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EMERGENCY STANDARD
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STANDARDS ASSOCIATION OF AUSTRALIA.

Headquarters :
Science House, Gloucester and Essex Streets, Sydney.

AUSTRALIAN STANDARD SPECIFICATION FOR AIRCRAFT MATERIAL
(Emergency Series)

ALUMINIUM ALLOY BARS, BILLETS AND
FORGINGS.

(Suitable for Engine Crankcases.)

This standard forms one of a series prepared by the Standards Association of Australia at the request of Departments of the Commonwealth Government for use in relation to the supply of materials required for defence purposes. In appropriate cases these specifications will be reviewed for inclusion in the normal series of Australian standards.

This specification covers the alloy generally known as "A.A.61S."

- Section I. Provisions Applicable to all Sections of this Specification.
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Section III. Forgings.

SECTION I.

Provisions Applicable to all Sections of this Specification.

1. Quality of Material.

(a) The aluminium used in the manufacture of this alloy shall comply with the latest issue of British Standard No. L31.

(b) No scrap shall be used in the manufacture of this alloy other than that produced in the manufacturer's own works.

2. Chemical Composition.

(a) The chemical composition of the alloy shall be :

Silicon	...	...	...	...	...	0.60 to 1.20%
Magnesium	...	...	...	...	...	0.50 to 0.70%
Chromium	...	...	...	...	...	0.15 to 0.35%
Manganese	...	...	...	...	...	0.15% maximum
Copper	...	...	...	...	...	0.30% "
Iron	...	...	...	...	...	0.75% "
Other metallic impurities, each	...	...	...	...	...	0.03% "
Aluminium	...	..	...	...	...	the remainder

(b) The complete analysis of every cast shall be supplied to the inspector.

3. Tensile Test. From test samples representing bars or billets and forgings, tensile test pieces shall be machined to the dimensions of the largest possible size of British standard tensile test piece, Fig. 1, 2, 3 or 4 of B.S. No. 2A.4.

The parallel portion of any test piece may be increased in length to accommodate the extensometer employed.

The load shall be applied axially.

Should a tensile test piece break outside the middle half of its gauge length, the test may be discarded and another test made.

4. Freedom from Defects.

- (a) The material shall be free from defects.
- (b) Any material may be rejected for faults in manufacture, notwithstanding that it has been passed previously on chemical composition and mechanical tests.

SECTION II.

Bars and Billets for Forging.

5. Manufacture.

- (a) Material may be supplied in the form of cast billets for large forgings or in the "as rolled" or "as extruded" bar condition.
- (b) Margins of manufacture, when required, shall be agreed between the manufacturer and the purchaser and shall be specified on the order.

6. Heat-Treatment. The test samples selected and prepared as specified in Clause 7 shall be given uniform heat-treatment and ageing in such a manner that they will conform to the mechanical properties specified in Clause 8.

7. Selection and Preparation of Mechanical Test Samples.

(a) Bars and billets from the same cast shall be grouped in a parcel and the inspector shall select one test sample from the largest size of bar or billet in the parcel for mechanical testing.

The test samples shall be removed from the bars or billets by nicking and breaking off or they may be sawn and, after separation from the bar, fractured. The end of the bar from which the test sample was taken shall be etched and shall show freedom from pipe or other defect.

(b) The portion of the bar or billet selected for the test samples shall be prepared as follows :

- (i) Test samples from bars up to and including $1\frac{1}{8}$ in. diameter or width across flats shall not be machined or forged, but shall be heat-treated in the full size.
- (ii) Bars and billets over $1\frac{1}{8}$ in. diameter or width across flats may be forged and/or machined at the option of the manufacturer to test samples $1\frac{1}{8}$ in. diameter and be heat-treated in that size.

(c) The tensile test piece shall be machined concentrically from the test sample.

(d) The test samples shall be marked as directed by the inspector before they are removed from the bars or billets, and shall be heat-treated as specified in Clause 6, but shall not be further heat-treated or mechanically worked before testing.

8. Tensile Test.

(a) Test pieces from the samples selected and prepared as specified in Clause 7 shall comply with the following tensile test requirements :

0.1% Proof Stress	...	...	...	not less than 15.0 tons per sq. in.
Ultimate Tensile Strength	...	...	...	not less than 20.0 tons per sq. in.
Elongation on 2 in.	...	...	...	not less than 12%.

9. Re-tests. If any test piece fails to comply with the tensile test requirements specified in Clause 8, the inspector shall select for test from the same parcel two other samples, one of which shall be from the bar or billet from which the original test sample was taken, unless that bar or billet has been withdrawn by the manufacturer. Test pieces prepared from these two further samples as specified in Clause 7 shall comply with the tensile test specified in Clause 8.

10. Identification.

(a) Each bar and billet shall, unless otherwise agreed between the manufacturer and the purchaser, be colour identified in accordance with the provisions of Australian Standard No. (E)D.500*.

(b) All bars under 1 in. nominal dimension from the same cast and in the same condition shall be wired up in bundles to each of which shall be securely attached a durable tag bearing such marks as will ensure full identification of the bars with this specification, with their particular cast and condition and with the manufacturer.

(c) Each bar and billet 1 in. and over in any sectional dimension shall be stamped near one end or on the colour bands with such marks as will ensure full identification of the bars and billets with this specification, with their particular cast and condition and with the manufacturer.

*A.S. No. (E)D.500, "Colour Identification of Metallic Materials for Aircraft."

SECTION III.

Forgings.

11. Manufacture.

(a) The forgings shall conform to the shape and dimensions specified on the order, within such variations as may be stated on the order or on drawings accompanying the order.

(b) The forgings shall be of uniform quality and condition, free from blisters, fins, seams, laps, cracks, segregations or other injurious defects.

(c) The forgings shall not be repaired by plugging or welding.

12. Heat-Treatment.

(a) The forgings shall be given a uniform heat-treatment and ageing to produce material which will conform to the mechanical properties specified in Clauses 14 and 16.

(b) If requested, the manufacturer shall supply the purchaser with a complete record of the heat-treatment performed upon the forgings.

13. Selection and Preparation of Mechanical Test Samples.

(a) Test samples from the same cast as the forgings they represent shall be forged to the ruling thickness of the forgings and shall be identified with the cast by means of a serial number. Such test pieces shall then receive the same pre-heating and heat-treatment cycle as the forgings which they represent.

(b) Forgings of the same pattern, made from the same cast, pre-heated and heat-treated together in accordance with Clause 12, shall be grouped in parcels and the inspector shall select one test sample to represent each parcel for mechanical testing. The test samples shall be marked as directed by the inspector and shall not be further heat-treated or mechanically worked before testing.

(c) For test samples up to and including $1\frac{1}{8}$ in. diameter or width across flats the tensile test piece shall be machined concentrically from the test sample.

For test samples over $1\frac{1}{8}$ in. diameter or width across flats the longitudinal axis of the tensile test piece shall be not less than $\frac{3}{16}$ in. from the surface of the test sample.

14. **Tensile Test.** Test pieces from the samples selected and prepared as specified in Clause 13 shall comply with the following tensile test requirements :

0.1% Proof Stress	...	...	...	not less than 15.0 tons per sq. in.
Ultimate Tensile Strength	...	...	...	not less than 20.0 tons per sq. in.
Elongation on 2 in.	...	...	...	not less than 12%.

15. **Re-tests.** If any test piece fails to comply with the requirements specified in Clause 14, the inspector may reject the parcel represented by that test piece, or at the request of the manufacturer adopt either of the following procedures :

- (i) select for test two further samples which have been prepared in accordance with Clause 13, and have been heat-treated with the parcel from which the original sample was taken. Both these samples shall comply with the test requirements specified in Clause 14, or
- (ii) allow the parcel to be re-heat-treated in accordance with Clause 12. A test sample from the re-heat-treated parcel, selected and prepared in accordance with Clause 13, shall comply with the test requirements of Clause 14.

16. Hardness Test.

(a) All forgings shall be tested on the surface for hardness by an approved method and the hardness value shall not be less than 90 Brinell (500 Kg., 10 mm.) or its equivalent on the scale of the method adopted.

(b) If any forgings fail to comply with Clause 16 (a) they may be rejected, or at the request of the manufacturer, be re-heat-treated in accordance with Clause 12 and re-tested in accordance with Clauses 13, 14 and 16.

17. **Macroscopic Examination.** Large and important forgings, such as crankcases, shall be etched and subjected to macroscopic examination. Such forgings shall be free from cracks, spongy areas or other defects which would adversely affect their serviceability. Apparent defects in any forging shall be explored, and unless they can be removed by subsequent machining operations the forging shall be rejected.

18. Identification.

(a) All forgings under 5 lb. weight, of the same part number, from the same cast and heat-treated together, shall be made up into parcels to each of which shall be securely attached a durable tag bearing the part number and such other marks as will ensure full identification of the forgings with this specification, with the cast and heat-treatment batch numbers and with the manufacturer.

(b) All forgings of 5 lb. weight or over shall each be tagged or otherwise marked with the part number and such other marks as will ensure full identification of the forgings with this specification, with the cast and heat-treatment batch numbers and with the manufacturer.

(c) Metal stamping shall not be used as a means of identification where the stamp marks are likely to affect the physical properties of the forging, but is allowable on heavy sections which have large machining allowances.

In cases where the purchaser is agreeable light metal stamping may be used on unmachined forgings.

For the purposes of this specification the term "Inspector" shall be interpreted in the manner directed by the Australian Airworthiness Authority concerned.

This specification, prepared by the Special Committee on Aircraft Materials and Components, was approved on behalf of the Council of the Association on 13th August, 1942.

NOTE.

In order to keep abreast of progress in the industries concerned, Australian standards are subject to periodical review. Suggestions for improvement, addressed to the Headquarters of the Association, will be welcomed.