AEROSPACE MATERIAL SPECIFICATION

AMS4320™	REV. C

Issued 1981-07
Revised 2005-09
Reaffirmed 2014-04
Stabilized 2022-09

Superseding AMS4320B

Aluminum Alloy Forgings
7.7Zn - 2.5Mg - 1.5Cu - 0.16Cr (7149-T73)
Solution and Precipitation Heat Treated
(Composition similar to UNS A97149)

RATIONALE

AMS4320C has been declared "STABILIZED" by AMS Committee D Nonferrous Alloys Committee. This document will no longer be updated and may no longer represent standard industry practice. This document was stabilized because Committee D can find no producers for this document.

NOTE: Previously, this document was reaffirmed. The last technical update of this document occurred in September, 2005. Users of this document should refer to the cognizant engineering organization for disposition of any issues with reports/certifications to the specification, including exceptions listed on the certification. In many cases, the purchaser may represent a sub-tier supplier and not the cognizant engineering organization.

STABILIZED NOTICE

AMS4320C has been declared “STABILIZED” by SAE AMS Committee D, Nonferrous Alloys Committee, and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/AMS4320C/

1. SCOPE:

1.1 Form:

This specification covers an aluminum alloy in the form of die forgings, hand forgings, and forging stock.

1.2 Application:

These forgings have been used typically for parts requiring high strength and resistance to stress-corrosion cracking, but usage is not limited to such applications.

2. APPLICABLE DOCUMENTS:

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or www.sae.org.

AMS 2355	Quality Assurance Sampling and Testing of Aluminum Alloys and Magnesium Alloys, Wrought Products (Except Forging Stock) and Flash Welded Rings
AMS 2772	Heat Treatment of aluminum Alloy Raw Materials
AMS 2808	Identification, Forgings
AMS-STD-1537	Electrical Conductivity Test for Verification of Heat Treatment of Aluminum Alloys, Eddy Current Method
AS1990	Aluminum Alloy Tempers

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959 or www.astm.org.

ASTM G 47	Determining Susceptibility to Stress-Corrosion Cracking of 2XXX and 7XXX High Strength Aluminum Alloy Products
ASTM B 594	Ultrasonic Inspection of Aluminum-Alloy Wrought Products for Aerospace Applications

2.3 ANSI Publications:

Available from ANSI, 25 West 43rd Street, 4th Floor, New York, NY 10036 or www.ansi.org.

ANSI H 35.2	Dimensional Tolerances for Aluminum Mill Products
ANSI H 35.2M	Dimensional Tolerances for Aluminum Mill Products (Metric)

3. TECHNICAL REQUIREMENTS:

3.1 Composition:

Shall conform to the percentages by weight, determined in accordance with AMS 2355.

TABLE 1 - Composition

Element	min	max
Silicon	--	0.15
Iron	--	0.20
Copper	1.2	1.9
Manganese	--	0.20
Magnesium	2.0	2.9
Chromium	0.10	0.22
Zinc	7.2	8.2
Titanium	--	0.10
Other Elements, each	--	0.05
Other Elements, total	--	0.15
Aluminum	remainder	

3.2 Condition:

The product shall be supplied in the following condition:

3.2.1 Die and Hand Forgings: Solution and precipitation heat treated in accordance with AMS 2772 and as noted in 3.3 to the T73 temper (See AS1990).

3.2.2 Forging Stock: Forging stock used to produce forgings to this specification shall be ingot or wrought stock in the -F tempers. Forging stock ordered to this specification is for manufacturing forgings defined in 3.2.1. Material shall comply with the requirements of Table 1.

3.3 Heat Treatment:

Shall be performed in accordance with AMS 2772 except as follows:

3.3.1 Solution Heat Treatment: Heat to 875 °F ± 10 (468 °C ± 6), hold at heat for not less than 60 minutes, and quench in water at 130 to 150 °F (54 to 66 °C).

3.3.2 Holding Period: Hold at room temperature for not less than 48 hours.

3.3.3 Precipitation Heat Treatment: Heat to 250 °F ± 10 (121 °C ± 6), hold at heat for 24 hours ± 1, increase temperature to 330 °F ± 5 (166 °C ± 3), hold at heat for 14 hours ± 0.5, and cool in air. For section thicknesses over 4 inches (102 mm), the second step may be reduced to 325 °F ± 5 (163 °C ± 3).

3.3.3.1 The practices for the second step of the precipitation heat treatment are recommendations; some adjustments may be necessary depending on furnace equipment, size of load, forging configuration, etc.

3.4 Properties:

The product shall conform to the following requirements, determined in accordance with AMS 2355:

3.4.1 Forgings:

3.4.1.1 Tensile Properties: Shall be as follows:

3.4.1.1.1 Separately Forged Test Specimens: Shall be as follows in Table 2, determined on specimens machined from separately-forged coupons representing the forgings and heat treated with the forgings or machined from prolongations on heat treated forgings:

TABLE 2 - Minimum Tensile Properties

Property	Value
Tensile Strength, minimum	72.0 ksi (496 MPa)
Yield Strength at 0.2% Offset	62.0 ksi (427 MPa)
Elongation in 4D	7%

3.4.1.1.2 Die Forgings:

3.4.1.1.2.1 With Grain Flow: Specimens, machined from forgings with axis of specimen in area of gage length varying not more than 15 degrees from parallel to forging flow lines, shall have the properties shown in Table 3.

TABLE 3A - Minimum Tensile Properties, Inch/Pound Units

Nominal Thickness at Time of Heat Treatment Inches	Tensile Strength ksi	Yield Strength At 0.2% Offset ksi	Elongation In 4D %
Up to 2, incl	72.0	62.0	7
Over 2 to 4, incl	71.0	61.0	7
Over 4 to 5, incl	70.0	60.0	7

TABLE 3B - Minimum Tensile Properties, SI Units

Nominal Thickness at Time of Heat Treatment Millimeters	Tensile Strength MPa	Yield Strength At 0.2% Offset MPa	Elongation In 4D %
Up to 51, incl	496	427	7
Over 51 to 102, incl	490	421	7
Over 102 to 127, incl	483	414	7

3.4.1.1.2.2 Across Grain Flow: Specimens, machined from forgings with axis of specimen in area of gage length varying not more than 15 degrees from transverse to forging flow lines, shall have the properties shown in Table 4.

TABLE 4A - Minimum Tensile Properties, Inch/Pound Units

Nominal Thickness at Time of Heat Treatment Inches	Tensile Strength ksi	Yield Strength At 0.2% Offset ksi	Elongation In 4D %
Up to 1, incl	71.0	61.0	3
Over 1 to 3, incl	70.0	60.0	3
Over 3 to 4, incl	70.0	60.0	2
Over 4 to 5, incl	68.0	58.0	2

TABLE 4B - Minimum Tensile Properties, SI Units

Nominal Thickness at Time of Heat Treatment Millimeters	Tensile Strength MPa	Yield Strength At 0.2% Offset MPa	Elongation In 4D %
Up to 25, incl	490	421	3
Over 25 to 76, incl	483	414	3
Over 76 to 102, incl	483	414	2
Over 102 to 127, incl	469	400	2

3.4.1.1.2.2.1 Elongation requirements do not apply to specimens having a gage-length diameter under 0.250 inch (6.35 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 0.125 inch (3.18 mm) of the trimmed flash line.

3.4.1.1.3 Hand Forgings: Specimens, machined from forgings having an essentially square or rectangular cross-section heat treated in the indicated thickness shall have the properties shown in Table 5 provided as-forged section thickness does not exceed 5 inches (127 mm).

TABLE 5A - Minimum Tensile Properties, Inch/Pound Units

Nominal Thickness at Time of Heat Treatment Inches	Specimen Orientation	Tensile Strength ksi	Yield Strength At 0.2% Offset ksi	Elongation In 4D %
2 to 3, incl	Longitudinal	71	61,000	9
	Long-Trans.	71	59,000	4
	Short-Trans.	69	58,000	3
Over 3 to 4, incl	Longitudinal	69	59,000	8
	Long-Trans.	69	57,000	3
	Short-Trans.	67	56,000	2
Over 4 to 5, incl	Longitudinal	67	56,000	7
	Long-Trans.	67	56,000	3
	Short-Trans.	66	55,000	2

TABLE 5B - Minimum Tensile Properties, SI Units

Nominal Thickness at Time of Heat Treatment Millimeters	Specimen Orientation	Tensile Strength MPa	Yield Strength At 0.2% Offset MPA	Elongation In 4D %
51 to 76, incl	Longitudinal	490	421	9
	Long-Trans.	490	407	4
	Short-Trans.	476	400	3
Over 76 to 102, incl	Longitudinal	476	407	8
	Long-Trans.	476	393	3
	Short-Trans.	462	386	2
Over 102 to 127, incl	Longitudinal	462	386	7
	Long-Trans.	462	386	3
	Short-Trans.	455	379	2

3.4.1.2 Stress-Corrosion Resistance: Specimens cut from forgings shall meet the electrical conductivity test of 3.4.1.2.1 and shall exhibit no evidence of stress-corrosion cracking when tested in accordance with 3.4.1.2.2. The test of 3.4.1.2.2 need not be performed on forgings meeting the requirements of 3.4.1.2.1.1 and 3.4.1.2.1.2.

3.4.1.2.1 Electrical Conductivity: Shall be as in 3.4.1.2.1.2, determined on the surface of the sample in accordance with ASTM B 342.

3.4.1.2.1.1 If the conductivity is 40.0% IACS (International Annealed Copper Standard) (23.2 MS/m) or higher and longitudinal tensile properties meet specified requirements, the forgings are acceptable.

3.4.1.2.1.2 If the conductivity is 38.0 to 39.9% IACS (22.0 to 23.1 MS/m), incl, if the longitudinal tensile properties meet specified requirements, and if the longitudinal yield strength does not exceed the specified minimum by more than 9.9 ksi (68 MPa), the forgings are acceptable.

3.4.1.2.1.3 If the conductivity is 38.0 to 39% IACS (22.0 to 23.1 MS/m), incl, and longitudinal yield strength exceeds the specified minimum value by more than 9.9 ksi (68 MPa), the forgings shall be given additional precipitation heat treatment. If, after such treatment, the forgings meet the requirements of 3.4.1.2.1 and 3.4.1.2.1.2 or 3.4.1.3.1.3, the forgings are acceptable.

3.4.1.2.1.4 If the conductivity is below 38.0% IACS (22.0 MS/m), the forgings are not acceptable but may be reheat treated as in 3.3 to meet the specified requirements.

3.4.1.2.2 Stress-Corrosion Cracking Resistance: Specimens cut from forgings 0.750 inch (19.05 mm) and over in nominal thickness shall show no evidence of stress-corrosion cracking in accordance with ASTM G 47 in the short-transverse direction to 75% of the specified minimum yield strength for the principal test direction (longitudinal for die forgings or long-transverse for hand forgings).

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

3.4.2 Forging Stock: When a sample of stock is forged to a test coupon having a degree of mechanical working not greater than the forging and heat treated in the same manner as forgings, specimens taken from the heat treated coupon shall conform to the requirements of 3.4.1.1.1 and 3.4.1.2. If a test specimen taken from the stock after heat treatment in the same manner as forgings conforms to the requirements of 3.4.1.1.1 and 3.4.1.2, the test shall be accepted as equivalent to tests of a forged coupon.

3.5 Quality:

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

3.5.1 Die forgings shall be subjected to a caustic etch followed by visual examination of the forging surfaces for conditions such as seams, laps, bursts, and quench cracks. Surface imperfections which can be removed so that they do not reappear on re-etching and the required section thickness can be maintained are acceptable.

3.5.2 When specified, each forging shall be subjected to ultrasonic inspection in accordance with ASTM B 594 and shall meet the following requirements of that specification

3.5.2.1 Die forgings 0.500 to 4.000 inches (12.70 to 101.50 mm), incl, in section thickness and weighing not over 300 pounds (136 kg) shall meet Class B.

3.5.2.2 Hand forgings 1.000 to 5.000 inches (24.40 to 127.00 mm) in section thickness and weighing not more than 600 pounds (272 kg) shall meet Class A.

3.5.3 When specified, forgings shall be subjected to fluorescent penetrant inspection in accordance with ASTM E 1417. Acceptance criteria shall be as agreed upon by purchaser and vendor.

3.6 Tolerances:

Forging stock shall conform to all applicable requirements of ANSI H 35.2 or ANSI H 35.2M.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The vendor of forgings shall supply all samples for vendor's tests and shall be responsible for the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the forgings conform to specified requirements.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Composition (3.1), tensile properties (3.4.1.1), stress-corrosion resistance (3.4.1.2.2), surface visual examination (3.5.1), ultrasonic soundness (3.5.2), and fluorescent penetrant inspection (3.5.3) when specified, are acceptance tests and, except for composition, shall be performed on each lot.

4.2.2 Periodic Tests: Forging stock to demonstrate ability to develop required properties (3.4.2) and stress-corrosion resistance (3.4.1.2.2) are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing:

Shall be in accordance with AMS 2355.