



AEROSPACE MATERIAL SPECIFICATIONS

SOCIETY OF AUTOMOTIVE ENGINEERS, Inc.

485 Lexington Ave., New York, N. Y. 10017

AMS 5590

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Revised

ALLOY TUBING, SEAMLESS, CORROSION AND HEAT RESISTANT
Nickel Base - 19Cr - 3.1Mo - 5.1(Cb + Ta) - 0.90Ti - 0.50Al
Consumable Electrode or Vacuum Induction Melted
1950 F (1065.6 C) Solution Treated

1. **ACKNOWLEDGMENT:** A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.
2. **APPLICATION:** Primarily for fluid lines and structural components requiring high strength at cryogenic temperatures and short time use up to 1000 F (538 C) and oxidation resistance up to 1800 F (982 C), particularly those which are formed or welded and then heat treated to develop desired properties.
3. **COMPOSITION:**

	min	max
Carbon	--	0.08
Manganese	--	0.35
Silicon	--	0.35
Phosphorus	--	0.015
Sulfur	--	0.015
Chromium	17.00 - 21.00	
Nickel	50.00 - 55.00	
Cobalt	--	1.00
Molybdenum	2.80 - 3.30	
Columbium + Tantalum	4.75 - 5.50	
Titanium	0.65 - 1.15	
Aluminum	0.20 - 0.80	
Boron	--	0.006
Copper	--	0.30
Iron	remainder	

- 3.1 **Check Analysis:** Composition variations shall meet the requirements of the latest issue of AMS 2269.
4. **CONDITION:** Unless otherwise specified, cold drawn, solution heat treated, and descaled. A light polish to improve surface appearance may be utilized after the descaling operation.

5. **TECHNICAL REQUIREMENTS:**

- 5.1 **Solution Heat Treatment:** Unless otherwise specified, tubing shall conform to the requirements of 5.2 and shall be capable of meeting the requirements of 5.3. No specific heat treating instructions are specified but it is recommended that the tubing be solution heat treated by heating in a suitable protective atmosphere to 1950 F \pm 25 (1065.6 C \pm 14), holding at heat for not more than 30 min., and cooling at a rate equivalent to air cool or faster.

5.2 **Properties After Solution Heat Treatment:**

- 5.2.1 **Tensile Properties:** Tubing having OD of 0.125 in. and over with wall thickness 0.015 in. and over shall conform to the following requirements:

Tensile Strength, psi	145,000 max
Yield Strength at 0.2% Offset, psi	85,000 max
Elongation, % in 2 in.	30 min

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- 5.2.1.1 Tubing under 0.125 in. in OD or under 0.015 in. in wall thickness shall have tensile properties as agreed upon by purchaser and vendor.
- 5.2.2 Flarability: Tubing 0.188 to 2.00 in., incl, in OD shall be capable of being 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. 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 a permanent expanded OD not less than 1.25 times the original nominal diameter.
- 5.2.2.1 Tubing with nominal OD greater than 2.00 in. or less than 0.188 in. shall have flarability as agreed upon by purchaser and vendor.
- 5.2.3 Pressure Test: Tubing shall show no bulges, leaks, or other defects when subjected to an internal hydrostatic pressure of 5000 psig or pressure sufficient to cause a tensile stress of 40,000 psi in the tubing wall, whichever is less. The hydrostatic pressure (P) shall be based on:

$$P = 2 \frac{St}{D}$$

where, S = 40,000 psi tensile stress

t = Minimum wall thickness (nominal thickness minus maximum negative tolerance) in inches

D = Nominal OD in inches.

- 5.2.4 Grain Size: Shall be predominantly 3 or finer with occasional grains as large as 2 permissible as determined by comparison of a polished and etched specimen with the chart in the issue of ASTM E112 listed in the latest issue of AMS 2350.
- 5.3 Properties After Precipitation Heat Treatment: Tubing precipitation heat treated by heating to 1400 F \pm 15 (760 C \pm 8.3), holding at heat for 10 hr, furnace cooling to 1200 F \pm 15 (648.9 C \pm 8.3), holding at 1200 F \pm 15 (648.9 C \pm 8.3) until a total precipitation time of 20 hr has been reached, and cooling at a rate equivalent to air cool or faster shall conform to the following requirements:
- 5.3.1 Tensile Properties at Room Temperature: The following requirements apply to tubing having OD of 0.125 in. and over with wall thickness 0.015 in. and over.

Tensile Strength, psi	170,000 min
Yield Strength at 0.2% Offset or at 0.0138 in. in 2 in. Extension Under Load (E = 29,600,000), psi	145,000 min
Elongation, % in 2 in.	15 min

- 5.3.1.1 Tubing under 0.125 in. in OD or under 0.015 in. in wall thickness shall have tensile properties as agreed upon by purchaser and vendor.

6. QUALITY:

- 6.1 Material shall be multiple melted using consumable electrode practice in the remelt cycle or shall be induction melted under vacuum, unless otherwise permitted. If consumable electrode melting is not performed in vacuum, electrodes which have been produced by vacuum induction melting shall be used for remelting.
- 6.2 Tubing shall have a finish conforming to the best practice for high quality aircraft material. Tubing shall be uniform in quality and condition, clean, sound, and free from foreign materials and from internal and external imperfections detrimental to fabrication or to performance of parts. External and internal surface imperfections such as handling marks, straightening marks, light mandrel and die marks, shallow pits, seams, scores, and scale pattern will not be considered injurious provided the imperfections are removable within the tolerances specified herein for wall thickness.