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400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

SAE

AMS 4165F

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Superseding AMS 4165E

ALUMINUM ALLOY EXTRUSIONS 4.4Cu - 1.5Mg - 0.60Mn (2024-T3511) Stress-Relieved Stretched and Straightened

UNS A92024

1. SCOPE:

1.1 Form:

This specification covers an aluminum alloy in the form of extruded bars, rods, wire, shapes, and tubing.

1.2 Application:

These extrusions have been used typically for parts subject to excessive warpage during machining due to residual stresses, and for parts requiring high strength and whose fabrication does not normally involve welding, but usage is not limited to such applications.

- 1.2.1 Certain processing procedures may cause these extrusions to become susceptible to stress corrosion cracking; ARP823 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 SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

- AMS 2205 Tolerances, Aluminum Alloy and Magnesium Alloy Extrusions
- MAM 2205 Tolerances, Metric, Aluminum Alloy and Magnesium Alloy Extrusions
- AMS 2355 Quality Assurance Sampling and Testing of Aluminum Alloys and Magnesium Alloys, Wrought Products (Except Forging Stock) and Flash Welded Rings
- MAM 2355 Quality Assurance Sampling and Testing of Aluminum Alloys and Magnesium Alloys, Wrought Products (Except Forging Stock) and Flash Welded Rings, Metric (SI) Units

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2.1 SAE Publications (Continued):

AMS 2811 Identification, Aluminum and Magnesium Alloy Wrought Products
 ARP823 Minimizing Stress-Corrosion Cracking in Wrought Heat-Treatable
 Aluminum Alloy Products

2.2 ASTM Publications:

Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM B 594 Ultrasonic Inspection of Aluminum-Alloy Products for Aerospace
 Applications

ASTM B 660 Packaging/Packing of Aluminum and Magnesium Products

2.3 U.S. Government Publications:

Available from Standardization Documents Order Desk, Building 4D, 700 Robbins
 Avenue, Philadelphia, PA 19111-5094.

MIL-H-6088 Heat Treatment of Aluminum Alloys

3. TECHNICAL REQUIREMENTS:

3.1 Composition:
(R)

Shall conform to the percentages by weight shown in Table 1, determined in
 accordance with AMS 2355 or MAM 2355.

TABLE 1 - Composition

Element	min	max
Copper	3.8	4.9
Magnesium	1.2	1.8
Manganese	0.30	0.9
Iron	--	0.50
Silicon	--	0.50
Zinc	--	0.25
Titanium	--	0.15
Chromium	--	0.10
Other Impurities, each	--	0.05
Other Impurities, total	--	0.15
Aluminum	remainder	

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3.2 Condition:

Solution heat treated in accordance with MIL-H-6088 and stress relieved by stretching to produce a nominal permanent set of 1-1/2%, but not less than 1% nor more than 3%.

3.2.1 Extrusions may receive minor straightening, after stretching, of an amount necessary to meet the requirements of 3.5.

3.2.2 Extrusions shall be supplied with an as-extruded surface finish; light polishing to remove minor surface imperfections is permissible provided such imperfections can be removed within the dimensional tolerances.

3.3 Properties:

Extrusions shall conform to the following requirements, determined in accordance with AMS 2355 or MAM 2355:

3.3.1 Longitudinal Tensile Properties: Shall be as specified in Table 1, Table 2, and 3.3.1.3.

3.3.1.1 Bars, Rods, Wire, and Shapes:

TABLE 1A - Minimum Tensile Properties, Inch/Pound Units

Nominal Diameter or Thickness Inches	Nominal Cross Sectional Area Square Inches	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 Inches or 4D, %
Up to 0.249, incl	All	57.0	42.0	12
Over 0.249 to 0.749, incl	All	60.0	44.0	12
Over 0.749 to 1.499, incl	All	65.0	46.0	10
Over 1.499	Up to 25, incl	70.0	52.0	10
Over 1.499	Over 25 to 32, incl	68.0	48.0	8

TABLE 1B - Minimum Tensile Properties, SI Units

Nominal Diameter or Thickness Millimeters	Nominal Cross Sectional Area Square Centimeters	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50.8 mm or 4D, %
Up to 6.32, incl	All	393	290	12
Over 6.32 to 19.02, incl	All	414	303	12
Over 19.02 to 38.07, incl	All	448	317	10
Over 38.07	Up to 161, incl	483	359	10
Over 38.07	Over 161 to 206, incl	469	331	8

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3.3.1.2 Round Tubing:

TABLE 2A - Minimum Tensile Properties, Inch/Pound Units

Nominal Wall Thickness Inches	Nominal Wall Area Square Inches	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 Inches or 4D, %
Up to 0.249, incl	All	57.0	42.0	10
Over 0.249 to 0.749, incl	All	60.0	44.0	10
Over 0.749 to 1.499, incl	All	65.0	46.0	10
Over 1.499	Up to 25, incl	70.0	48.0	10
Over 1.499	Over 25 to 32, incl	68.0	46.0	8

TABLE 2B - Minimum Tensile Properties, SI Units

Nominal Wall Thickness Millimeters	Nominal Wall Area Square Centimeters	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50.8 mm or 4D, %
Up to 6.32, incl	All	393	290	10
Over 6.32 to 19.02, incl	All	414	303	10
Over 19.02 to 38.07, incl	All	448	317	10
Over 38.07	Up to 161, incl	483	331	10
Over 38.07	Over 161 to 206, incl	469	317	8

3.3.1.3 Tensile property requirements for sizes over 1.499 inches (38.07 mm) in nominal diameter or distance between parallel sides or in nominal wall thickness or over 32 square inches (206 cm²) in nominal cross sectional area shall be as agreed upon by purchaser and vendor.

3.3.2 Hardness: Should be not lower than 100 HB/10/500 or 106 HB/10/1000, but the (R) extrusions shall not be rejected on the basis of hardness if the tensile property requirements are met.

3.4 Quality:

Extrusions, 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 extrusions.