AEROSPACE MATERIAL SPECIFICATION

AMS4083™	REV. N

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Superseding AMS4083M

Aluminum Alloy Tubing, Hydraulic, Seamless, Drawn, Round, 1.0Mg - 0.60Si - 0.28Cu - 0.20Cr (6061-T6), Solution and Precipitation Heat Treated

(Composition similar to UNS 96061)

RATIONALE

AMS4083N results from a Five-Year Review and update of this specification with changes to update wording to prohibit unauthorized exceptions (see 3.3.1.1 and 8.5), relocate Definitions (see 2.4), and update Applicable Documents (see Section 2).

1. SCOPE

1.1 Form

This specification covers an aluminum alloy in the form of seamless round tubing with wall thickness from 0.025 to 0.500 inch (0.64 to 12.70 mm), inclusive (see 8.6).

1.2 Application

This tubing has been used typically for parts operating under high pressure, such as hydraulic systems and fuel and oil lines, but usage is not limited to such applications.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS2355 Quality Assurance, Sampling and Testing, Aluminum Alloys and Magnesium Alloy, Wrought Products (Except Forging Stock), and Rolled, Forged, or Flash Welded Rings

AMS2772 Heat Treatment of Aluminum Alloy Raw Materials

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

For more information on this standard, visit
https://www.sae.org/standards/content/AMS4083N/

AS4330 Tubing, Flared, Standard, Dimensions For, Design Standard

AS7766 Terms Used in Aerospace Metals Specifications

AS33583 Tubing End, Double Flare, Standard Dimensions For

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B660 Packaging/Packing of Aluminum and Magnesium Products

ASTM B666/B666M Identification Marking of Aluminum and Magnesium Products

ASTM E215 Standardizing Equipment and Electromagnetic Examination of Seamless Aluminum-Alloy Tube

2.3 ANSI Accredited Publications

Copies of these documents are available online at https://webstore.ansi.org/.

ANSI H35.2 Dimensional Tolerances for Aluminum Mill Products

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

2.4 Definitions

Terms used in AMS are defined in AS7766 and as follows:

2.4.1 A double flare is similar to a standard single flare except that the flare is folded back on itself such that the cut edge is inside the flare near the ID of the tube. Definitions and illustrations of single flaring are shown in AS4330; double flaring is defined and illustrated in AS33583.

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1, determined in accordance with AMS2355.

Table 1 - Composition

Element	Min	Max
Silicon	0.40	0.8
Iron	--	0.7
Copper	0.15	0.40
Manganese	--	0.15
Magnesium	0.8	1.2
Chromium	0.04	0.35
Zinc	--	0.25
Titanium	--	0.15
Others, each	--	0.05
Others, total	--	0.15
Aluminum	remainder	

3.2 Condition

Solution and precipitation heat treated in accordance with AMS2772.

3.2.1 Tubing shall be supplied unground with an as-drawn surface finish, unless otherwise specified by the purchaser.

3.3 Properties

Tubing shall conform to the following requirements, determined on the mill-produced size in accordance with AMS2355, except as specified in 3.4.3.2:

3.3.1 Tensile Properties

Shall be as specified in Table 2.

Table 2A - 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 Cut-Out Specimen %	Elongation in 2 Inches or 4D Full Section Specimen %
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 2B - 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 Cut-Out Specimen %	Elongation in 50.8 mm or 4D Full Section Specimen %
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

3.3.1.1 Mechanical property requirements for tubing outside the wall thickness range of 1.1 shall be as agreed upon by the purchaser and producer and reported per 4.4.1 (see 8.6).

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 eight times the nominal wall thickness. Tubing having nominal wall thickness 10% or more of the nominal OD shall withstand, without cracking, flattening sideways under a load applied gradually at room temperature until the outside dimension under load equals 90% of the nominal OD.

3.3.2.1 If tubing does not pass the flattening test of 3.3.2, a section of tube not less than 0.5 inch (12.7 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 degrees around a mandrel having a diameter equal to six 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.

3.3.3 Flarability

Specimens as in 4.3.1 from tubing 0.375 inch (9.52 mm) and under in nominal OD shall withstand being double-flared (see 2.4.1) and from tubing over 0.375 inch (9.52 mm) in nominal OD shall withstand being single-flared 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-degree included angle to produce a flare having a permanent expanded OD not less than specified in Table 3.

Table 3A - Flarability requirements, inch/pound units

Nominal OD Inches	Expanded OD Inches	Nominal OD Inches	Expanded OD Inches
0.125	0.200	1.000	1.187
0.188	0.302	1.250	1.500
0.250	0.359	1.500	1.721
0.312	0.421	1.750	2.106
0.375	0.484	2.000	2.356
0.500	0.656	2.500	2.856
0.625	0.781	3.000	3.356
0.750	0.937		

Table 3B - Flarability requirements, SI units

Nominal OD Millimeters	Expanded OD Millimeters	Nominal OD Millimeters	Expanded OD Millimeters
3.18	5.08	25.40	30.15
4.78	7.67	31.75	38.10
6.35	9.12	38.10	43.71
7.92	10.69	44.45	53.49
9.52	12.29	50.80	59.84
12.70	16.66	63.50	72.54
15.88	19.84	76.20	85.24
19.05	23.80		

3.3.3.1 Tubing with nominal OD between any two standard sizes shown in Table 3 shall take the same percentage flare as that for the larger of the two sizes.

3.3.4 Hydraulic Strength

Tubing shall withstand an internal hydrostatic pressure (P), based on Equation 1, without developing leaks and without an increase in mean diameter of more than 0.2%:

$$P = S \frac{D^2 - d^2}{D^2 + d^2} \quad \text{(Eq. 1)}$$

where:

S = 35.0 ksi (241 MPa)

D = maximum OD (nominal OD plus tolerance)

d = maximum ID (D minus twice the minimum wall thickness)

3.3.4.1 Mean diameter is the average of two diameters at right angles to each other in the same transverse plane; measurements before and after testing should be taken at substantially the same location.

3.4 Quality

Tubing, as received by the 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 Metallographic Examination

A polished and etched cross section of a tube from each lot shall show no evidence of cracks, seams, or folds when examined at 100X magnification.

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

3.4.3 Leak Test

Each length of tubing shall be tested for leaks in accordance with either 3.4.3.1 or 3.4.3.2; the method of test shall be at the option of the producer unless the purchaser specifies the method of test.

3.4.3.1 Immersion Test

A tube, immersed in water or other suitable liquid while an air pressure of 250 psi (1724 kPa) is applied to the inside of the tube and held for not less than 5 seconds, shall show no leakage as indicated by bubbles in the immersion fluid.

3.4.3.2 Eddy Current Test

Secondary reference standards in accordance with ASTM E215 shall be used to set threshold levels.

3.4.3.2.1 If Method A (refer to ASTM E215) is used to establish secondary standards, tubes exhibiting eddy current responses smaller than those obtained from the d_b holes are acceptable. Tubes exhibiting eddy current responses equivalent to or greater than those obtained from the d_b holes in the reference standard are not acceptable.

3.4.3.2.2 If Method B (refer to ASTM E215) is used to establish secondary standards, and the alarm level is set as specified in ASTM E215, Method B, tubes exhibiting eddy current responses that trigger the alarm are not acceptable.

3.5 Tolerances

Tubing shall conform to all applicable requirements of ANSI H35.2 or ANSI H 35.2M.

3.6 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.1.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of tubing shall supply all samples for the producer's tests and shall be responsible for the performance of all required tests. The purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the tubing conforms to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Composition (see 3.1), tensile properties (see 3.3.1), flarability (see 3.3.3), metallographic examination (see 3.4.1), leak determination (see 3.4.3), and tolerances (see 3.5) are acceptance tests and, except for composition, shall be performed on each lot.

4.2.2 Periodic Tests

Flattening (see 3.3.2) and hydraulic strength (see 3.3.4) are periodic tests and shall be performed at a frequency selected by the producer unless frequency of testing is specified by the purchaser.