a temperature between 160 °C and 190 °C.

NOTE The following temperatures and times at temperature have been found appropriate:

Temperature	Time at temperature
°C	hours
165	12 to 18
175	9 to 12
185	3 to 6

6 Mechanical properties

6.1 Tensile test. Unless they are required by BS L 100 to be fixed by agreement between the manufacturer and the purchaser, the mechanical properties obtained from test pieces selected and prepared in accordance with the relevant requirements of BS L 100 shall be not less than the following values:

Material represented	Test sample prepared by	Diameter or minor sectional dimension of forging stock		0.2 % proof stress	Tensile strength	Elongation on gauge length of	
						50 mm	$5.65\sqrt{S_o}$
		mm		N/mm²	N/mm²	%	%
Extruded forging stock Forgings made from: Cast billets Hot-rolled plate Extruded stock	F	All sizes		395	450	6	6
		Over	Up to and including				
Extruded forging stock Forgings made from extruded stock	M	—	10	380	430	6	—
		10	20	400	450	6	6
		20	75	420	460	—	6
		75	150	390	430	—	5
		150	200	350	400	—	5

M = machining F = forging

NOTE 1 N/mm² = 1 MN/m² = 0.102 kgf/mm² = 0.1 hbar = 0.065 tonf/in². Information on SI units is given in BS 3763, *"The International System of units (SI)"* and in PD 5686, *"The use of SI units"*. See also BS 350, *"Conversion factors and tables"*.

6.2 Hardness test. The Brinell hardness number of forgings and of forged test pieces, heat treated in accordance with Clause **5**, shall be not less than 134.

Appendix A British Standards covering other forms of material of similar composition

Form	Solution treated and aged at room temperature	Solution treated and precipitation treated	Supplied for solution treatment by the user
Bars and extruded sections (not exceeding 200 mm diameter or minor sectional dimension)	BS L 102	BS L 65	—
Forging stock and forgings	BS L 103	—	—
Hexagonal bars for nuts, couplings and hollow machined parts (free from peripheral and asymmetric coarse grain)	—	BS L 87	—
Sheet and strip	BS L 70	BS L 104	BS L 106[a]
Aluminium-coated sheet and strip	BS L 72	BS L 73	BS L 107[a]
Close toleranced sheet and strip (aluminium-coated)	BS L 89	BS L 90	BS L 108[a]
Tube (not exceeding 10 mm wall thickness)	BS L 105	BS L 63	—
Wire for solid, cold-forged rivets (not exceeding 10 mm diameter)	—	—	BS L 37
Plate: controlled stretched	—	BS L 93	—
Plate: not controlled stretched	—	BS L 94	—

[a] In course of preparation.

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London
W4 4AL