SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 5578F

Issued NOV 1969
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Superseding AMS 5578E

Steel, Corrosion and Heat-Resistant, Welded Tubing
12Cr - 8.5Ni - 0.30Cb - 1.1Ti - 2.0Cu
Vacuum Induction Plus Consumable Electrode Vacuum Melted
Solution Heat Treated, Precipitation Hardenable

(Composition similar to UNS S45500)

1. SCOPE:

1.1 Form:

This specification covers a premium-quality corrosion and heat-resistant steel in the form of welded and drawn tubing.

1.2 Application:

This tubing has been used typically for parts requiring corrosion resistance and high strength up to 800 °F (427 °C) after precipitation heat treatment, but usage is not limited to such applications.

1.2.1 Certain design and processing procedures may cause this tubing to become susceptible to stress-corrosion cracking after precipitation heat treatment; ARP1110 recommends practices to minimize such conditions.

2. APPLICABLE DOCUMENTS:

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

TO PLACE A DOCUMENT ORDER:
Tel: 877-606-7323 (inside USA and Canada)
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: custsvc@sae.org
SAE WEB ADDRESS: http://www.sae.org

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or www.sae.org.

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, Corrosion and Heat-Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels, and Iron Alloys
AMS 2300	Steel Cleanliness, Premium Aircraft-Quality, Magnetic Particle Inspection Procedure
MAM 2300	Steel Cleanliness, Premium Aircraft-Quality, Magnetic Particle Inspection Procedure, Metric (SI) Measurement
AMS 2371	Quality Assurance Sampling and Testing, Corrosion and Heat-Resistant Steels and Alloys, Wrought Products and Forging Stock
AMS 2634	Ultrasonic Inspection, Thin Wall Metal Tubing
AMS 2750	Pyrometry
AMS 2807	Identification, Carbon and Low-Alloy Steels, Corrosion and Heat-Resistant Steels and Alloys, Sheet, Strip, Plate, and Aircraft Tubing
ARP1110	Minimizing Stress Corrosion Cracking in Wrought Forms of Steels and Corrosion-Resistant Steels and Alloys

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor, West Conshohocken, PA 19428-2959 or www.astm.org.

ASTM A 370	Mechanical Testing of Steel Products
ASTM E 353	Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys
ASTM E 426	Electromagnetic (Eddy-Current) Examination of Seamless and Welded Tubular Products, Austenitic Stainless Steel and Similar Alloys
ASTM E 1417	Liquid Penetrant Examination

3. TECHNICAL REQUIREMENTS:

3.1 Composition:

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 353, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - Composition

Element	min	max
Carbon	--	0.05
Manganese	--	0.50
Silicon	--	0.50
Phosphorus	--	0.015
Sulfur	--	0.015
Chromium	11.00	12.50
Nickel	7.50	9.50
Columbium	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 applicable requirements of AMS 2248.

3.2 Melting Practice:

Steel shall be multiple melted using vacuum induction melting followed by consumable electrode vacuum remelting.

3.3 Condition:

Solution heat treated and, unless solution heat treatment is performed in an atmosphere yielding a bright finish, pickled as required or passivated. Tubing shall have been cold worked sufficiently to ensure proper weld reinforcement height and roundness in the weld reinforcement area.

3.4 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 external surface appearance may be employed after solution heat treatment.

3.5 Solution Heat Treatment:

Tubing shall be solution heat treated by heating to 1525 °F ± 25 (829 °C ± 14), holding at heat for a time commensurate with wall thickness and heating equipment and procedure used but not less than 5 minutes, and quenching in water. Pyrometry shall be in accordance with AMS 2750.

3.6 Properties:

Tubing shall conform to the following requirements; hardness and tensile testing shall be performed in accordance with ASTM A 370.

3.6.1 As Solution Heat Treated:

3.6.1.1 Tensile Strength: Shall be not higher than 165 ksi (1138 MPa).

3.6.2 After Precipitation Heat Treatment: Tubing shall meet the requirements of 3.6.2.1 and 3.6.2.2 after being precipitation heat treated by heating to 950 °F ± 10 (510 °C ± 6), holding at heat for 4 hours ± 0.25, and cooling to room temperature at a rate equivalent to air cooling.

3.6.2.1 Tensile Properties: Shall be as shown in Table 2.

TABLE 2A - Minimum Tensile Properties, Inch/Pound Units

Nominal Wall Thickness Inch	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 Inches or 4D %
Up to 0.020, excl	220	205	--
0.020 to 0.062, incl	220	205	4
Over 0.062	220	205	3

TABLE 2B - Minimum Tensile Properties, SI Units

Nominal Wall Thickness Millimeters	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50.8 mm or 4D %
Up to 0.51, excl	1517	1413	--
0.51 to 1.57, incl	1517	1413	4
Over 1.57	1517	1413	3

3.6.2.2 Hardness: Shall be not lower than 42 HRC, or equivalent (See 8.2).

3.7 Quality:

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 grease, oil and other matter, 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.

3.7.1 Steel shall be premium aircraft quality conforming to AMS 2300 or MAM 2300.

3.7.2 When specified by purchaser, tubing shall be subjected to fluorescent penetrant inspection in accordance with ASTM E 1417, to ultrasonic inspection in accordance with AMS 2634, to electromagnetic (eddy-current) inspection in accordance with ASTM E 426, or to any combination thereof. Tubing shall meet the acceptance criteria established by the cognizant engineering organization.

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 the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the tubing conforms to specified requirements.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests for the following requirements are acceptance tests and shall be performed on each heat or lot as applicable:

4.2.1.1 Composition (3.1) of each heat.

4.2.1.2 Tensile properties (3.6.1.1) of each lot as solution heat treated.

4.2.1.3 Tensile properties (3.6.2.1) and hardness (3.6.2.2) of each lot after precipitation heat treatment at 950 °F (510 °C).

4.2.1.4 Tolerances (3.8).

4.2.2 Periodic Tests: Tests for the following requirements are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by the purchaser.

4.2.2.1 Frequency severity cleanliness rating (3.7.1).

4.3 Sampling and Testing:

Shall be in accordance with AMS 2371.