



AEROSPACE MATERIAL SPECIFICATION	AMS6325™	REV. K
	Issued 1942-08 Reaffirmed 2000-08 Revised 2015-12 Superseding AMS6325J	
Steel, Bars, and Forgings 0.50Cr - 0.55Ni - 0.25Mo (0.38 - 0.43C) (SAE 8740) Heat Treated, 105 ksi (724 MPa) Tensile Strength (Composition similar to UNS G87400)		

RATIONALE

AMS6325K results from a Five Year Review and update of this specification that revises macrostructure, grain size testing, decarburization testing methods, and reporting.

1. SCOPE

1.1 Form

This specification covers an aircraft-quality, low-alloy steel in the form of heat treated bars and forgings.

1.2 Application

These products have been used typically for parts, such as nuts, bolts, and screws, 1.750 inches (44.45 mm) and under in section thickness requiring a minimum tensile strength of 105 ksi (724 MPa), 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.

- AMS2251 Tolerances, Low-Alloy Steel Bars
- 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

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AMS2372	Quality Assurance Sampling and Testing, Carbon and Low-Alloy Steel Forgings
AMS2750	Pyrometry
AMS2759/1	Heat Treatment of Carbon and Low-Alloy Steel Parts Minimum Tensile Strength Below 220 ksi (1517 MPa)
AMS2806	Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Corrosion and Heat-Resistant Steels and Alloys
AMS2808	Identification Forgings
AS1182	Standard Stock Removal Allowance, Aircraft-Quality and Premium Aircraft-Quality Steel Bars and Mechanical 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 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
ASTM E381	Macroetch Testing Steel Bars, Billets, Blooms, and Forgings
ASTM E384	Knoop and Vickers Hardness of Materials

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 E350, by spectrochemical methods, 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 are optional grain refining elements and need not be determined or reported unless used to satisfy the average grain size requirements of 3.4.2.2.

3.1.2 Check Analysis

Composition variations shall meet the applicable requirements of AMS2259.

3.2 Condition

The product shall be supplied in the following condition:

3.2.1 Bars

Bar shall not be cut from plate (also see 4.4.2).

3.2.1.1 Bars 0.500 Inch (12.70 mm) and Under in Nominal Diameter or Least Distance Between Parallel Sides

Cold finished, hardened, and tempered.

3.2.1.2 Bars Over 0.500 Inch (12.70 mm) in Nominal Diameter or Least Distance Between Parallel Sides

Hot finished, (or cold finished when so ordered), hardened, and tempered.

3.2.2 Forgings

Hardened and tempered in accordance with AMS2759/1.

3.3 Heat Treatment

The product shall be austenitized and hardened by quenching from 1550 °F ± 25 °F (843 °C ± 14 °C) and tempered as required to meet the requirements of 3.4.4 and 3.4.5. Pyrometry shall be in accordance with AMS2750.

3.4 Properties

The product shall conform to the following requirements; hardness and tensile testing shall be performed in accordance with ASTM A370:

3.4.1 Macrostructure

Visual examination of transverse full cross-sections from bars and forging stock 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.

Table 2 - Macrostructure limits

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

Note 1: Limits for larger sizes shall be agreed upon by purchaser and producer. The purchaser shall have written approval of the agreement from the cognizant engineering organization.

3.4.2 Average Grain Size

Average grain size shall be determined by either 3.4.2.1 or 3.4.2.2.

3.4.2.1 Shall be ASTM No. 5 or finer, determined in accordance with ASTM E112 on specimens following heat treatment per 3.3 and the specimen shall be without further heat treatment that involves re-austenitization.

3.4.2.2 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):

3.4.2.2.1 A total aluminum content of 0.020 to 0.050%.

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

3.4.2.2.3 A vanadium content of 0.02 to 0.08%.

3.4.2.2.4 A columbium content of 0.02 to 0.05%.

3.4.3 Decarburization

3.4.3.1 Bars ordered ground, turned, or polished shall be free from decarburization on the ground, turned, or polished surfaces.

3.4.3.2 Decarburization of bars that 3.4.3.1 is not applicable shall be not greater than shown in Table 3.

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

Nominal Diameter or Distance Between Parallel Sides Inches			Total Depth of Decarburization Inch
Up	to	0.375, incl	0.010
Over 0.375	to	0.500, incl	0.012
Over 0.500	to	0.625, incl	0.014
Over 0.625	to	1.000, incl	0.017
Over 1.000	to	1.500, incl	0.020
Over 1.500	to	1.750, incl	0.025

Table 3B - Maximum total depth of decarburization, SI units

Nominal Diameter or Distance Between Parallel Sides Millimeters			Total Depth of Decarburization Millimeter
Up	to	9.52, incl	0.25
Over 9.52	to	12.70, incl	0.30
Over 12.70	to	15.88, incl	0.36
Over 15.88	to	25.40, incl	0.43
Over 25.40	to	38.10, incl	0.51
Over 38.10	to	44.45, incl	0.64

3.4.3.3 Decarburization shall be evaluated by one of the two methods of 3.4.3.3.1 or 3.4.3.3.2.

3.4.3.3.1 Metallographic Method

A cross section taken perpendicular to the surface shall be prepared, etched, and visually examined metallographically at a magnification not to exceed 100X. The product shall not show a layer of complete (ferrite) or partial decarburization exceeding the limits of Table 3.

3.4.3.3.2 Hardness Traverse Method

The total depth of decarburization shall be determined by a traverse method using microhardness testing in accordance with ASTM E384, at a magnification not exceeding 100X, conducted on a hardened but untempered specimen protected during heat treatment to prevent changes in surface carbon content. Tempering is generally not recommended, but if tempered, the tempering temperature shall be not higher than 300 °F (149 °C). Depth of decarburization is defined as the perpendicular distance from the surface to the depth under that surface where there is not further increase in hardness. Such 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.

3.4.3.3.3 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.

3.4.3.3.4 In case of dispute, the total depth of decarburization determined using the microhardness traverse method shall govern.

3.4.4 Tensile Properties

Specimens, cut from bars 1.750 inches (44.45 mm) and under in nominal diameter or distance between parallel sides and from forgings 1.750 inches (44.45 mm) and under in nominal cross section, shall conform to the properties shown in Table 4.

Table 4 - Minimum tensile properties

Property	Value
Tensile Strength	105 ksi (724 MPa)
Yield Strength at 0.2% Offset	85 ksi (586 MPa)
Elongation in 4D	17%
Reduction of Area	55%

3.4.5 Hardness

Shall be 233 to 262 HB, or equivalent (see 8.2).

3.5 Quality

The product, 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 product.

3.5.1 Steel shall be aircraft-quality conforming to AMS2301.

3.5.2 Bars ordered hot rolled or cold drawn, or ground, turned, or polished shall, after removal of the standard stock removal allowance in accordance with AS1182, be free from seams, laps, tears, and cracks open to the machined, ground, turned, or polished surface.

3.5.3 Grain flow of die forgings, except in areas that contain flash-line end grain, shall follow the general contour of the forgings showing no evidence of reentrant grain flow.

3.6 Tolerances

Bars shall conform to all applicable requirements of AMS2251.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of the product shall supply all samples for producer's tests and shall be responsible for the performance all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Composition (3.1), macrostructure (3.4.1), average grain size (3.4.2), decarburization (3.4.3), tensile properties (3.4.4), hardness (3.4.5), frequency-severity cleanliness (3.5.1), and tolerances (3.6) are acceptance tests and shall be performed on each heat or lot as applicable. If grain refining elements (3.4.2.2) are not present, the ASTM E112 grain size test (3.4.2.1) shall be conducted on each lot.