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

AEROSPACE MATERIAL SPECIFICATION

AMS 4087E
Superseding AMS 4087D

Issued 11-1-45
Revised 10-16-78

UNS A92024

ALUMINUM ALLOY TUBING, SEAMLESS, DRAWN
4.4Cu - 1.5Mg - 0.60Mn (2024-0)

SAENORM.COM : Click to view the full PDF of ams4087e

1. SCOPE:

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

1.2 Application: Primarily for parts and assemblies such as brackets where high-strength, non-weldable material is required. Parts are usually solution heat treated and aged before use.

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
Copper	3.8	4.9
Magnesium	1.2	1.8
Manganese	0.30	0.9
Iron	--	0.50
ø Silicon	--	0.50
Zinc	--	0.25
Zirconium plus Titanium	--	0.20
Titanium	--	0.15
Chromium	--	0.10
Other Impurities, each	--	0.05
Other Impurities, total	--	0.15
Aluminum	remainder	

SAE Technical Board rules provide that: "All technical reports, including standards approved and practices recommended, are advisory only. Their use by anyone engaged in industry or trade or their use by governmental agencies is entirely voluntary. There is no agreement to adhere to any SAE standard or recommended practice, and no commitment to conform to or be guided by any technical report. In formulating and approving technical reports, the Board and its Committees will not investigate or consider patents which may apply to the subject matter. Prospective users of the report are responsible for protecting themselves against liability for infringement of patents."

Copyright 1978 by Society of Automotive Engineers, Inc.
All rights reserved.

Printed in U.S.A.

3.2 Condition: Annealed.

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	32,000 psi (221 MPa)
Yield Strength at 0.2% Offset, max	15,000 psi (103 MPa)

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		
Inch	(Millimetres)	Flattening Factor
Up to 0.049, incl	(Up to 1.24, incl)	3
Over 0.049	(Over 1.24)	4

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 1/3 to 1/2 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		
Inch	(Millimetres)	Bend Factor
Up to 0.049, incl	(Up to 1.24, incl)	1
Over 0.049	(Over 1.24)	2

3.3.1.3 Flarability: Tubing with nominal OD of 0.375 in. (9.52 mm) and under shall withstand double-flaring and tubing with nominal OD over 0.375 in. (9.52 mm) shall withstand single-flaring without formation of cracks or other visible defects by being forced axially, at room temperature, with steady pressure over a hardened and polished tapered steel pin having a 74-deg included angle to produce a flare having a permanent expanded OD not less than specified in Table I.

TABLE I

Nominal OD Inches	Expanded OD Inches	Nominal OD Inches	Expanded OD Inches
0.125	0.224	0.750	0.937
0.188	0.302	1.000	1.187
0.250	0.359	1.250	1.500
0.312	0.421	1.500	1.721
0.375	0.484	1.750	2.106
0.500	0.656	2.000	2.356
0.625	0.781	2.500	2.856
		3.000	3.356

SAENORM.COM : Click to view the full PDF of ams4087e

TABLE I (SI)

Nominal OD Millimetres	Expanded OD Millimetres	Nominal OD Millimetres	Expanded OD Millimetres
3.18	5.69	19.05	23.80
4.78	7.67	25.40	30.15
6.35	9.12	31.75	38.10
7.92	10.69	38.10	43.71
9.52	12.29	44.45	53.49
12.70	16.66	50.80	59.84
15.88	19.84	63.50	72.54
		76.20	85.24

3.3.1.3.1 Tubing with nominal OD between any two standard sizes shown in 3.3.1.3 shall take the same percentage flare as shown for the larger of the two sizes.

3.3.1.3.2 Flarability requirements for tubing having nominal OD less than 0.125 in. (3.18 mm) or greater greater than 3.000 in. (76.20 mm) shall be as agreed upon by purchaser and vendor.

3.3.2 After Solution Heat Treatment and Aging: Tubing as received by purchaser shall, after solution heat ø treatment in accordance with AMS 2770 and aging for not less than 4 days at room temperature, have the following properties:

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

TABLE II

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
0.018 to 0.024, incl	64,000	40,000	--	10
Over 0.024 to 0.049, incl	64,000	40,000	10	12
Over 0.049 to 0.259, incl	64,000	40,000	10	14
Over 0.259 to 0.500, incl	64,000	40,000	12	16

TABLE II (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
0.46 to 0.61	441	276	--	10
Over 0.61 to 1.24	441	276	10	12
Over 1.24 to 6.58	441	276	10	14
Over 6.58 to 12.70	441	276	12	16

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

SAENORM.COM : Click to view the full PDF of ams4087e

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, cracks, splits, seams, inclusions, or severe crosshatching (surface breaks) that cannot be removed by lightly hand-sanding, using 180 grit or finer sandpaper.

3.5 Tolerances: Unless otherwise specified, tolerances shall conform to all applicable requirements of AMS 2203.

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 as annealed (3.3.1.1) and after solution heat treatment and aging (3.3.2.1), quality (3.4), and tolerances (3.5) are classified as acceptance tests and shall be performed on each lot of tubing.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for flattening (3.3.1.2) and flarability (3.3.1.3) are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.3 Sampling: Shall be in accordance with AMS 2355 and the following:

4.3.1 Specimens for flarability test shall be full tubes or sections cut from tubes. The end of the specimen to be flared shall be cut square, with the cut end smooth and free from burrs, but, except for sizes 0.375 in. (9.52 mm) and under, not rounded.

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.

4.5 Resampling and Retesting: Shall be in accordance with AMS 2355.

SAENORM.COM : Click to view the full PDF of ams4087e