



AEROSPACE MATERIAL

Society of Automotive Engineers, Inc. SPECIFICATION

400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AMS 4144B

Superseding 4144A

Issued 9-1-65

Revised 10-15-79

UNS A92219

ALUMINUM ALLOY HAND FORGINGS AND RINGS

6.3Cu - 0.30Mn - 0.18Zr - 0.10V - 0.06Ti (2219-T852)

Solution Heat Treated, Stress Relief Compressed, and Precipitation Heat Treated

1. SCOPE:

1.1 Form: This specification covers an aluminum alloy in the form of hand forgings and rolled rings.

1.2 Application: Primarily for structural parts subject to warpage during machining. May be welded in the -T852 condition but properties are improved by re-heat treatment to -T6 temper after welding. Certain design and fabricating procedures may cause these products to be susceptible to stress-corrosion cracking; ARP 823 recommends practices to minimize such conditions.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) and Aerospace Recommended Practices (ARP) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

- AMS 2350 - Standards and Test Methods
- AMS 2375 - Control of Forgings Requiring First Article Approval
- AMS 2630 - Ultrasonic Inspection
- AMS 2808 - Identification, Forgings

2.1.2 Aerospace Recommended Practices:

ARP 823 - Minimizing Stress Corrosion Cracking in Wrought, Heat-Treatable Aluminum Alloy Products

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

- ASTM B557 - Tension Testing of Wrought and Cast Aluminum- and Magnesium-Alloy Products
- ASTM E10 - Brinell Hardness of Metallic Materials
- ASTM E34 - Chemical Analysis of Aluminum and Aluminum Alloys

2.3 Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

SAE Technical Board rules provide that: "All technical reports, including standards approved and practices recommended, are advisory only. Their use by anyone engaged in industry or trade or by governmental agencies is entirely voluntary. There is no agreement to adhere to or be guided by any technical report. In formulating and approving technical reports, the Board and its Committees will not investigate or consider patents which may apply to the subject matter. Prospective users of the report are responsible for protecting themselves against liability for infringement of patents."

2.3.2 Military Specifications:

MIL-H-6088 - Heat Treatment of Aluminum Alloys

2.3.3 Military Standards:

MIL-STD-649 - Aluminum and Magnesium Products, Preparation for Shipment and Storage

3. TECHNICAL REQUIREMENTS:

3.1.2 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E34, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other analytical methods approved by purchaser:

	min	max
Copper	5.8	6.8
Manganese	0.20	0.40
Zirconium	0.10	0.25
Vanadium	0.05	0.15
Titanium	0.02	0.10
Iron	--	0.30
Silicon	--	0.20
Zinc	--	0.10
Magnesium	--	0.02
Other Impurities, each	--	0.05
Other Impurities, total	--	0.15
Aluminum		remainder

3.2 Condition: Solution heat treated, stress-relieved by compressing, and precipitation heat treated. The compressing in the solution heat treated condition shall produce a permanent set of 1 - 5%. Heat treatments shall be performed in accordance with MIL-H-6088.

3.3 Properties: The product shall conform to the following requirements:

3.3.1 Tensile Properties: Shall be as follows, determined in accordance with ASTM B557:

3.3.1.1 Hand Forgings: Test specimens machined from hand forgings 17 in. (432 mm) and under in nominal thickness shall conform to the requirements of Table I. Tests may be waived for any test direction having less than 2 in. (51 mm) of solid metal. Tests need not be made in the longitudinal direction unless specifically required by purchaser.

TABLE I

Nominal Thickness Inches	Specimen Orientation	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation in 4D %, min
Up to 4, incl	Longitudinal	62,000	50,000	6
	Long Trans.	62,000	49,000	4
	Short Trans.	60,000	46,000	3
Over 4 to 6, incl	Longitudinal	58,000	44,000	6
	Long Trans.	56,000	42,000	4
	Short Trans.	56,000	41,000	3
Over 6 to 8, incl	Longitudinal	57,000	43,000	6
	Long Trans.	55,000	41,000	4
	Short Trans.	55,000	40,000	3
Over 8 to 10, incl	Longitudinal	56,000	42,000	6
	Long Trans.	54,000	41,000	3
	Short Trans.	54,000	39,000	3
Over 10 to 12, incl	Longitudinal	54,000	41,000	6
	Long Trans.	53,000	40,000	3
	Short Trans.	53,000	39,000	2
Over 12 to 14, incl	Longitudinal	53,000	40,000	6
	Long Trans.	52,000	40,000	3
	Short Trans.	52,000	38,000	2
Over 14 to 17, incl	Longitudinal	51,000	39,000	6
	Long Trans.	50,000	39,000	3
	Short Trans.	50,000	37,000	2

SAENORM.COM Click to view the full PDF of AMS 4144B

TABLE I (SI)

Nominal Thickness Millimetres	Specimen Orientation	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 4D %, min
Up to 102, incl	Longitudinal	427	345	6
	Long Trans.	427	338	4
	Short Trans.	414	317	3
Over 102 to 152, incl	Longitudinal	400	303	6
	Long Trans.	386	290	4
	Short Trans.	386	283	3
Over 152 to 203, incl	Longitudinal	393	296	6
	Long Trans.	379	283	4
	Short Trans.	379	276	3
Over 203 to 254, incl	Longitudinal	386	290	6
	Long Trans.	372	283	3
	Short Trans.	372	269	3
Over 254 to 305, incl	Longitudinal	372	283	6
	Long Trans.	365	276	3
	Short Trans.	365	269	2
Over 305 to 356, incl	Longitudinal	365	276	6
	Long Trans.	358	276	3
	Short Trans.	358	262	2
Over 356 to 432, incl	Longitudinal	352	269	6
	Long Trans.	345	269	3
	Short Trans.	345	255	2

3.3.1.1.1 Tensile properties of specimens machined from forgings over 17 in. (432 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

3.3.1.2 Rolled Rings:

3.3.1.2.1 Tangential: Test specimens machined from rings 2.5 in. (64 mm) and under in nominal thickness with axis of specimen tangential to the ring OD (axis parallel to the direction of rolling) shall conform to the following requirements:

Tensile Strength, min	60,000 psi (414 MPa)
Yield Strength at 0.2% Offset, min	48,000 psi (331 MPa)
Elongation in 4D, min	6%

3.3.1.2.2 **Axial:** Test specimens machined from rings 2.5 in. (64 mm) and under in nominal radial thickness with axis of specimen parallel to axis of ring (axis transverse to direction of rolling) shall conform to the following requirements:

Tensile Strength, min	60,000 psi (414 MPa)
Yield Strength at 0.2% Offset, min	46,000 psi (317 MPa)
Elongation in 4D, min	4%

3.3.1.2.3 Tensile properties of specimens machined from rings over 2.5 in. (64 mm) in nominal radial thickness shall be as agreed upon by purchaser and vendor.

3.3.2 **Hardness:** Should be not lower than 115 HB/10/500, 115 HB/14.3/1000, or 122 HB/10/1000, determined in accordance with ASTM E10, but forgings and rolled rings shall not be rejected on the basis of hardness if the tensile property requirements are met.

3.4 **Quality:** The product, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from internal and external imperfections detrimental to usage of the product.

3.4.1 When specified, forgings and rolled rings shall be subjected to a caustic etch followed by visual examination of the product surfaces for defect indications and/or to ultrasonic inspection in accordance with AMS 2630. Standards for acceptance shall be as agreed upon by purchaser and vendor.

4. **QUALITY ASSURANCE PROVISIONS:**

4.1 **Responsibility for Inspection:** The vendor of the product shall supply all samples and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.5 Purchaser reserves the right to perform such confirmatory testing as he deems necessary to ensure that the product conforms to the requirements of this specification.

4.2 **Classification of Tests:**

4.2.1 **Acceptance Tests:** Tests to determine conformance to all technical requirements of this specification are classified as acceptance tests and shall be performed on each lot.

4.2.2 **Preproduction Tests:** Tests to determine conformance to all technical requirements of this specification when AMS 2375 is specified are classified as preproduction tests and shall be performed on the first-article shipment of a forging or rolled ring to a purchaser, when a change in material or processing requires reapproval as in 4.4, and when purchaser deems confirmatory testing to be required.

4.2.2.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction forgings or rolled rings shall be submitted to the cognizant agency as directed by the procuring activity, the contracting officer, or the request for procurement.

4.3 **Sampling:** Shall be as follows; a lot shall be all forgings or rolled rings of the same nominal cross-section and configuration heat treated in the same batch furnace load or charged consecutively in not more than 8-hr continuous furnace operation:

4.3.1 **Composition:** At least one sample shall be taken by the producer from each group of ingots poured simultaneously from the same source of molten metal.

4.3.1.1 Unless compliance with 4.3.1 is established, an analysis shall be made for each 6000 lb (2724 kg) or less of alloy comprising the lot except that not more than one analysis shall be required per piece.

4.3.2 **Tensile Properties:**