



AEROSPACE MATERIAL SPECIFICATION	AMS6323™	REV. N
	Issued 1944-11 Reaffirmed 2007-04 Revised 2022-10	
Superseding AMS6323M		
Steel, Mechanical Tubing 0.50Cr - 0.55Ni - 0.25Mo (0.38 - 0.43C) (SAE 8740) (Composition similar to UNS G87400)		

RATIONALE

AMS6323N is the result of a Five-Year Review and update of the specification. The revision prohibits unauthorized exceptions (3.6, 4.4.3, 8.7), updates composition and reporting requirements (3.1, 3.1.2), acknowledges that there is no specific condition for this material (3.2, 8.8), updates macrostructure requirements consistent with other specifications (3.3.1, 8.8), modifies jominy requirements (3.3.3), updates decarburization requirements (3.3.4.4), acknowledges periodic testing per AMS2301 (4.2.1, 4.4.2), adds a stock removal note (8.4), and allows prior revision (8.6).

1. SCOPE

1.1 Form

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

1.2 Application

This tubing has been used typically for parts, 0.375 inch (9.52 mm) and under in section thickness at time of heat treatment, requiring a through-hardening steel capable of developing hardness as high as 50 HRC when hardened and tempered, and also for parts of greater thickness but requiring proportionately lower hardness, 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 +1 724-776-4970 (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 |

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SAE WEB ADDRESS:

For more information on this standard, visit
<https://www.sae.org/standards/content/AMS6323N/>

AMS2370	Quality Assurance Sampling and Testing, Carbon and Low-Alloy Steel, Wrought Products and Forging Stock
AMS2806	Identification ,Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Corrosion- and Heat-Resistant Steels and Alloys
AS1182	Standard Stock Removal Allowance, Aircraft-Quality and Premium Aircraft-Quality Steel Bars and Mechanical Tubing
AS7766	Terms Used in Aerospace Metals Specifications

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 A255	Determining Hardenability of Steel
ASTM A751	Chemical Analysis of Steel Products
ASTM E18	Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E112	Determining the Average Grain Size
ASTM E140	Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness
ASTM E381	Macroetch Testing Steel Bars, Billets, Blooms, and Forgings
ASTM E1077	Estimating the Depth of Decarburization of Steel Specimens

2.3 Definitions

Terms used in AMS are defined in AS7766.

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1, determined in accordance with ASTM A751 or by other analytical methods acceptable to purchaser.

Table 1 - Composition

Element	Min	Max
Carbon	0.38	0.43
Manganese	0.75	1.00
Silicon	0.15	0.35
Phosphorus	--	0.025
Sulfur	--	0.025
Chromium	0.40	0.60
Nickel	0.40	0.70
Molybdenum	0.20	0.30
Copper	--	0.35

3.1.1 Aluminum, vanadium, and columbium (niobium) are optional grain refining elements and need not be determined or reported unless used to satisfy the average grain size requirements of 3.3.2.2.

3.1.2 Producer may test for any element not listed in Table 1 and include this analysis in the report of 4.4. Reporting of any element not listed in the composition table is not a basis for rejection, unless limits of acceptability are specified by the purchaser.

3.1.3 Check Analysis

Composition variations shall meet the applicable requirements of AMS2259.

3.2 Condition

Cold finished, having hardness not higher than 25 HRC, or equivalent (see 8.2). Tubing ordered hot finished and annealed or tempered (see 8.8) shall have hardness not higher than 99 HRB, or equivalent. Hardness shall be determined in accordance with ASTM E18.

3.3 Properties

Tubing shall conform to the following requirements:

3.3.1 Macrostructure

Visual examination of transverse full cross-sections from tube rounds, etched in hot hydrochloric acid in accordance with ASTM E381, shall show no pipe or cracks. Porosity, segregation, inclusions, and other imperfections shall be no worse than the macrographs of ASTM E381 shown in Table 2.

3.3.1.1 Macrostructure examination is not required for mechanical tubing that is produced directly from ingots or large blooms unless otherwise agreed upon by purchaser and producer (see 8.8).

3.3.1.2 If mechanical tubing is produced directly from ingots or large blooms, transverse sections may be taken from the tubing. Macrostructure standards for such tubes shall be as agreed upon by purchaser and producer (see 8.8).

Table 2 - Macrostructure limits

Cross-Sectional Area Square Inches	Cross-Sectional Area Square Centimeters	Macrographs
Up to 36, incl	Up to 232, incl	S2 - R1 - C2
Over 36 to 133, incl	Over 232 to 858, incl	S2 - R2 - C3
Over 133	Over 858	Note 1

Note 1: Limits for larger sizes shall be agreed upon by purchaser and producer.

3.3.2 Average Grain Size

Average grain size shall be determined by either 3.3.2.1 or 3.3.2.2.

3.3.2.1 Shall be ASTM No. 5 or finer determined in accordance with ASTM E112.

3.3.2.2 The product of a heat shall be considered to have an ASTM No. 5 or finer austenitic grain size if one or more of the following are determined by heat analysis (see 8.5):

3.3.2.2.1 A total aluminum content of 0.020 to 0.050%.

3.3.2.2.2 An acid soluble aluminum content of 0.015 to 0.050%.

3.3.2.2.3 A vanadium content of 0.02 to 0.08%.

3.3.2.2.4 A columbium (niobium) content of 0.02 to 0.05%.

3.3.3 Hardenability

Shall be J 5/16 inch (7.9 mm) = 50 HRC minimum and J 8/16 inch (12.7 mm) = 40 HRC minimum, determined on the standard end-quench test specimen in accordance with ASTM A255, except that the steel shall be normalized at 1700 °F ± 10 °F (927 °C ± 6 °C) and the test specimen austenitized at 1500 °F ± 10 °F (816 °C ± 6 °C). Cast specimens do not need to be normalized.

3.3.4 Decarburization

3.3.4.1 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.

3.3.4.2 Allowable decarburization of pierced billets, of tube rounds and tubing for redrawing or forging, or of tubing ordered to specified microstructural requirements shall be as agreed upon by purchaser and producer.

3.3.4.3 Decarburization of tubing that 3.3.4.1 or 3.3.4.2 is not applicable shall be not greater than shown in Table 3.

Table 3A - Maximum depth of decarburization, inch/pound units

Nominal Wall Thickness Inches	Total Depth ID Inches	Total Depth OD Inches
Up to 0.109, incl	0.008	0.015
Over 0.109 to 0.203, incl	0.010	0.020
Over 0.203 to 0.400, incl	0.012	0.025
Over 0.400 to 0.600, incl	0.015	0.030
Over 0.600 to 1.000, incl	0.017	0.035
Over 1.000	0.020	0.040

Table 3B - maximum depth of decarburization, SI units

Nominal Wall Thickness Millimeters	Total Depth ID Millimeters	Total Depth OD Millimeters
Up to 2.77, incl	0.20	0.38
Over 2.77 to 5.16, incl	0.25	0.51
Over 5.16 to 10.16, incl	0.30	0.64
Over 10.16 to 15.24, incl	0.38	0.76
Over 15.24 to 25.40, incl	0.43	0.89
Over 25.40	0.51	1.02

3.3.4.4 Decarburization

Decarburization shall be evaluated by one of the two methods of 3.3.4.4.1 or 3.3.4.4.2, selected at the discretion of the producer.

3.3.4.4.1 Metallographic Method

A cross section taken perpendicular to the surface shall be etched, and examined metallographically at a magnification not to exceed 200X in accordance with ASTM E1077. The product shall not show a layer of complete (ferrite) or partial decarburization exceeding the limits of Table 3.

3.3.4.4.2 Hardness Traverse Method

The total depth of decarburization shall be determined by a traverse method using microindentation hardness testing in accordance with ASTM E1077. Samples shall be hardened in a protective atmosphere to prevent changes in surface carbon content. Samples may be tempered at the option of the producer. Measurements shall be far enough away from any adjacent surface to be uninfluenced by any decarburization on the adjacent surface. Acceptance shall be as listed in Table 3.

3.3.4.4.3 When determining the depth of decarburization, it is permissible to disregard local areas provided the decarburization of such areas does not exceed the limits of Table 3 by more than 0.005 inch (0.13 mm) and the width is 0.065 inch (1.65 mm) or less.

3.3.4.4.4 In case of dispute, the total depth of decarburization determined using the microindentation hardness traverse method shall govern.

3.4 Quality

Tubing, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from imperfections detrimental to usage of the tubing.

3.4.1 Steel shall be aircraft quality conforming to AMS2301.

3.4.2 Mechanical tubing shall be free from seams, laps, tears, and cracks after removal of the standard stock removal allowance in accordance with AS1182.

3.5 Tolerances

Shall conform to all applicable requirements of AMS2253.

3.6 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.3.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of tubing shall supply all samples for producer'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

All technical requirements are acceptance tests and shall be performed on each heat or lot as applicable. If grain refining elements (3.3.2.2) are not present, the ASTM E112 grain size test (3.3.2.1) shall be conducted on each lot. If process qualification in accordance with AMS2301 has been met, the frequency-severity cleanliness rating shall be conducted on a periodic basis as defined in AMS2301.

4.2.2 Periodic Tests

If grain refining elements (3.3.2.2) are present, the ASTM E112 grain size test (3.3.2.1) shall be conducted on a periodic basis and shall be performed at a frequency selected by the producer (not to exceed 1 year) unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing

Shall be in accordance with AMS2370.