Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 4079C
Superseding AMS 4079B
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UNS A96061

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

1. SCOPE:

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

1.2 Application: Primarily for ducts requiring small radius bends and moderate strength after solution and precipitation heat treatment.

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) 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 2203 - Tolerances, Aluminum Alloy Drawn Tubing
AMS 2350 - Standards and Test Methods
AMS 2355 - Quality Assurance Sampling and Testing of Aluminum-Base and Magnesium-Base Alloys, Wrought Products (Except Forgings and Forging Stock) and Flash Welded Rings
AMS 2770 - Heat Treatment of Aluminum and Aluminum Alloys

2.2 Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.2.1 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 in accordance with AMS 2355:

	min	max
Magnesium	0.8	1.2
Silicon	0.40	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, then 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:

3.3.1 As Annealed:

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

Tensile Strength, max	22,000 psi (152 MPa)
Yield Strength at 0.2% Offset, max	14,000 psi (96.5 MPa)
Elongation in 2 in. (50 mm) or 4D, min	
Strip	15%
Full Section	15%

3.3.1.1.1 Tensile property requirements for tubing having nominal wall thickness under 0.018 in. (0.46 mm) or over 0.500 in. (12.70 mm) shall be as agreed upon by purchaser and vendor.

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 times the nominal wall thickness.

Nominal Wall Thickness		Flattening
Inch	Millimetres	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 in. (13 mm) in length and embracing one-third to one-half the circumference of the tube shall withstand, without cracking, bending at room temperature through an angle of 180 deg around a diameter equal to the bend factor 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.

Nominal Wall Thickness		Bend
Inch	Millimetres	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 following properties ø after being solution and precipitation heat treated in accordance with AMS 2770:

3.3.2.1 Tensile Properties: Shall be as specified in Table I and 3.3.2.1.1.

TABLE I

Nominal Wall Thickness Inch	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation in 2 in. or 4D %, min	
			Strip	Full Section
0.025 to 0.049, incl	42,000	35,000	8	10
Over 0.049 to 0.259, incl	42,000	35,000	10	12
Over 0.259 to 0.500, incl	42,000	35,000	12	14

TABLE I (SI)

Nominal Wall Thickness Millimetres	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 50 mm or 4D %, min	
			Strip	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

3.3.2.1.1 Tensile property requirements for tubing having nominal wall thickness under 0.025 in. (0.64 mm) or over 0.500 in. (12.70 mm) shall be as agreed upon by purchaser and vendor.

3.3.2.2 Hardness: Should be not lower than 50 HRB or equivalent but tubing shall not be rejected on the basis of hardness if the tensile property requirements of 3.3.2.1 are met.

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

3.4.1 Detrimental imperfections include, but are not limited to, any 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: 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 AMS 2203.

3.5.1 Mean Diameter:

TABLE II

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 II (SI)

Nominal OD Millimetres	Tolerance, Millimetre 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: ±7% or ±0.002 in. (±0.05 mm), whichever is greater, for wall thicknesses under 0.035 in. (0.89 mm); ±7% or ±0.003 in. (±0.08 mm), whichever is greater, for wall thicknesses of 0.035 in. (0.89 mm) and over.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of tubing shall supply all samples and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.4. Purchaser reserves the right to perform such confirmatory testing as he deems necessary to ensure that the tubing conforms 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 properties (3.3.1.1 and 3.3.2.1), hardness (3.3.2.2), quality (3.4), and tolerances (3.5) are classified as acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for flattening (3.3.1.2) are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by the purchaser.

4.3 Sampling: Shall be in accordance with AMS 2355 and as specified herein.

4.4 Reports:

4.4.1 The vendor of tubing shall furnish with each shipment three copies of a report stating that the tubing conforms to the chemical composition and other technical requirements of this specification. This report shall include the purchase order number, material specification number and its revision letter, size, and quantity.

4.4.2 The vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, material specification number and its revision letter, contractor or other direct supplier of tubing, part number, and quantity. When tubing for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of tubing to determine conformance to the requirements of this specification, and shall include in the report a statement that the tubing conforms, or shall include copies of laboratory reports showing the results of tests to determine conformance.