AEROSPACE MATERIAL SPECIFICATION

AMS6360	REV. M

Issued 1939-12
Revised 2013-10

Superseding AMS6360L

Steel Tubing, Seamless
0.95Cr - 0.20Mo (0.28 - 0.33C) (SAE 4130)
Normalized or Stress Relieved
(Composition similar to UNS G41300)

RATIONALE

AMS6360M results from a Five Year Review and update of this specification.

1. SCOPE

1.1 Form

This specification covers an aircraft-quality, low-alloy steel in the form of seamless tubing.

1.2 Application

This tubing has been typically used in thin-walled sections where minimum tensile strength up to 160 ksi (1103 MPa) is required and where parts may be welded during fabrication, 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 International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AMS2253 Tolerances, Carbon and Alloy Steel Tubing

AMS2259 Chemical Check Analysis Limits, Wrought Low-Alloy and Carbon Steels

AMS2301 Steel Cleanliness, Aircraft Quality, Magnetic Particle Inspection Procedure

AMS2370 Quality Assurance Sampling and Testing, Carbon and Low-Alloy Steel Wrought Products and Forging Stock

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/AMS6360M

AMS2807 Identification, Carbon and Low-Alloy Steels, Corrosion and Heat-Resistant Steels and Alloys, Sheet, Strip, Plate and Aircraft Tubing

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, 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 Knoop and Vickers Hardness of Materials

ASTM E 1444 Magnetic Particle Testing

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 applicable requirements of AMS2259.

3.2 Condition

The tubing shall be supplied cold finished and either normalized and tempered, stress relieved, or otherwise heat treated.

3.3 Properties

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

3.3.1 Tensile Properties

Shall be as shown in Table 2.

TABLE 2A - MINIMUM TENSILE PROPERTIES, INCH/POUND UNITS

Nominal OD Inch		Nominal Wall Thickness Inch		Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 Inches % Full Tube	Elongation in 2 Inches % Strip
Up to	0.500, excl	Up to	0.188, incl	95	75	10	-
Up to	0.500, excl	Over	0.188	90	70	10	-
	0.500 and over	Up to	0.188, incl	95	75	12	7
	0.500 and over	Over	0.188	90	70	15	10

TABLE 2B - MINIMUM TENSILE PROPERTIES, SI UNITS

Nominal OD Millimeters		Nominal Wall Thickness Millimeters		Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50.8 mm % Full Tube	Elongation in 50.8 mm % Strip
Up to	12.70, excl	Up to	4.78, incl	655	517	10	-
Up to	12.70, excl	Over	4.78	621	483	10	-
	12.70 and over	Up to	4.78, incl	655	517	12	7
	12.70 and over	Over	4.78	621	483	15	10

3.3.2 Average Grain Size

Shall be ASTM No. 5 or finer, determined in accordance with ASTM E 112.

3.3.3 Decarburization

3.3.3.1 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 3.

3.3.3.2 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.

3.3.3.3 Tubing to which 3.3.3.1 or 3.3.3.2 is not applicable shall be free from complete decarburization. Partial decarburization shall not exceed the limits specified in Table 3.

TABLE 3A –MAXIMUM DEPTH OF DECARBURIZATION, 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	0.25T
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 0.200, incl	0.020	0.020	0.026

TABLE 3B – MAXIMUM DEPTH OF DECARBURIZATION, SI UNITS

Nominal Wall Thickness (T) Millimeters	Depth of Partial Decarburization Millimeter ID	Depth of Partial Decarburization Millimeter OD	Depth of Partial Decarburization Millimeter 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 5.08, incl	0.51	0.51	0.66

3.3.3.4 Decarburization shall be measured by the microscopic method or by a traverse method using microhardness testing in accordance with ASTM E 384. The microhardness method shall be conducted on a hardened but untempered specimen protected during heat treatment to prevent changes in surface carbon content. Depth of decarburization, when measured by the microhardness method, is defined as the perpendicular distance from the surface to the depth under that surface where there is no further increase in hardness. Such measurements shall be far enough away from any adjacent surface to be uninfluenced by decarburization on the adjacent surface. In case of dispute, the depth of decarburization determined using the microhardness traverse method shall govern.

3.3.3.4.1 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.

3.4 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.

3.4.1 Steel shall be aircraft quality conforming to AMS2301.

3.4.2 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.

3.5 Tolerances

Shall conform to all applicable requirements of AMS2253.

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.