

AEROSPACE MATERIAL SPECIFICATION

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Superseding AMS 6362E

Steel Tubing, Seamless
0.95Cr - 0.20Mo (0.28 - 0.33C) (SAE 4130)
150 ksi (1034 MPa) Tensile Strength
(Composition similar to 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 inch (4.78 mm).

1.2 Application:

This tubing has been used typically for general use where a minimum tensile strength of 150 ksi (1034 MPa) is required, but usage is not limited to such applications.

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.

2.1 SAE Publications:

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

AMS 2253	Tolerances, Carbon and Alloy Steel Tubing
AMS 2259	Chemical Check Analysis Limits, Wrought Low-Alloy and Carbon Steels
AMS 2301	Steel Cleanliness, Aircraft Quality, Magnetic Particle Inspection Procedure
AMS 2370	Quality Assurance Sampling and Testing, Carbon and Low-Alloy Steel Wrought Products and Forging Stock
AMS 2807	Identification, Carbon and Low-Alloy Steels, Corrosion and Heat-Resistant Steels and Alloys, Sheet, Strip, Plate and Aircraft Tubing

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2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959 or www.astm.org.

ASTM A 370	Mechanical Testing of Steel Products
ASTM E 112	Determining Average Grain Size
ASTM E 350	Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron
ASTM E 384	Microindentation Hardness of Materials
ASTM E 1444	Magnetic Particle 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 350, by spectrochemical methods, or by other analytical methods acceptable to purchaser:

TABLE 1 - Composition

Element	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 requirements of AMS 2259.

3.2 Condition:

Hardened by quenching from a temperature within the range 1500 to 1600 °F (816 to 871 °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; tensile testing shall be performed in accordance with ASTM A 370:

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

TABLE 2 - Minimum Tensile Properties

Tensile Strength	150 ksi (1034 MPa)
Yield Strength at 0.2% Offset	135 ksi (931 MPa)
Elongation in 2 Inches (50.8 mm)	
Full Tube	10%
Strip	6%

3.4.2 Average Grain Size: Shall be ASTM No. 5 or finer, determined in accordance with ASTM E 112.

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 when measured at 90X to 110X. Decarburization on tubing ID shall not exceed the maximum depth specified in Table 3.

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 (ferritic) decarburization. Partial decarburization shall not exceed the limits specified in Table 3.

TABLE 3A - Decarburization Limits, Inch/Pound Units

Nominal Wall Thickness (T) Inch	Depth of Partial Decarburization Inch ID	Depth of Partial Decarburization Inch OD	Depth of Partial Decarburization Inch ID+OD
	Up to 0.040, incl	0.18T	0.18T
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 3B - Decarburization Limits, SI Units

Nominal Wall Thickness (T) Millimeters	Depth of Partial Decarburization Millimeters	Depth of Partial Decarburization Millimeters	Depth of Partial Decarburization Millimeters
	ID	OD	ID+OD
Up to 1.02, incl	0.18T	0.18T	0.25T
Over 1.02 to 1.27, incl	0.23	0.23	0.30
Over 1.27 to 1.78, incl	0.25	0.25	0.36
Over 1.78 to 2.03, incl	0.30	0.30	0.41
Over 2.03 to 2.29, incl	0.36	0.36	0.46
Over 2.29 to 2.54, incl	0.38	0.38	0.51
Over 2.54 to 3.81, incl	0.43	0.43	0.56
Over 3.81 to 4.78, incl	0.51	0.51	0.66

3.4.3.4 Decarburization shall be measured by the metallographic method, by the HR30N scale hardness testing method, or by microhardness traverse method in accordance with ASTM E 384. The hardness method(s) shall be conducted on a 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 decarburization thereon. In case of dispute, the depth of decarburization determined via the microhardness traverse method shall govern.

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 inch (0.13 mm) and the width is 0.065 inch (1.65 mm) or less.

3.5 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 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.

3.5.1 Steel shall be aircraft quality conforming to AMS 2301.

3.5.2 When specified, the tubing, either with or without machining of the surface, shall be subjected to magnetic particle inspection in accordance with ASTM E 1444. Standards for acceptance shall be as agreed upon by purchaser and vendor.

3.6 Tolerances:

Shall be in accordance with AMS 2253.

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:

All technical requirements are acceptance tests and shall be performed on each heat or lot as applicable.

4.3 Sampling and Testing:

Shall be in accordance with AMS 2370.

4.4 Reports:

The vendor of tubing shall furnish with each shipment a report showing the results of tests for composition and frequency-severity cleanliness rating of each heat and for tensile properties and average grain size of each lot, and stating that the product conforms to the other technical requirements. This report shall include the purchase order number, heat and lot numbers, AMS 6362F, size, and quantity.

4.5 Resampling and Retesting:

Shall be in accordance with AMS 2370.

5. PREPARATION FOR DELIVERY:

5.1 Sizes:

Except when exact lengths or multiples of exact lengths are ordered, straight tubing will be acceptable in mill lengths of 6 to 20 feet (1.8 to 6.1 m) but not more than 10% of any shipment shall be supplied in lengths shorter than 10 feet (3 m).

5.2 Identification:

Shall be in accordance with AMS 2807.

5.3 Protective Treatment:

Tubing shall be protected from corrosion prior to shipment.