

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

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Superseding AMS 4079D

ALUMINUM ALLOY, DRAWN, ROUND, SEAMLESS, TUBING 1.0Mg - 0.60Si - 0.28Cu - 0.20Cr (6061-0) Close Tolerance, Annealed

UNS A96061

1. SCOPE:

1.1 Form:

This specification covers an aluminum alloy in the form of drawn, round, seamless tubing.

1.2 Application:

This tubing has been used typically for ducts requiring small radius bends and moderate strength after solution and precipitation heat treatment, but usage is not limited to such applications.

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 2355 Quality Assurance Sampling and Testing, Aluminum Alloys and Magnesium Alloys, Wrought Products, Except Forging Stock, and Rolled, Forged, or Flash Welded Rings
- MAM 2355 Quality Assurance Sampling and Testing, Aluminum Alloys and Magnesium Alloys, Wrought Products, Except Forging Stock, and Rolled, Forged, or Flash Welded Rings, Metric (SI) Units
- AMS 2770 Heat Treatment of Aluminum and Aluminum Alloys
- AMS 2811 Identification, Aluminum and Magnesium Alloy Wrought Products

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2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM B 660 Packaging/Packing of Aluminum and Magnesium Products

2.3 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-H-6088 Heat Treatment of Aluminum Alloys

2.4 ANSI Publications:

Available from American National Standards Institute, Inc., 11 West 42nd Street, New York, NY 10036-8002.

ANSI H35.2 Dimensional Tolerances for Aluminum Mill Products

ANSI H35.2M Dimensional Tolerances for Aluminum Mill Products (Metric)

3. TECHNICAL REQUIREMENTS:

3.1 Composition:

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
Magnesium	0.8	1.2
Silicon	0.4	0.8
Copper	0.15	0.40
Chromium	0.04	0.35
Iron	--	0.7
Zinc	--	0.25
Manganese	--	0.15
Titanium	--	0.15
Other Impurities, each	--	0.05
Other Impurities, total	--	0.15
Aluminum	remainder	

3.2 Condition:

Annealed in accordance with MIL-H-6088, and drawn, if required, to meet dimensional tolerances of 3.5.

3.3 Properties:

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

3.3.1 As Annealed:

- 3.3.1.1 Tensile Properties: Shall be as shown in Table 2 for tubing having nominal wall thickness of 0.018 to 0.500 inch (0.46 to 12.70 mm), inclusive.

TABLE 2 - Tensile Properties

Property	Value
Tensile Strength, max	22.0 ksi (152 MPa)
Yield Strength at 0.2% Offset, max	14.0 ksi (97 MPa)
Elongation in 2 inches (50.8 mm) or 4D, min	
Strip	15%
Full Section	15%

- 3.3.1.2 Flattening: Tubing, having nominal wall thickness less than 10% of the nominal OD, shall withstand, without cracking, flattening sideways under a load applied gradually at room temperature until the outside dimension under load is equal to the flattening factor shown in Table 3 times the nominal wall thickness.

TABLE 3 - Flattening Factor

Nominal Wall Thickness Inch	Nominal Wall Thickness Millimeters	Factor
Up to 0.120, incl	Up to 3.05, incl	3
Over 0.120 to 0.238, incl	Over 3.05 to 6.05, incl	4
Over 0.238 to 0.500, incl	Over 6.05 to 12.70, incl	6

- 3.3.1.2.1 If tubing does not pass the flattening test of 3.3.1.2, a section of tube not less than 1/2 inch (12.7 mm) in length and including one-third to one-half the circumference of the tube shall withstand, without cracking, bending at room temperature through an angle of 180 degrees around a diameter equal to the bend factor shown in Table 4 times the nominal wall thickness of the tubing with axis of bend parallel to axis of tube and with inside of tube on inside of bend.

TABLE 4 - Bending Parameters

Nominal Wall Thickness Inch	Nominal Wall Thickness Millimeters	Factor
Up to 0.120, incl	Up to 3.05, incl	1
Over 0.120 to 0.238, incl	Over 3.05 to 6.05, incl	2
Over 0.238 to 0.500, incl	Over 6.05 to 12.70, incl	4

3.3.2 After Solution and Precipitation Heat Treatment: Tubing shall have the properties shown in Table 5 after being solution and precipitation heat treated in accordance with AMS 2770 to the -T62 temper.

3.3.2.1 Tensile Properties: Shall be as specified in Table 5.

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

Nominal Wall Thickness Inch	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 inches or 4D % Strip	Elongation in 2 inches or 4D % Full Section
0.025 to 0.049, incl	42.0	35.0	8	10
Over 0.049 to 0.259, incl	42.0	35.0	10	12
Over 0.259 to 0.500, incl	42.0	35.0	12	14

TABLE 5B - Minimum Tensile Properties, SI Units

Nominal Wall Thickness Millimeters	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50.8 mm or 4D % Strip	Elongation in 50.8 mm or 4D % Full Section
0.64 to 1.24, incl	290	241	8	10
Over 1.24 to 6.58, incl	290	241	10	12
Over 6.58 to 12.70, incl	290	241	12	14

3.3.2.2 Hardness shall be not lower than 85 HRE but tubing shall not be rejected on the basis of (R) hardness provided the specimen on which hardness was measured meets the tensile properties of 3.3.2.1.

3.4 Quality:

Tubing, 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 tubing.

3.4.1 Detrimental imperfections include, but are not limited to, cracks, splits, seams, inclusions, or severe cross-hatching (surface breaks) that cannot be removed by lightly hand-sanding using 180 grit or finer sandpaper.

3.5 Tolerances:

(R)

Except as specified in 3.5.1 for mean diameter and 3.5.2 for wall thickness, tolerances shall conform to all applicable requirements of ANSI H35.2 or ANSI H.35.2M.

3.5.1 Mean Diameter: Shall be as shown in Table 6.

TABLE 6A - Tolerances, Mean Diameter, Inch/Pound Units

Nominal OD Inches		Tolerance, Inch Plus and Minus
	0.500 to 1.000, incl	0.002
Over	1.000 to 3.000, incl	0.003
Over	3.000 to 5.000, incl	0.004
Over	5.000 to 6.000, incl	0.005
Over	6.000 to 8.000, incl	0.008
Over	8.000 to 10.000, incl	0.010
Over	10.000 to 12.000, incl	0.013

TABLE 6B - Tolerances, Mean Diameter, SI Units

Nominal OD Millimeters		Tolerance, Millimeters Plus and Minus
	12.70 to 25.40, incl	0.05
Over	25.40 to 76.20, incl	0.08
Over	76.20 to 127.00, incl	0.10
Over	127.00 to 152.40, incl	0.13
Over	152.40 to 203.20, incl	0.20
Over	203.20 to 254.00, incl	0.25
Over	254.00 to 304.80, incl	0.33

3.5.1.1 Mean diameter is the average of two measurements taken at right angles to each other at the same longitudinal location on the tube.

3.5.2 Wall Thickness: $\pm 7\%$ or ± 0.002 inch (± 0.05 mm), whichever is greater, for wall thicknesses under 0.035 inch (0.89 mm); $\pm 7\%$ or ± 0.003 inch (± 0.08 mm), whichever is greater, for wall thicknesses of 0.035 inch (0.89 mm) and over.