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AEROSPACE MATERIAL SPECIFICATION

AMS 6362C
Superseding AMS 6362B

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STEEL TUBING, SEAMLESS
0.95Cr - 0.20Mo (0.28-0.33C) (SAE 4130)
150,000 psi (1035 MPa) Tensile Strength

UNS G41300

1. SCOPE:

1.1 Form: This specification covers an aircraft-quality, low-alloy steel in the form of round, seamless tubing having a wall thickness not greater than 0.188 in. (4.70 mm).

1.2 Application: Primarily for general use where a minimum tensile strength of 150,000 psi (1035 MPa) is required.

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 2253 - Tolerances, Carbon and Alloy Steel Tubing
MAM 2253 - Tolerances, Metric, Carbon and Alloy Steel Tubing
AMS 2259 - Chemical Check Analysis Limits, Wrought Low-Alloy and Carbon Steels
AMS 2301 - Aircraft Quality Steel Cleanliness, Magnetic Particle Inspection Procedure
AMS 2350 - Standards and Test Methods
AMS 2370 - Quality Assurance Sampling of Carbon and Low-Alloy Steels, Wrought Products Except Forgings and Forging Stock
AMS 2640 - Magnetic Particle Inspection

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 E112 - Determining Average Grain Size
ASTM E350 - Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

2.3.2 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 E350, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other analytical methods approved by purchaser:

	min	max
Carbon	0.28	0.33
Manganese	0.40	0.60
Silicon	0.15	0.35
Phosphorus	--	0.025
Sulfur	--	0.025
Chromium	0.80	1.10
Molybdenum	0.15	0.25
Nickel	--	0.25
Copper	--	0.35

3.1.1 Check Analysis: Composition variations shall meet the applicable requirements of AMS 2259.

3.2 Condition: Hardened by quenching from a temperature within the range 1500° - 1600°F (815° - 870°C) and tempered to meet the requirements of 3.4.1.

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

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

3.4.1 Tensile Properties:

Tensile Strength, min	150,000 psi (1035 MPa)
Yield Strength at 0.2% Offset, min	135,000 psi (930 MPa)
Elongation in 2 in. (50 mm), min	
Full Tube	10%
Strip	6%

3.4.2 Grain Size: Predominantly 5 or finer with occasional grains as large as 3 permissible, determined in accordance with ASTM E112.

3.4.3 Decarburization:

3.4.3.1 Tubing ordered ground, turned, or polished shall be free from decarburization on the ground, turned, or polished surfaces. Decarburization on tubing ID shall not exceed the maximum depth specified in Table I.

3.4.3.2 Allowable decarburization of pierced billets, of tubing for redrawing, or of tubing ordered to specified microstructural requirements shall be as agreed upon by purchaser and vendor.

3.4.3.3 Tubing to which 3.4.3.1 or 3.4.3.2 is not applicable shall be free from complete decarburization. Partial decarburization shall not exceed the limits specified in Table I.

TABLE I

Nominal Wall Thickness Inch	Depth of Partial Decarburization Inch		
	ID	OD	ID+OD
Up to 0.040, incl	0.008	0.008	0.010
Over 0.040 to 0.050, incl	0.009	0.009	0.012
Over 0.050 to 0.070, incl	0.010	0.010	0.014
Over 0.070 to 0.080, incl	0.012	0.012	0.016
Over 0.080 to 0.090, incl	0.014	0.014	0.018
Over 0.090 to 0.100, incl	0.015	0.015	0.020
Over 0.100 to 0.150, incl	0.017	0.017	0.022
Over 0.150 to 0.188, incl	0.020	0.020	0.026

TABLE I (SI)

Nominal Wall Thickness Millimetres	Depth of Partial Decarburization Millimetre		
	ID	OD	ID+OD
Up to 1.00, incl	0.20	0.20	0.25
Over 1.00 to 1.25, incl	0.22	0.22	0.30
Over 1.25 to 1.75, incl	0.25	0.25	0.35
Over 1.75 to 2.00, incl	0.30	0.30	0.40
Over 2.00 to 2.25, incl	0.35	0.35	0.45
Over 2.25 to 2.50, incl	0.38	0.38	0.50
Over 2.50 to 3.75, incl	0.42	0.42	0.55
Over 3.75 to 4.70, incl	0.50	0.50	0.65

3.4.3.4 Decarburization shall be measured by the microscopic method or by Rockwell Superficial 30-N scale or equivalent hardness testing method on hardened but untempered specimens protected during heat treatment to prevent changes in surface carbon content. Depth of decarburization, when measured by a hardness method, is defined as the perpendicular distance from the surface to the depth under that surface below which there is no further increase in hardness. Such measurements shall be far enough away from any adjacent surface to be uninfluenced by any decarburization or lack of decarburization thereon.

3.4.3.4.1 When determining the depth of decarburization, it is permissible to disregard local areas provided the decarburization of such areas does not exceed the above limits by more than 0.005 in. (0.12 mm) and the width is 0.065 in. (1.65 mm) or less.

3.5 Quality:

3.5.1 Steel shall be aircraft quality conforming to AMS 2301.

3.5.2 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.

3.5.2.1 When specified, the tubing, either with or without machining of the surface, shall pass magnetic particle inspection in accordance with AMS 2640. Standards for acceptance shall be as agreed upon by purchaser and vendor.

3.6 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).

3.7 Tolerances: Unless otherwise specified, tolerances shall conform to all applicable requirements of AMS 2253 or MAM 2253.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of tubing shall supply all Ø 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 Ø composition (3.1), tensile properties (3.4.1), grain size (3.4.2), decarburization (3.4.3), AMS 2301 frequency-severity rating (3.5.1), and tolerances (3.7) 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 magnetic particle inspection (3.5.2.1) when specified 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 2370.

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, grain size, and AMS 2301 frequency-severity rating of each heat and for tensile properties of each lot. This report shall include the purchase order number, heat number, AMS 6362C, size, and quantity from each heat.

4.4.2 The vendor of finished or semi-finished parts shall furnish with each shipment a report showing the purchase order number, AMS 6362C, 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 2370.