



AEROSPACE MATERIAL SPECIFICATION

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

AMS 5582A

Superseding AMS 5582

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ALLOY TUBING, SEAMLESS, CORROSION AND HEAT RESISTANT
72Ni - 15.5Cr - 0.95 (Cb+Ta) - 2.5Ti - 0.70Al - 7.0Fe

1. SCOPE:

- 1.1 Form: This specification covers a corrosion and heat resistant nickel alloy in the form of seamless tubing.
- 1.2 Application: Primarily for fluid lines requiring high strength up to 1500°F (815°C) and oxidation resistance up to 1800°F (980°C). Parts may be formed and then heat treated to improve strength at elevated temperatures.

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 2263 - Tolerances, Nickel, Nickel-Base, and Cobalt-Base Alloy Tubing
 - AMS 2269 - Chemical Check Analysis Limits, Wrought Nickel Alloys and Cobalt Alloys
 - AMS 2350 - Standards and Test Methods
 - AMS 2371 - Quality Assurance Sampling of Corrosion and Heat Resistant Steels and Alloys, Wrought Products Except Forgings and Forging Stock
 - 2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.
 - ASTM E8 - Tension Testing of Metallic Materials
 - ASTM E112 - Estimating the Average Grain Size of Metals
 - ASTM E139 - Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials
 - ASTM E354 - Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys
 - 2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.
 - 2.3.1 Federal Standards:
 - Federal Test Method Standard No. 151 - Metals; Test Methods
 - 2.3.2 Military Standards:
 - MIL-STD-163 - Steel Mill Products, Preparation for Shipment and Storage

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3. TECHNICAL REQUIREMENTS :

3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E354, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other analytical methods approved by purchaser:

	min	max
∅ Carbon	--	0.08
Manganese	--	1.00
Silicon	--	0.50
Sulfur	--	0.010
Chromium	14.00 -	17.00
Nickel + Cobalt	70.00	--
Columbium + Tantalum	0.70 -	1.20
Titanium	2.25 -	2.75
Aluminum	0.40 -	1.00
Iron	5.00 -	9.00
Cobalt (3.1.1)	--	1.00
Copper	--	0.50

3.1.1 Determination not required for routine acceptance.

∅ 3.1.2 Check Analysis: Composition variations shall meet the requirements of AMS 2269.

3.2 Condition: Annealed and descaled. Annealing shall be performed in a suitable protective atmosphere at such temperature and for such time as will produce tubing meeting the requirements of 3.4. Cooling from the annealing temperature shall be at a rate equivalent to air cool or faster.

∅ 3.3 Fabrication: Tubing shall be produced by a seamless process. The external and internal surface finishes may be produced by pickling, bright annealing, or any method which will provide the required surface condition and which will not affect the limits of wall thickness or corrosion resistance.

3.4 Properties: Tubing 0.125 in. (3.18 mm) and over in nominal OD and 0.015 in. (0.38 mm) and over in nominal wall thickness shall conform to the following requirements. Properties of tubing under 0.125 in. (3.18 mm) in nominal OD or under 0.015 in. (0.38 mm) in nominal wall thickness shall be as agreed upon by purchaser and vendor.

3.4.1 As Annealed:

3.4.1.1 Tensile Properties: Shall be as follows, determined in accordance with ASTM E8:

∅ Tensile Strength, max	140,000 psi (965 MPa)
Yield Strength at 0.2% Offset, max	80,000 psi (552 MPa)
Elongation in 2 in. (50 mm) or 4D, min	
Strip Specimen	30%
Full Tube	35%

∅ 3.4.1.2 Grain Size: Shall average not over 0.0060 in. (0.155 mm) in diameter (Grain Size No. 2.5), determined by comparison of a polished and etched specimen with the chart in ASTM E112.

∅ 3.4.1.3 Flarability: Specimens as in 4.3.1 from tubing 0.188 to 2.000 in. (4.78 to 50.80 mm), incl, in nominal OD shall withstand flaring at room temperature, without formation of cracks or other visible defects, by being forced axially 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 1.20 times the original nominal OD.

3.4.1.3.1 Flareability requirements for tubing with nominal OD greater than 2.000 in. (50.80 mm) or less than 0.188 in. (4.78 mm) shall be as agreed upon by purchaser and vendor.

3.4.1.4 Pressure Test: Tubing shall show no bulges, leaks, pinholes, cracks, or other defects when subjected to an internal hydrostatic pressure sufficient to cause a tensile stress of 20,000 psi (138 MPa) in the tubing wall. The hydrostatic pressure (P) shall be determined from the equation:

$$P = S \frac{D^2 - d^2}{D^2 + d^2}$$

where, S = 20,000 psi (138 MPa) tensile stress

D = Nominal OD in inches (mm)

d = Nominal ID in inches (mm)

P = Test pressure in psi (MPa)

3.4.2 After Precipitation Heat Treatment: Tubing shall have the following properties after being precipitation heat treated by heating to 1300°F ± 25 (705°C ± 15), holding at heat for 20 hr ± 1, and cooling in air:

3.4.2.1 Tensile Properties: Shall be as follows, determined in accordance with ASTM E8:

∅ Tensile Strength, min	155,000 psi (1,069 MPa)
∅ Yield Strength at 0.2% Offset, min	100,000 psi (690 MPa)
∅ Elongation in 2 in. (50 mm) or 4D, min	
Strip Specimen	15%
Full Tube	20%

3.4.2.2 Stress-Rupture Properties at 1350°F (732°C): A tensile test specimen, maintained at 1350°F ± 3 (732°C ± 2) while a load sufficient to produce an initial axial stress of 45,000 psi (310 MPa) is applied continuously, shall not rupture in less than 23 hours. The test shall be continued to rupture without change of load. Elongation after rupture, measured at room temperature, shall be reported. Tests shall be conducted in accordance with ASTM E139.

3.4.2.2.1 The test of 3.4.2.2 may be conducted using a load higher than required to produce an initial axial stress of 45,000 psi (310 MPa) but load shall not be changed while test is in progress. Time to rupture and elongation requirements shall be as specified in 3.4.2.2.

3.4.2.2.2 When permitted by purchaser, the test of 3.4.2.2 may be conducted using incremental loading. In such case, the load required to produce an initial axial stress of 45,000 psi (310 MPa) shall be used to rupture or for 23 hr, whichever occurs first. After the 23 hr and at intervals of 8 - 16 hr, preferably 8 - 10 hr, thereafter, the stress shall be increased in increments of 2500 psi (17.2 MPa). Time to rupture and elongation requirements shall be as specified in 3.4.2.2.

3.5 Quality:

3.5.1 Tubing, as received by purchaser, shall be uniform in quality and condition and shall have a finish conforming to the best practice for high quality aircraft tubing. It shall be smooth, and free from heavy scale or oxide, burrs, seams, tears, grooves, laminations, slivers, pits, and other injurious conditions. Surface imperfections such as handling marks, straightening marks, light mandrel and die marks, shallow pits, and scale pattern will not be considered injurious if the imperfections are removable within the tolerances specified for wall thickness but removal of such imperfections is not required.

3.5.2 Tubing shall be free from grease or other foreign matter. 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. Discoloration of the cloth, without the presence of flakes or grit, is acceptable.

- 3.6 Tolerances: Unless otherwise specified, tolerances shall conform to all applicable requirements of
Ø AMS 2263.

4. QUALITY ASSURANCE PROVISIONS:

- 4.1 Responsibility for Inspection: The vendor of tubing shall supply all samples for vendor's tests 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 sample and to perform such confirmatory testing as he deems necessary to ensure that the tubing conforms to the requirements of this specification.
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Ø 4.2 Classification of Tests:

- 4.2.1 Acceptance Tests: Tests to determine conformance to requirements for composition (3.1), tensile properties (3.4.1.1 and 3.4.2.1), grain size (3.4.1.2), pressure test (3.4.1.4), stress-rupture properties (3.4.2.2), and tolerances (3.6) are classified as acceptance tests and shall be performed on each lot.
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- 4.2.2 Periodic Tests: Tests to determine conformance to requirements for flarability (3.4.1.3) are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.
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Ø 4.3 Sampling: Shall be in accordance with AMS 2371 and the following:

- 4.3.1 Specimens for flarability (3.4.1.3) 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 not rounded.
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4.4 Reports:

- 4.4.1 The vendor of tubing shall furnish with each shipment three copies of a report showing the results of tests for chemical composition of each heat and the results of tests on each lot to determine conformance to the other acceptance tests requirements of this specification. This report shall include the purchase order number, heat number, AMS 5582A, size, and quantity from each heat.
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- 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, AMS 5582A, 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 2371.

Ø 5. PREPARATION FOR DELIVERY:

5.1 Identification: Tubing shall be identified as follows:

- 5.1.1 Straight Tubes 0.029 In. (0.75 mm) and Over in Nominal Wall Thickness and 0.500 In. (12.50 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 (900 mm) with AMS 5582A, heat number, manufacturer's identification, and nominal wall thickness. The characters shall be of such size as to be clearly legible, shall be applied using a suitable marking fluid, and shall be removable in hot alkaline cleaning solution without rubbing. The markings shall have no deleterious effect on the tubing or its performance and shall be sufficiently stable to withstand normal handling.
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