

Submitted for recognition as an American National Standard

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

UNS N07750

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 shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

- 2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

- AMS 2263 - Tolerances, Nickel, Nickel Alloy, and Cobalt Alloy Tubing  
MAM 2263 - Tolerances, Metric, Nickel, Nickel Alloy, and Cobalt 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

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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 - Determining Average Grain Size

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 Military Standards:

MIL-STD-163 - Steel Mill Products, Preparation for Shipment and Storage

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight,  $\emptyset$  determined by wet chemical methods in accordance with ASTM E354 or by spectrochemical or 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. (3.00 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. (3.00 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 (550 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. (0.15 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. (4.75 to 50.00 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 Flarability requirements for tubing with nominal OD over 2.000 in. (50.00 mm) or under 0.188 in. (4.75 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 (P) sufficient to cause a tensile stress of 20,000 psi (140 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, P = Test pressure in psi (MPa)  
 S = 20,000 psi (140 MPa)  
 D = Nominal OD in inches (mm)  
 d = Nominal ID in inches (mm)

3.4.2 After Precipitation Heat Treatment: Tubing shall have the following properties after being precipitation heat treated by heating to 1300°F  $\pm$  25 (705°C  $\pm$  15), holding at heat for 20 hr  $\pm$  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 (1070 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%

3.5 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 imperfections detrimental to usage of the tubing. 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. A clean white cloth shall not collect metallic flakes or particles 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 Sizes: Except when exact lengths or multiples of exact lengths are ordered,  $\emptyset$  straight tubing will be acceptable in mill lengths of 6 - 24 ft (2 - 7.5 m) but not more than 25% of any shipment shall be supplied in lengths shorter than 6 - 9 ft (2 - 3 m).

3.7 Tolerances: Shall conform to all applicable requirements of AMS 2263 or MAM 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 any confirmatory testing deemed 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  $\emptyset$  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), and tolerances (3.7) are classified as acceptance tests and shall be performed on each heat or lot as applicable.