AEROSPACE MATERIAL SPECIFICATION

AMS6325™	REV. M

Issued 1942-09
Reaffirmed 2000-09
Revised 2024-12

Superseding AMS6325L

(R) Steel, Bars, and Forgings,
Aircraft Quality,
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

AMS6325M is the result of a Five-Year Review and update of the specification. The revision adds material quality to the Title, removes alternative testing methods for grain size determination (see 3.1.1, 3.4.2.2, 4.2.2, 4.4.1, and 8.4 [prior revision]), updates macroetch requirements (see 3.4.1 and 8.8), revises decarburization testing (see 3.4.3.3), adds tensile strain rate (see 3.4.4.1), addresses updates to AMS2301 requirements (see 4.2.1 and 4.4.4), adds guidance on finish sizes (see 8.6), and updates the exceptions clauses (see 8.7).

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.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
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For more information on this standard, visit
https://www.sae.org/standards/content/AMS6325M/

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

AMS2372 Quality Assurance Sampling and Testing, Carbon and Low-Alloy Steel Forgings

AMS2750 Pyrometry

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

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 A370 Mechanical Testing of Steel Products

ASTM A751 Standard Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

ASTM E112 Determining 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

ASTME1077 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

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 the 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 The 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.

3.1.2 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

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

3.2.1.2 Bars 0.500 inch (12.70 mm) and under in nominal diameter or least distance between parallel sides shall be cold finished, hardened, and tempered.

3.2.1.3 Bars over 0.500 inch (12.70 mm) in nominal diameter or least distance between parallel sides shall be hot finished, (or cold finished when so ordered), hardened, and tempered.

3.2.2 Forgings

Forgings shall be hardened and tempered.

3.3 Heat Treatment

The product shall be austenitized and hardened by quenching at 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 forgings, 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, incl	Over 232 to 858, incl	S2 - R2 - C3
Over 133	Over 858	(1)

(1) Limits for larger sizes shall be agreed upon by the purchaser and producer.

3.4.1.1 Macrostructure examination is not required for bored/hollow forgings (including ring forgings) that are produced directly from ingots or blooms unless specified by the purchaser, in which case the purchaser shall specify the standards to be used.

3.4.2 Average Grain Size

3.4.2.1 The average grain size 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.

3.4.3 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 200X. Optical indications of decarburization shall not show a layer of complete (ferrite) or partial decarburization exceeding the limits of Table 3.

3.4.3.3.2 Hardness Traverse (Microindentation) 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 and protected during heat treatment to prevent changes in surface carbon content. Samples may be tempered at the option of the producer. Tempering is generally not recommended, but if tempered, the tempering temperature shall be not higher than 300 °F (149 °C). 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 microindentation hardness 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%

3.4.4.1 Unless otherwise specified, the strain rate shall be set at 0.005 in/in/min (0.005 mm/mm/min) and maintained within a tolerance of ±0.002 in/in/min (±0.002 mm/mm/min) through 0.2% offset yield strain. After the yield strain, the speed of the testing machine shall be set between 0.05 and 0.5 in/in (0.05 and 0.5 mm/mm) of the length of the reduced parallel section (or distance between the grips for specimens not having a reduced section) per minute. Alternatively, an extensometer and strain rate indicator may be used to set the strain rate between 0.05 and 0.5 in/in/min (0.05 and 0.5 mm/mm/min). The requirement for compliance becomes effective for material produced 1 year after the publication date of this specification.

3.4.5 Hardness

Hardness shall be 233 to 262 HBW, or equivalent (see 8.2).

3.5 Quality

The product, as received by the 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.

3.7 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 the product shall supply all samples for the producer's tests and shall be responsible for the performance of all required tests. The 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 (see 3.1), macrostructure (see 3.4.1), average grain size (see 3.4.2), decarburization (see 3.4.3), tensile properties (see 3.4.4), hardness (see 3.4.5), frequency-severity cleanliness (see 3.5.1), and tolerances (see 3.6) are acceptance tests and shall be performed on each heat or lot as applicable. 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

Grain flow of die forgings (see 3.5.3) is a periodic test and shall be performed at a frequency selected by the producer unless a frequency of testing is specified by the purchaser.

4.3 Sampling and Testing

4.3.1 Bars shall be sampled and tested in accordance with AMS2370.

4.3.2 Forgings shall be sampled and tested in accordance with AMS2372.

4.4 Reports

4.4.1 The producer of the product shall furnish with each shipment a report showing: producer identity; country where the metal was melted (e.g., final melt in the case of metal processed by multiple melting operations); results of tests for composition, macrostructure (except when not required per 3.4.1.1), and frequency-severity cleanliness rating of each heat (see 4.4.4); and results of tests for tensile properties, hardness, and, if measured, average grain size of each lot. The report shall state that the product conforms to the other technical requirements and shall include the purchase order number, heat and lot numbers, AMS6325M, product form and size or part number, and quantity. If forgings are supplied, the size and melt source of stock used to make the forgings shall also be included.

4.4.2 Report the nominal metallurgically worked cross-sectional size and the cut size, if different (see 3.2.1.1).

4.4.3 When material produced to this specification is beyond the sizes allowed in the scope or tables, or other exceptions are taken to the technical requirements listed in Section 3, the report shall contain a statement "This material is certified as AMS6325M(EXC) because of the following exceptions:" and the specific exceptions shall be listed (see 5.2.1).