AEROSPACE MATERIAL SPECIFICATION

AMS6327™	REV. M

Issued 1942-09
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Revised 2024-06

Superseding AMS6327L

(R) Steel Bars and Forgings
0.50Cr - 0.55Ni - 0.25Mo (0.38 - 0.43C) (SAE 8740)
Heat Treated, 125 ksi (862 MPa) Tensile Strength
(Composition similar to UNS G87400)

RATIONALE

AMS6327M is the result of a Five-Year Review and update of the specification. The revision updates compostiion testing and reporting (see 3.1 and 3.1.2), addresses grain size requirements based on composition (see 3.1.1, 3.4.1, 4.2.1, 4.2.2, 4.4.1, and 8.4), addresses exceptions based on size (see 1.1, Table 2, 3.4.4.2, 3.7, 4.3.4, 5.2.1, and 8.7), updates the heat-treatment specification (see 3.2.2), addresses macrostructure requirements (see 3.4.2.1 and 8.8), updates decarburization test methods (see 3.4.3.3.1 and 3.4.3.3.2), updates based on changes in AMS2301 (see 4.2.1 and 4.4.4), adds note based on finish (see 8.5), and allows prior revision (see 8.6).

1. SCOPE

1.1 Form

This specification covers an aircraft-quality, low-alloy steel in the form of bars and forgings 1.50 inches or less in diameter or least distance between parallel sides (thickness) .

1.2 Application

These products have been used typically for parts, such as nuts, bolts, and screws, 1.50 inch (38.1 mm) and under in section thickness, requiring a minimum tensile strength of 125 ksi (862 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)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/AMS6327M

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

AMS2761 Heat Treatment of Steel Raw Materials

AMS2806 Identification Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels, and Corrosion and Heat-Resistant Steels and Alloys

AMS2808 Identification, Forgings

AMS6322 Steel Bars, Forgings, and Rings and Stock for Forging or Flash Welded Rings, Aircraft-Quality, 0.50Cr - 0.55Ni - 0.25Mo (0.38 - 0.43C) (8740)

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 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, Inspection, and Rating Steel Products Comprising 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

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 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 3.4.1.

3.1.2 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.

3.1.3 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 (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 shall be 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 shall be hot finished, or cold finished when so ordered, and hardened and tempered.

3.2.2 Forgings

Forgings shall be hardened and tempered in accordance with AMS2761.

3.2.2.1 Forging stock produced to AMS6322 may be used as starting material for forgings.

3.3 Heat Treatment

Bars shall be hardened by quenching from 1550 °F ± 25 °F (843 °C ± 14 °C) and tempered as required; 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 Average Grain Size

Average grain size shall be determined by either 3.4.1.1 or 3.4.1.2.

3.4.1.1 The average grain size shall be ASTM No. 5 or finer, determined in accordance with ASTM E112.

3.4.1.2 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 8.4):

- A total aluminum content of 0.020 to 0.050%
- An acid soluble aluminum content of 0.015 to 0.050%
- A vanadium content of 0.02 to 0.08%
- A columbium (niobium) content of 0.02 to 0.05%

3.4.2 Macrostructure

Visual examination of transverse full cross sections from bars and billets, 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.

3.4.2.1 Macrostructure examination is not required for bored/hollow forgings (including ring forgings) that are produced directly from ingots or large blooms unless otherwise agreed upon by the 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.		

3.4.3 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 depth of decarburization limits, inch/pound units

Nominal Diameter or Distance Between Parallel Sides Inches	Total Depth of Decarburization Inches
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

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

Nominal Diameter or Distance Between Parallel Sides Millimeters	Total Depth of Decarburization Millimeters
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

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, selected at the discretion of the producer.

3.4.3.3.1 Metallographic (Microscopic) 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.

3.4.3.3.2 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 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.

3.4.3.3.3 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 1.500 inches (38.10 mm) and under in nominal diameter or distance between parallel sides and from forgings 1.500 inches (38.10 mm) and under in nominal cross section shall conform to the requirements of Table 4.

Table 4 - Minimum mechanical properties

Property	Value
Tensile Strength	125 ksi (862 Mpa)
Yield Strength at 0.2% Offset	100 ksi (689 Mpa)
Elongation in 2 inches (50 mm) or 4D	16%
Reduction of Area	50%

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 in/in and 0.5 in/in (0.05 mm/mm and 0.5 mm/mm) of the length of the reduced 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 in/in/min and 0.5 in/in/min (0.05 mm/mm/min and 0.5 mm/mm/min).

3.4.4.2 Mechanical property requirements for product outside the range in 3.4.4 shall be agreed between the purchaser and producer and reported as in 4.4.3.

3.4.5 Hardness

Hardness shall be 252 to 311 HBW, or equivalent (see 8.2), but the product shall not be rejected on the basis of hardness if the tensile property requirements of 3.4.4 are acceptable, determined on specimens taken from the same sample as the one with nonconforming hardness or from another sample with similar nonconforming hardness.

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

3.5.3 Forgings shall have substantially uniform macrostructure. Standards for acceptance shall be as agreed upon by the purchaser and producer (see 8.8).

3.5.4 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 tolerances 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), average grain size (see 3.4.1), macrostructure (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 grain refining elements (see 3.4.1.2) are not present, the ASTM E112 grain size test (see 3.4.1.1) 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 (see 3.4.1.2) are present, the ASTM E112 grain size test (see 3.4.1.1) 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 the purchaser. Grain flow of die forgings (see 3.5.4) 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

4.3.1 Bars shall be sampled in accordance with AMS2370.

4.3.2 Forgings shall be sampled in accordance with AMS2372.

4.4 Reports

4.4.1 The producer of bars and forgings shall furnish with each shipment a report showing the producer's identity, country where the metal was melted (e.g., final melt in the case of metal processed by multiple melting operations), results of composition, macrostructure, and frequency-severity cleanliness rating for each heat (see 4.4.4) and tensile properties, hardness and if measured, average grain size of each lot, and stating that the product conforms to other technical requirements. This report shall include the purchase order number, heat and lot numbers, AMS6327M, product form and size (and/or part number, if applicable), and quantity. If forgings are supplied, the size and melt source of stock used to make the forgings shall also be included. If the grain size requirement of 3.4.1 is met by the aluminum, vanadium, and/or columbium (niobium) content, the aluminum, vanadium, and/or columbium (niobium) content shall be reported and a statement that the chemistry satisfies the grain size requirement shall be included.

4.4.2 Report the nominal metallurgically worked size and the cut size, if different (see 3.2.1).

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 (see 5.2.1), the report shall contain a statement "This material is certified as AMS6327M(EXC) because of the following exceptions:" and the specific exceptions shall be listed.

4.4.4 Reduced Testing

If the producer has qualified for periodic testing for frequency-severity cleanliness rating in accordance with AMS2301, then the frequency severity cleanliness rating is not required to be reported for each shipment. In this circumstance the report shall read, "Process qualification in accordance with AMS2301 has been completed."

4.5 Resampling and Retesting

4.5.1 Bars shall be resampled and retested in accordance with AMS2370.

4.5.2 Forgings shall be resampled and retested in accordance with AMS2372.

5. PREPARATION FOR DELIVERY

5.1 Sizes

Except when exact lengths or multiples of exact lengths are ordered, straight bars 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

5.2.1 Bars

In accordance with AMS2806. When technical exceptions are taken (see 4.4.3), the material shall be marked with AMS6327M(EXC).

5.2.2 Forgings

In accordance with AMS2808.