AEROSPACE MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.
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AMS 4091

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ALUMINUM ALLOY TUBING, HYDRAULIC
1Mg - 0.6Si - 0.25Cu - 0.09Cr (6062-T4)

1. ACKNOWLEDGMENT: A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.

2. APPLICATION: Primarily for aircraft hydraulic system lines to be formed in the solution heat treated condition and subsequently precipitation hardened.

3. COMPOSITION:

Magnesium	0.8 - 1.2
Silicon	0.40 - 0.8
Copper	0.15 - 0.40
Chromium	0.04 - 0.14
Iron	0.7 max
Zinc	0.25 max
Manganese	0.15 max
Titanium	0.15 max
Other Impurities, each	0.05 max
Other Impurities, total	0.15 max
Aluminum	remainder

4. CONDITION: Solution heat treated.

4.1 Unless otherwise specified, tubing shall be supplied unground.

5. TECHNICAL REQUIREMENTS:

5.1 Tensile Properties:

Nominal OD Inches	Nominal Wall Thickness Inch	Tensile Strength psi, min	Yield Strength at 0.2% Offset or at Extension Indicated (E = 9,900,000) psi, min	Extension Under Load in. in 2 in.	Elongation % in 2 in. min Full Tube	Strip
0.25 to 2, incl	0.049 and under	30,000	16,000	0.0072	16	14
0.25 to 2, incl	Over 0.049 to 0.259, incl	30,000	16,000	0.0072	18	16
0.25 to 2, incl	Over 0.259 to 0.500, incl	30,000	16,000	0.0072	20	18

5.2 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 6 times the nominal wall thickness.

5.2.1 If tubing does not pass the flattening test of 5.2, a section of the tube not less than 1/2 in. 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 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.

5.3 Flarability: Tubing with nominal OD of 0.375 in. and under shall be capable of being double-flared and tubing with nominal OD over 0.375 in. shall be capable of being single-flared without formation of cracks or other visible defects. Specimens for flaring may be cut from any portion of the tube, or an entire tube may be used as a specimen. The end of the specimen to be flared shall be cut square, with the cut end smooth and free from burrs, but not rounded except for sizes 0.375 in. and under. The specimen shall, at room temperature, be forced axially with steady pressure over a hardened and polished tapered steel pin having a 74 deg included angle, to produce a flare having the permanent expanded OD specified in the following table:

Nominal OD Inches	Expanded OD Inches, min	Nominal OD Inches	Expanded OD Inches, min
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		

5.3.1 Tubing with intermediate nominal OD shall take the same percentage flare as that for the next larger OD.

5.3.2 Tubing with nominal OD greater than 2.00 in. shall have flarability as agreed upon by purchaser and vendor.

5.4 Hydraulic Strength: Each length of tubing shall be capable of withstanding an internal hydrostatic pressure (P), calculated according to the following formula, without developing leaks and without an increase in mean diameter of more than 0.2%:

$$P = \frac{1.9tS}{D-t}$$

Where:

P = Test pressure in psi.
t = Minimum wall thickness (nominal wall thickness minus maximum negative tolerance) in inches.
S = Yield strength from 5.1 or 5.5 as applicable.
D = Nominal OD of tube in inches.

5.4.1 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.

5.5 Tensile Properties After Precipitation Hardening: Tubing after proper precipitation heat treatment shall conform to the following requirements:

Nominal OD Inches	Nominal Wall Thickness Inch	Tensile Strength psi, min	Yield Strength at 0.2% Offset or at Extension Indicated (E = 9,900,000) psi, min	Extension Under Load in. in 2 in.	Elongation % in 2 in. min Full Tube	Strip
0.25 to 2, incl	0.049 and under	42,000	35,000	0.0111	10	8
0.25 to 2, incl	Over 0.049 to 0.259, incl	42,000	35,000	0.0111	12	10
0.25 to 2, incl	Over 0.259 to 0.500, incl	42,000	35,000	0.0111	14	12

6. QUALITY:

6.1 Tubing shall be uniform in quality and condition, clean, sound, and free from foreign materials and from internal and external defects detrimental to fabrication or to performance of parts. A polished and etched cross-section of a tube shall show no evidence of cracks, seams, or folds when examined at a magnification of 100 diameters.

6.2 Cleanliness of Tubing: Tubing shall be free from grease or other foreign matter and shall have a good workmanlike finish. No metallic flakes or particles shall be collected by a clean white cloth when it is drawn through the length of the bore of a test sample. The presence of metallic flakes or particles on the cloth will be cause for rejection. Discoloration of the cloth, without the presence of flakes or grit, will not be cause for rejection.

7. TOLERANCES: Unless otherwise specified, tolerances shall conform to the latest issue of AMS 2203 as applicable and as specified below:

7.1 Diameter: Table I, columns headed "Mean Diameter", and "Diameter at any Point" for Heat Treatable Alloys.

7.2 Wall Thickness: Table II, columns headed "Mean Wall Thickness", and "Wall Thickness at any Point" for Heat Treatable Alloys.

8. REPORTS:

8.1 Unless otherwise specified, the vendor of the product shall furnish with each shipment three copies of a report stating that the product conforms to the chemical composition and technical requirements of this specification. This report shall include the purchase order number, material specification number, size, and quantity.

8.2 Unless otherwise specified, 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, contractor or other direct supplier of material, part number, and quantity. When material for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of material to determine conformance to the requirements of this specification, and shall include in the report a statement that the material conforms, or shall include copies of laboratory reports showing the results of tests to determine conformance.