



# AEROSPACE MATERIAL SPECIFICATION

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

## AMS 4088G

Superseding AMS 4088F

Issued 1-1-42  
Revised 10-16-78

UNS A92024

ALUMINUM ALLOY TUBING, SEAMLESS, DRAWN  
4.4Cu - 1.5Mg - 0.60Mn (2024-T3)

### 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 a high-strength, non-weldable material is required.

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

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

#### 2.2.1 Military Specifications:

MIL-H-6088 - Heat Treatment of Aluminum Alloys

#### 2.2.2 Military Standards:

MIL-STD-649 - Aluminum and Magnesium Products, Preparation for Shipment and Storage

SAE Technical Board rules provide that: "All technical reports, including standards approved and published by SAE, are advisory only. Their use by anyone engaged in industry or trade or the 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."

### 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
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	

Ø 3.2 Condition: Solution heat treated in accordance with MIL-H-6088 and cold worked.

Ø 3.3 Properties: The product shall conform to the following requirements, determined in accordance with AMS 2355:

3.3.1 Tensile Properties: Shall be as specified in Table I and 3.3.1.1.

**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
0.018 to 0.024, incl	64,000	42,000	--	10
Over 0.024 to 0.049, incl	64,000	42,000	10	12
Over 0.049 to 0.259, incl	64,000	42,000	10	14
Over 0.259 to 0.500, incl	64,000	42,000	12	16

**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
0.46 to 0.61, incl	441	290	--	10
Over 0.61 to 1.24, incl	441	290	10	12
Over 1.24 to 6.58, incl	441	290	10	14
Over 6.58 to 12.70, incl	441	290	12	16

- 3.3.1.1 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.
- 3.3.2 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 8 times the nominal wall thickness.
  - 3.3.2.1 If tubing does not pass the flattening test of 3.3.2, 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 6 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.
- 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 (3.3.1), 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 (3.3.2) 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.
- 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.

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

5. PREPARATION FOR DELIVERY:

5.1 Identification: Tubing shall be identified as follows:

5.1.1 Straight Tubes 0.029 In. (0.74 mm) and Over in Nominal Wall Thicknesses and 0.500 In. (12.70 mm) and Over in Nominal OD, Minor Axis, or Least Width of Flat Surface: Shall be marked in a row of characters recurring at intervals not greater than 3 ft (914 mm) with the alloy number and temper, AMS 4088 or applicable Federal or Military specification designation, and manufacturer's identification. The characters shall be of such size as to be clearly legible, shall be applied using a suitable marking fluid, and shall be sufficiently stable to withstand normal handling. The markings shall have no deleterious effect on the tubing or its performance.

5.1.2 Straight Tubes Under 0.029 In. (0.74 mm) in Nominal Wall Thickness or Under 0.500 In. (12.70 mm) in Nominal OD, Minor Axis, or Least Width of Flat Surface: Shall be securely bundled, boxed, or secured on lifts and identified by two durable tags marked with the information of 5.1.1 and attached, not farther than 2 ft (610 mm) from each end, to the tubes in each bundle, box, or lift.

5.1.3 Coiled Tubing: Shall be securely bundled and identified with the information of 5.1.1 by a durable tag attached to each coil or on the tape used to bind the coil.

5.2 Protective Treatment: Tubing shall be oiled, prior to shipment, with a light corrosion-inhibiting oil.

5.3 Packaging:

5.3.1 Tubing shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the tubing to ensure carrier acceptance and safe delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

5.3.2 For direct U. S. Military procurement, packaging shall be in accordance with MIL-STD-649, Level A or Level C, as specified in the request for procurement. Commercial packaging as in 5.3.1 will be acceptable if it meets the requirements of Level C.

6. ACKNOWLEDGMENT: A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.

7. REJECTIONS: Tubing not conforming to this specification or to authorized modifications will be subject to rejection.