

STEEL TUBING, WELDED, CORROSION AND MODERATE HEAT RESISTANT
17Cr - 7.1Ni - 1.1Al
Solution Heat Treated, Precipitation-Hardenable

UNS S17700

1. SCOPE:

1.1 Form: This specification covers a corrosion and moderate heat resistant steel in the form of welded tubing.

1.2 Application: Primarily for parts requiring corrosion resistance and high strength up to 600°F (315°C) after precipitation heat treatment.

1.2.1 Certain design and processing procedures may cause this tubing to become susceptible to stress-corrosion cracking after precipitation heat treatment; ARP 1110 recommends practices to minimize such conditions.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications and Aerospace Recommended Practices 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 2243 - Tolerances, Corrosion and Heat Resistant Steel Tubing

MAM 2243 - Tolerances, Metric, Corrosion and Heat Resistant Steel Tubing

AMS 2248 - Chemical Check Analysis Limits, Wrought Corrosion and Heat Resistant Steels and Alloys, Maraging and Other Highly-Alloy Steels, and Iron 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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2.1.2 Aerospace Recommended Practices:

ARP 1110 - Minimizing Stress Corrosion Cracking in Heat Treatable Wrought Low Alloy and Martensitic Corrosion Resistant Steels

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM A370 - Mechanical Testing of Steel Products

ASTM E353 - Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel Iron 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, determined by wet chemical methods in accordance with ASTM E353 or by spectrochemical or other analytical methods approved by purchaser:

	min	max
Carbon	--	0.09
Manganese	--	1.00
Silicon	--	1.00
Phosphorus	--	0.040
Sulfur	--	0.030
Chromium	16.00 -	18.00
Nickel	6.50 -	7.75
Aluminum	0.75 -	1.50

3.1.1 Check Analysis: Composition variations shall meet the requirements of AMS 2248.

3.2 Condition: Solution heat treated and descaled.

3.3 Fabrication: Tubing shall be produced by a welded and drawn process. Any finishing operation applied to remove objectionable pits and surface blemishes shall be performed prior to final solution heat treatment. A light polish to improve surface appearance may be employed after solution heat treatment. Passivation treatment shall follow any polishing treatment.

3.4 Solution Heat Treatment: Tubing shall be solution heat treated by heating to $1950^{\circ}\text{F} \pm 25$ ($1065^{\circ}\text{C} \pm 15$), holding at heat for a time commensurate with wall thickness and heating equipment and procedure used, and cooling in air or quenching in water.

3.5 Properties: Tubing shall conform to the following requirements; hardness and tensile testing shall be performed in accordance with ASTM A370.

3.5.1 As Solution Heat Treated:

3.5.1.1 Tensile Properties:

Tensile Strength, max	150,000 psi (1035 MPa)
Yield Strength at 0.2% Offset, max	55,000 psi (380 MPa)
Elongation in 2 in. (50 mm), min	20%

3.5.1.2 Hardness: Should be not higher than 92 HRB, or equivalent, but tubing shall not be rejected on the basis of hardness if the tensile property requirements of 3.5.1.1 are met.

3.5.1.3 Flarability: Specimens as in 4.3.1 shall withstand, without formation of cracks or other visible defects, flaring at room temperature 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 as agreed upon by purchaser and vendor.

3.5.1.4 Pressure Test: Tubing shall show no bulges, leaks, pinholes, cracks, or other defects when subjected to an internal hydrostatic pressure, based on nominal dimensions, sufficient to cause a tensile stress of 20,000 psi (140 MPa) in the tubing wall.

3.5.2 After Austenite Conditioning and Precipitation Heat Treating: Tubing shall have the properties in 3.5.2.1 and 3.5.2.2 after being austenite conditioned by heating to $1400^{\circ}\text{F} + 25$ ($760^{\circ}\text{C} + 15$), holding at heat for 90 min. ± 5 , cooling to $55^{\circ}\text{F} + 5$ ($13^{\circ}\text{C} + 3$) within 1 hr, holding at that temperature for not less than 30 min., and precipitation heat treated by heating to $1050^{\circ}\text{F} + 10$ ($565^{\circ}\text{C} + 5$), holding at heat for 90 min. ± 5 , and cooling to room temperature.

3.5.2.1 Tensile Properties:

Tensile Strength, min	180,000 psi (1240 MPa)
Yield Strength at 0.2% Offset, min	150,000 psi (1035 MPa)
Elongation in 2 in. (50 mm), min	6%

3.5.2.2 Hardness: Should be not lower than 38 HRC, or equivalent, but the tubing shall not be rejected on the basis of hardness if the tensile property requirements of 3.5.2.1 are met.

3.6 Quality:

3.6.1 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.

- 3.6.2 If beads are present at the welds on the inner surface of the tubing, such beads shall be not thicker than 0.010 in. (0.25 mm). The outer surface of the tubing shall be free from beads.
- 3.6.3 When specified by purchaser, tubing shall be subjected to nondestructive testing. Methods of testing and standards for acceptance shall be as agreed upon by purchaser and vendor.
- 3.7 Sizes: Except when exact lengths or multiples of exact lengths are ordered, straight tubing will be acceptable in mill lengths of 6 - 20 ft (2 - 6 m) but not more than 10% of any shipment shall be supplied in lengths shorter than 10 ft (3 m).
- 3.8 Tolerances: Shall conform to all applicable requirements of AMS 2243 or MAM 2243.
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 composition (3.1), tensile properties (3.5.1.1 and 3.5.2.1), pressure test (3.5.1.4), quality (3.6), and tolerances (3.8) are classified as acceptance tests and shall be performed on each heat or lot as applicable.
- 4.2.2 Periodic Tests: Tests to determine conformance to requirements for flarability (3.5.1.3) are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.
- 4.3 Sampling: Shall be in accordance with AMS 2371 and the following:
- 4.3.1 Specimens for flarability test (3.5.1.3) shall be full tubes or sections cut from a tube. The end of the specimen to be flared shall be cut square, with the cut end smooth and free from burrs, but not rounded.
- 4.4 Reports:
- 4.4.1 The vendor of tubing shall furnish with each shipment a report showing the results of tests for chemical composition of each heat and for tensile properties and pressure test of each lot. This report shall include the purchase order number, heat number, AMS 5568C, size, and quantity.