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400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 4148A
Superseding AMS 4148

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UNS A97175

ALUMINUM ALLOY DIE FORGINGS
5.6Zn - 2.5Mg - 1.6Cu - 0.23Cr (7175-T66)
Solution and Precipitation Heat Treated

1. SCOPE:

1.1 Form: This specification covers an aluminum alloy in the form of high strength die forgings.

1.2 Application: Primarily for parts requiring a high level of mechanical properties. Certain design and processing procedures may cause these forgings to become 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 2645 - Fluorescent Penetrant 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 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 U.S. 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

2.3.2 Military Specifications:

MIL-H-6088 - Heat Treatment of Aluminum Alloys
MIL-I-8950 - Inspection, Ultrasonic, Wrought Metals, Process for

Printed in U.S.A.

2.3.3 Military Standards:

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

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods
ø 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
Zinc	5.1	6.1
Magnesium	2.1	2.9
Copper	1.2	2.0
Chromium	0.18	0.28
Iron	--	0.20
Silicon	--	0.15
Manganese	--	0.10
Titanium	--	0.10
Other Impurities, each	--	0.05
Other Impurities, total	--	0.15
Aluminum	remainder	

3.2 Condition: Solution and precipitation heat treated in accordance with the procedures and controls of
ø MIL-H-6088.

3.3 Properties: Forgings shall conform to the following requirements:

3.3.1 Tensile Properties: Shall be as follows, determined in accordance with ASTM B577:

3.3.1.1 With Grain Flow: Test specimens, machined from forgings 3 in. (76 mm) and under in nominal thickness or from prolongations on such forgings, with the axis of specimen in the area of gage length varying not more than 15 deg from parallel to the forging flow lines shall have the following properties:

Tensile Strength, min	86,000 psi (593 MPa)
Yield Strength at 0.2% Offset, min	76,000 psi (524 MPa)
Elongation in 2 in. (50 mm) or 4D, min	7%

3.3.1.2 Across Grain Flow: Test specimens, machined from forgings 3 in. (76 mm) and under in nominal thickness or from prolongations on such forgings, with the axis of specimen in the area of gage
ø length varying not more than 15 deg from perpendicular to the forging flow lines shall have the following properties. If the configuration of the forging or prolongation cannot accommodate the transverse specimen described, acceptance of the forgings shall be based on testing as in 3.3.1.3.

Tensile Strength, min	77,000 psi (531 MPa)
Yield Strength at 0.2% offset, min	66,000 psi (455 MPa)
Elongation in 2 in. (50 mm) or 4D, min	4%

3.3.1.3 At Angle to Grain Flow: Test specimens, machined from forgings 3 in. (76 mm) and under in nominal thickness or from prolongations on such forgings, with the axis of specimen in the area of
ø gage length varying more than 15 deg from parallel and also more than 15 deg from perpendicular to the forging flow lines, shall have the properties specified in 3.3.1.2. Such test results shall be identified as neither longitudinal nor transverse tensile test results.

3.3.1.4 Tensile property requirements, with, across, and at an angle to the grain flow, and for forgings
ø over 3 in. (76 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

3.3.1.5 Elongation requirements shall not apply to test specimens having a gage length diameter less than 0.250 in. (6.25 mm) or located in immediate proximity to an abrupt change in section thickness, or located so that any part of the specimen gage length is located within 1/8 in. (3 mm) of the trimmed flash line.

3.3.2 Hardness: Should be not lower than 140 HB/10/500, 140 HB/14.3/1000, or 145 HB/10/1000, determined in accordance with ASTM E10, but forgings shall not be rejected on the basis of hardness if the tensile property requirements are met.

Ø 3.3.3 Grain Flow: Shall be as specified on the drawing or as agreed upon by purchaser and vendor.

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

3.4.1 When specified, forgings shall be subjected to ultrasonic inspection in accordance with MIL-I-8950 Ø and, unless otherwise specified, shall meet the following requirements of that specification:

3.4.1.1 Forgings 0.500 to 4.000 in. (12.70 to 101.60 mm), incl, in nominal thickness and weighing not Ø over 300 lb (136 kg) shall meet Class B.

3.4.1.2 Acceptance criteria for forgings exceeding the limits of 3.4.1.1 shall be as agreed upon by purØ chaser and vendor.

3.4.2 When specified, forgings shall be subjected to fluorescent penetrant inspection in accordance with Ø AMS 2645. Standards for acceptance shall be as agreed upon by purchaser and vendor.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of forgings shall supply all samples for vendor's tests and Ø 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 sample and to perform such confirmatory testing as deemed necessary to ensure that the forgings conform to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to requirements for composition (3.1), tensile Ø properties (3.3.1), hardness (3.3.2), and, when specified, ultrasonic inspection (3.4.1) and fluorescent penetrant inspection (3.4.2) are classified as acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Tests of forgings to determine conformance to requirements for grain flow (3.3.3) Ø are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

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

4.2.3.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction Ø forgings 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 of the same nominal cross-section and conØ figuration heat treated in the same batch-furnace load or quenched from a continuous furnace consecutively during an 8-hr period.

4.3.1 Composition: At least one sample shall be taken by the producer from each group of ingots poured Ø 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 material comprising the lot except that not more than one analysis shall be required per piece.

Ø 4.3.2 Tensile Properties: One forging or one forging prolongation heat treated with each lot of forgings.

4.3.2.1 In lieu of a prolongation, not less than one tensile specimen with the grain flow and one tensile Ø specimen across the grain flow shall be cut from locations designated on the drawing from a forging representing each lot.

4.4 Approval: When specified, approval and control of forgings shall be in accordance with AMS 2375.

4.5 Reports:

4.5.1 The vendor of forgings shall furnish with each shipment three copies of a report stating that the chemi- Ø cal composition conforms to the requirements of this specification, showing the results of tests on each lot to determine conformance to the other acceptance test requirements, and stating that the forgings conform to the other technical requirements of this specification. This report shall include the purchase order number, lot number, AMS 4148A, size or part number, and quantity.

4.5.2 The vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, AMS 4148A, contractor or other direct supplier of forgings, part number, and quantity. When forgings for making parts are produced or purchased by the parts vendor, that vendor shall inspect each lot of forgings to determine conformance to the requirements of this specification, and shall include in the report a statement that the forgings conform, or shall include copies of laboratory reports showing the results of tests to determine conformance.

4.6 Resampling and Retesting: If any specimen used in the above tests fails to meet the specified requirements, disposition of the forgings may be based on the results of testing two additional specimens for each original nonconforming specimen. Retest specimens shall be taken as close as possible to the same Ø location in the same forging or from a second forging from the same lot as was the original unacceptable specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the forgings represented and no additional testing shall be permitted. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Identification: Forgings shall be identified in accordance with AMS 2808.

5.2 Packaging:

5.2.1 Forgings shall be prepared for shipment in accordance with commercial practice and in compliance Ø with applicable rules and regulations pertaining to the handling, packaging, and transportation of the forgings to ensure carrier acceptance and safe delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

5.2.2 For direct U.S. Military procurement, packaging shall be in accordance with MIL-STD-649, Level A Ø or Level C, as specified in the request for procurement. Commercial packaging as in 5.2.1 will be acceptable if it meets the requirements of Level C.