AEROSPACE MATERIAL SPECIFICATION

AMS4131™	REV. F

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Superseding AMS4131E

Aluminum Alloy, Die and Hand Forgings, 5.6Zn - 2.5Mg - 1.6Cu - 0.23Cr (7075-T74), Solution Heat Treated and Aged

(Composition similar to UNS A97075)

RATIONALE

AMS4131F results from a Five-Year Review and update of this specification with changes to update wording to prohibit unauthorized exceptions (see 3.3.1.4 and 8.5), relocate Definitions (see 2.4), and update Applicable Documents (see Section 2), Hardness Note (see 8.2.1), and Ordering Information (see 8.6).

1. SCOPE

1.1 Form

This specification covers an aluminum alloy in the form of die forgings and hand forgings up to 6.000 inches (152.40 mm) in nominal thickness at the time of heat treatment (see 8.6).

1.2 Application

These forgings have been used typically for parts requiring a combination of good 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 International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS2355 Quality Assurance, Sampling and Testing, Aluminum Alloys and Magnesium Alloy, Wrought Products (Except Forging Stock), and Rolled, Forged, or Flash Welded Rings

AMS2772 Heat Treatment of Aluminum Alloy Raw Materials

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/AMS4131F/

AMS2808 Identification, Forgings

AS7766 Terms Used in Aerospace Metals Specifications

2.2 ANSI Accredited Publications

Copies of these documents are available online at https://webstore.ansi.org/.

ANSI H35.1/H35.1M Standard Alloy and Temper Designation System for Aluminum

2.3 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B594 Ultrasonic Inspection of Aluminum-Alloy Wrought Products

ASTM B660 Packaging/Packing of Aluminum and Magnesium Products

ASTM E10 Brinell Hardness of Metallic Materials

ASTM E1417/E1417M Liquid Penetrant Testing

ASTM G47 Determining Susceptibility to Stress-Corrosion Cracking of 2XXX and 7XXX Aluminum Alloy Products

2.4 Definitions

Terms used in AMS are defined in AS7766.

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1, determined in accordance with AMS2355.

Table 1 - Composition

Element	Min	Max
Iron	--	0.50
Copper	1.2	2.0
Manganese	--	0.30
Magnesium	2.1	2.9
Chromium	0.18	0.28
Zinc	5.1	6.1
Titanium	--	0.20
Silicon	--	0.40
Other Impurities, each	--	0.05
Other Impurities, total	--	0.15
Aluminum	remainder	

3.2 Condition

Solution heat treated and aged in accordance with AMS2772 to the T74 temper (refer to ANSI H35.1/H35.1M).

3.3 Properties

Forgings shall conform to the following requirements, determined in accordance with AMS2355:

3.3.1 Tensile Properties

Shall be as follows:

3.3.1.1 Die Forgings

3.3.1.1.1 With Grain Flow

Specimens, machined from forgings 6.000 inches and under in nominal thickness at time of heat treatment or from prolongations on such forgings with axis of specimen in area of gauge length varying not more than 15 degrees from parallel to forging flow lines, shall have the properties shown in Table 2 provided the as-forged thickness was not more than twice the heat-treated thickness.

Table 2A - 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 3.000, incl	76.0	66.0	7
Over 3.000 to 4.000, incl	73.0	63.0	7
Over 4.000 to 5.000, incl	70.0	61.0	7
Over 5.000 to 6.000, incl	68.0	58.0	7

Table 2B - 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 76.20, incl	524	455	7
Over 76.20 to 101.60, incl	503	434	7
Over 101.60 to 127.00, incl	483	421	7
Over 127.00 to 152.40, incl	469	400	7

3.3.1.1.2 Across Grain Flow

Specimens, machined from forgings 6.000 inches and under in nominal thickness at time of heat treatment or from prolongations on such forgings with axis of specimen in area of gauge length varying not more than 15 degrees from perpendicular to forging flow lines, shall have the properties shown in Table 3 provided the as-forged thickness was not more than twice the heat-treated thickness. If configuration of the forging or prolongation cannot accommodate the transverse specimen described, acceptance of the forgings shall be based on testing as in 3.3.1.1.3.

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 3.000, incl	71.0	62.0	4
Over 3.000 to 4.000, incl	70.0	60.0	4
Over 4.000 to 5.000, incl	68.0	58.0	4
Over 5.000 to 6.000, incl	65.0	55.0	4

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 76.20, incl	490	427	4
Over 76.20 to 101.60, incl	483	414	4
Over 101.60 to 127.00, incl	469	400	4
Over 127.00 to 152.40, incl	448	379	4

3.3.1.1.2.1 Elongation requirements shall not apply to specimens having a gauge length diameter less than 0.250 inch or located in immediate proximity to an abrupt change in thickness or located so that any part of the specimen gauge length is located within 1/8 inch of the trimmed flash line.

3.3.1.1.3 At Angle to Flow Lines

Specimens, machined from forgings 6.000 inches and under in nominal thickness at time of heat treatment or from prolongations on such forgings with axis of specimen in area of gauge length varying more than 15 degrees from parallel and also more than 15 degrees from perpendicular to forging flow lines, shall have the properties shown in Table 3. Such test results shall be identified as neither longitudinal nor transverse tensile results.

3.3.1.2 Hand Forgings

Specimens, machined from forgings having an essentially square or rectangular cross section, shall have the properties shown in Table 4 provided the as-forged thickness does not exceed 6.000 inches.

Table 4A - 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 %
Up to 2.000, incl	Longitudinal	73.0	63.0	9
	Long-Trans.	71.0	60.0	5
Over 2.000 to 3.000, incl	Longitudinal	73.0	63.0	9
	Long-Trans.	71.0	60.0	5
	Short-Trans.	69.0	60.0	4
Over 3.000 to 4.000, incl	Longitudinal	71.0	61.0	9
	Long-Trans.	70.0	58.0	5
	Short-Trans.	68.0	57.0	4
Over 4.000 to 5.000, incl	Longitudinal	68.0	57.0	8
	Long-Trans.	67.0	56.0	5
	Short-Trans.	66.0	55.0	4
Over 5.000 to 6.000, incl	Longitudinal	65.0	54.0	8
	Long-Trans.	64.0	52.0	5
	Short-Trans.	63.0	52.0	4

Table 4B - 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 %
Up to 50.80, incl	Longitudinal	503	434	9
	Long-Trans.	490	414	5
Over 50.80 to 76.20, incl	Longitudinal	503	434	9
	Long-Trans.	490	414	5
	Short-Trans.	476	414	4
Over 76.20 to 101.60, incl	Longitudinal	490	421	9
	Long-Trans.	483	400	5
	Short-Trans.	469	393	4
Over 101.60 to 127.00, incl	Longitudinal	469	393	8
	Long-Trans.	462	386	5
	Short-Trans.	455	379	4
Over 127.00 to 152.40, incl	Longitudinal	448	372	8
	Long-Trans.	441	359	5
	Short-Trans.	434	359	4

3.3.1.3 Special Purpose Forgings

Tensile property requirements for specimens cut from special purpose forgings shall be as specified on the drawing or as agreed upon by the purchaser and producer (see 8.6).

3.3.1.4 Mechanical property requirements for product outside of the range covered by 1.1 shall be agreed upon between the purchaser and producer and reported per 4.4.1 (see 8.6).

3.3.2 Conductivity

Shall be as follows, determined in accordance with AMS2355:

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

3.3.2.2 If the conductivity is 38.0 to 39.9% IACS (22.0 to 23.1 MS/m), inclusive, and if tensile properties meet specified requirements, and if the tensile yield strength in the long-transverse direction does not exceed the specified minimum by more than 11.9 ksi (82 MPa), forgings are acceptable.

3.3.2.3 If the conductivity is below 40.0% IACS (23.2 MS/m) and the tensile yield strength in the long-transverse direction exceeds the specified minimum value by more than 11.9 ksi (82 MPa), the forgings shall be given additional aging heat treatment. If, after such treatment, forgings meet the requirements of 3.3.1 and 3.3.2.1 or 3.3.2.2, the forgings are acceptable.

3.3.2.4 If the conductivity is below 38.0% IACS (22.0 MS/m), the forgings are not acceptable and shall be reprocessed regardless of tensile property level.

3.3.3 Stress-Corrosion Resistance

Specimens cut from forgings, tested in accordance with ASTM G47, shall show no evidence of stress-corrosion cracking when stressed in the short-transverse direction (perpendicular to grain flow) to 35.0 ksi (241 MPa) for forgings 0.750 to 3.000 inches (19.05 to 76.00 mm) and under in nominal thickness and to 50% of the longitudinal (parallel to grain flow) yield strength for forgings over 3.000 inches (76.00 mm) in nominal thickness.

3.3.4 Grain flow of die forgings, except in areas that contain flash-line end grain, shall follow the general contour of the forgings showing no evidence of reentrant grain flow.

3.4 Quality

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

3.4.1 All forgings shall be subjected to ultrasonic inspection in accordance with ASTM B594 and shall meet the following ultrasonic classes:

3.4.1.1 Die forgings 0.50 to 4.00 inches (12.7 to 101.6 mm), inclusive, in nominal thickness: Class B

3.4.1.2 Hand forgings 1.00 to 6.00 inches (25.4 to 152.4 mm), inclusive, in nominal thickness: Class A

3.4.1.3 Acceptance criteria for forgings exceeding the limits of 3.4.1.1 or 3.4.1.2 shall be as agreed upon by the purchaser and producer (see 8.6).

3.4.2 Die forgings shall be etched to produce a surface suitable for visual examination of the forging surfaces for defect indications such as seams, laps, bursts, and quench cracks. Surface imperfections that can be removed, do not reappear on re-etching, and do not reduce required section thickness are acceptable.

3.4.3 All forgings shall be subjected to fluorescent penetrant inspection in accordance with ASTM E1417/E1417M. Acceptance standards shall be as agreed upon by the purchaser and producer (see 8.6).

3.5 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.1.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of forgings shall supply all samples for the producer's tests and shall be responsible for the performance of all required tests. The 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 (see 3.1), tensile properties (see 3.3.1), conductivity (see 3.3.2), ultrasonic inspection (see 3.4.1), surface visual examination (see 3.4.2), and fluorescent penetrant inspection (see 3.4.3) are acceptance tests and, except for composition, shall be performed on each inspection lot.

4.2.2 Periodic Tests

Stress-corrosion resistance (see 3.3.3) and grain flow of die forgings (see 3.3.4) are periodic tests and shall be performed at a frequency selected by the producer unless frequency of testing is specified by the purchaser.

4.3 Sampling and Testing

Shall be in accordance with AMS2355 and the following:

4.3.1 Ultrasonic inspection (see 3.4.1) and fluorescent penetrant inspection (see 3.4.3) of all forgings and surface imperfections (see 3.4.2) of die forgings.