

**AEROSPACE
MATERIAL
SPECIFICATION**

Submitted for recognition as an American National Standard

AMS 5578B
Superseding AMS 5578A

Issued 11-1-69
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STEEL TUBING, WELDED, CORROSION AND MODERATE HEAT RESISTANT
12Cr - 8.5Ni - 0.30(Cb+Ta) - 1.1Ti - 2.0Cu
Vacuum Induction Plus Vacuum Consumable Electrode Melted
Solution Heat Treated, Precipitation Hardenable

UNS S45500

1. SCOPE:

1.1 Form: This specification covers a premium-quality 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 800°F (425°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.

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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 2300 - Premium Aircraft-Quality Steel Cleanliness, Magnetic Particle Inspection Procedure
- MAM 2300 - Premium Aircraft-Quality Steel Cleanliness, Magnetic Particle Inspection Procedure, Metric (SI) Measurement
- 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

2.1.2 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 spectrographic or other analytical methods approved by purchaser:

| | min | max |
|----------------------|---------|-------|
| Carbon | -- | 0.05 |
| Manganese | -- | 0.50 |
| Silicon | -- | 0.50 |
| Phosphorus | -- | 0.015 |
| Sulphur | -- | 0.015 |
| Chromium | 11.00 - | 12.50 |
| Nickel | 7.50 - | 9.50 |
| Columbium + Tantalum | 0.10 - | 0.50 |
| Titanium | 0.80 - | 1.40 |
| Copper | 1.50 - | 2.50 |
| Molybdenum | -- | 0.50 |

- 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 $1525^{\circ}\text{F} + 25$ ($830^{\circ}\text{C} + 15$), holding at heat for a time commensurate with wall thickness and heating equipment and procedure used but not less than 5 min., and 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 Strength: Shall be not higher than 165,000 psi (1140 MPa).

- 3.5.1.2 Pressure Testing: Tubing shall show no bulges, leaks, 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 Precipitation Heat Treatment: Tubing shall meet the requirements of 3.5.2.1 and 3.5.2.2 after being precipitation heat treated by heating to $950^{\circ}\text{F} + 10$ ($510^{\circ}\text{C} + 5$), holding at heat for $4 \text{ hr} \pm 0.25$, and cooling in air to room temperature.

3.5.2.1 Tensile Properties:

| | |
|------------------------------------|------------------------|
| Tensile Strength, min | 220,000 psi (1515 MPa) |
| Yield Strength at 0.2% Offset, min | 205,000 psi (1410 MPa) |
| Elongation in 2 in. (50 mm), min | |

| Nominal Wall Thickness | | |
|------------------------|--------------------|----------------|
| Inch | Millimetres | |
| Up to 0.020, excl | Up to 0.50, excl | As agreed upon |
| 0.020 to 0.062, incl | 0.50 to 1.55, incl | 4% |
| Over 0.062 | Over 1.55 | 3% |

3.5.2.2 Hardness: Should be not lower than 42 HRC, or equivalent, but tubing shall not be rejected on the basis of hardness if the tensile property requirements of 3.5.2.1 are met.

3.5.3 Other Precipitation Heat Treatment: Properties after precipitation heat treatment at temperatures other than $950^{\circ}\text{F} \pm 10$ ($510^{\circ}\text{C} \pm 5$) shall be as agreed upon by purchaser and vendor.

3.6 QUALITY:

3.6.1 Steel shall be premium aircraft-quality conforming to AMS 2300 or MAM 2300; it shall be multiple melted using vacuum induction melting followed by vacuum consumable electrode melting.

3.6.2 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.

3.6.3 If weld flash is present at the welds on the inner surface of the tubing, such flash shall be not thicker than 0.010 in. (0.25 mm). The outer surface of the tubing shall be free from weld flash.

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), hardness (3.5.2.2), 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 of tubing as solution heat treated to determine conformance to requirements for pressure test (3.5.1.2) 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.

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 and frequency-severity cleanliness rating of each heat and for tensile properties and hardness of each lot. This report shall include the purchase order number, heat number, AMS 5578B, size, and quantity.

4.4.2 The vendor of finished or semi-finished parts shall furnish with each shipment a report showing the purchase order number, AMS 5578B, 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 either a statement that the tubing conforms or copies of laboratory reports showing the results of tests to determine conformance.

4.5 Resampling and Retesting: Shall be in accordance with AMS 2371.

5. PREPARATION FOR DELIVERY:

5.1 Identification: Tubing shall be identified as follows: