



AEROSPACE MATERIAL

Society of Automotive Engineers, Inc.

TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

SPECIFICATION

AMS 6327E

Superseding AMS 6327D

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STEEL BARS AND FORGINGS

0.50Cr - 0.55Ni - 0.25Mo (0.38 - 0.43C) (SAE 8740)

Heat Treated, 125,000 psi (862 MPa) Tensile Strength

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: Primarily for parts, such as nuts, bolts, and screws, with sections 1.50 in. (38.1 mm) or less in thickness requiring a minimum tensile strength of 125,000 psi (862 MPa).

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) and Aerospace Standards (AS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

- 2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., Two Pennsylvania Plaza, New York, New York 10001.

2.1.1 Aerospace Material Specifications:

AMS 2251 - Tolerances, Alloy Steel Bars
AMS 2259 - Chemical Check Analysis Limits, Wrought Low Alloy and Carbon Steels
AMS 2301 - Aircraft Quality Steel Cleanliness, Magnetic Particle Inspection Procedure
AMS 2350 - Standards and Test Methods
AMS 2370 - Quality Assurance Sampling of Carbon and Low Alloy Steels, Wrought Products Except Forgings
AMS 2372 - Quality Assurance Sampling of Carbon and Low Alloy Steels, Forgings and Forging Stock
AMS 2375 - Approval and Control of Critical Forgings
AMS 2808 - Identification, Forgings

2.1.2 Aerospace Standards:

AS 1182 - Standard Machining Allowance, Aircraft Quality and Premium Quality Steel Products

- 2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

ASTM A370 - Mechanical Testing of Steel Products
ASTM E112 - Estimating Average Grain Size of Metals
ASTM E350 - Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron
ASTM E381 - Rating Macroetched Steel

- 2.3 Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.

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2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

3. TECHNICAL REQUIREMENTS:

- 3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E350, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other approved analytical methods:

	min	max
Carbon	0.38 - 0.43	
Manganese	0.75 - 1.00	
Silicon	0.20 - 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 Check Analysis: Composition variations shall meet the requirements of AMS 2259, paragraph titled "Low Alloy Steels".

- 3.2 Condition: The product shall be supplied in the following condition:

3.2.1 Bars:

- 3.2.1.1 Bars 0.500 In. (12.70 mm) and Under in Diameter or Distance Between Parallel Sides: Cold finished, hardened and tempered.

- 3.2.1.2 Bars Over 0.500 In. (12.70 mm) in Diameter or Distance Between Parallel Sides: Hot finished, or cold finished when so ordered, hardened and tempered.

3.2.2 Forgings: Hardened and tempered.

- 3.3 Heat Treatment: Bars and forgings shall be hardened by quenching from $1550\text{ F} \pm 25$ ($843.3\text{ C} \pm 14$) and tempered as required to meet the requirements of 3.4.4 and 3.4.5.

- 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 Grain Size: Predominantly 5 or finer with occasional grains as large as 3 permissible, ASTM E112, McQuaid-Ehn test.

- 3.4.2 Macrostructure: Visual examination of transverse sections from bars, etched in accordance with ASTM E381 in hot hydrochloric acid (1:1) at $160 - 180\text{ F}$ ($71.1 - 82.2\text{ C}$) for sufficient time to develop a well-defined macrostructure, shall show no injurious imperfections such as pipe, cracks, porosity, segregation, and inclusions detrimental to fabrication or to performance of parts. Macrostructure shall be equal to or better than the following macrographs of ASTM E381:

Section Size		Macrographs
Square Inches	(Square Centimeters)	
Up to 36, incl	(Up to 232, incl)	S2 - R1 - C2
Over 36 to 100, incl	(Over 232 to 645, incl)	S2 - R2 - C3
Over 100	(Over 645)	As agreed upon

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 to which 3.3.3.1 is not applicable shall not be greater than shown in Table I:

TABLE I

Nominal Diameter or Distance Between Parallel Sides Inches	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

TABLE I (SI)

Nominal Diameter or Distance Between Parallel Sides Millimeters	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

3.4.3.2.1 Limits for depth of decarburization of bars over 1.500 in. (38.10 mm) in nominal diameter or distance between parallel sides shall be as agreed upon by purchaser and vendor.

3.4.3.3 Decarburization shall be measured by the microscopic method or by Rockwell Superficial 30-N scale or equivalent hardness testing method on specimens cut from bars. Depth of decarburization, when measured by a hardness method, is defined as the perpendicular distance from the surface to the depth under that surface below which there is no further increase in hardness. Such measurements shall be far enough away from any adjacent surface to be uninfluenced by any decarburization or lack of decarburization thereon.

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

3.4.4 Tensile Properties: Test specimens cut from bars 1.500 in. (38.10 mm) and under in diameter or distance between parallel sides and from forgings 1.500 in. (38.10 mm) and under in cross section shall conform to the following requirements:

Tensile Strength, min	125,000 psi (862 MPa)
Yield Strength at 0.2% Offset, min	100,000 psi (690 MPa)
Elongation in 2 in. (50.8 mm) or 4D, min	16%
Reduction of Area, min	50%

- 3.4.4.1 Tensile properties of bars over 1.500 in. (38.10 mm) in diameter or distance between parallel sides and of forgings over 1.500 in. (38.10 mm) in cross section shall be as agreed upon between purchaser and vendor.
- 3.4.5 Hardness: Shall be 262 - 311 HB or equivalent.
- 3.5 Quality: Steel shall be aircraft quality conforming to AMS 2301. The product shall be uniform in quality and condition, clean, sound, and free from foreign materials and from internal and external imperfections detrimental to fabrication or to performance of parts.
- 3.5.1 Bars ordered ground, turned, or polished shall be free from seams, laps, tears, and cracks open to the ground, turned, or polished surfaces.
- 3.5.2 Product ordered to surface conditions other than ground, turned, or polished shall, after removal of the standard machining allowance, be free from seams, laps, tears, cracks, and other defects exposed to the machined surfaces. Standard machining allowance shall be in accordance with AS 1182.
- 3.6 Sizes: Except when exact lengths or multiples of exact lengths are ordered, bars will be acceptable in mill lengths of 6 - 20 ft (1.8 - 6.1 m) but not more than 10% of any shipment shall be supplied in lengths shorter than 10 ft (3 m).
- 3.7 Tolerances: Unless otherwise specified, tolerances for bars shall conform to all applicable requirements of AMS 2251.
4. QUALITY ASSURANCE PROVISIONS:
- 4.1 Responsibility for Inspection: The vendor of the product shall supply all samples and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.5. Purchaser reserves the right to perform such confirmatory testing as he deems necessary to assure that the product conforms to the requirements of this specification.
- 4.2 Classification of Tests: Tests to determine conformance to all technical requirements of this specification are classified as acceptance or routine control tests.
- 4.3 Sampling: Shall be in accordance with the following:
- 4.3.1 Bars: AMS 2370.
- 4.3.2 Forgings: AMS 2372.
- 4.4 Approval: When specified, approval and control of critical forgings shall be in accordance with AMS 2375.
- 4.5 Reports:
- 4.5.1 The vendor of the product shall furnish with each shipment three copies of a report of the results of tests for chemical composition, grain size, macrostructure, and AMS 2301 frequency-severity rating of each heat in the shipment and for tensile properties of each size from each heat. This report shall include the purchase order number, heat number, material specification number and its revision letter, size, and quantity from each heat. If forgings are supplied, the part number and the size and melt source of stock used to make the forgings shall also be included.
- 4.5.2 The vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, material specification number and its revision letter, contractor or other direct supplier of material, part number, and quantity. When material for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of material to determine conformance to the requirements of this specification, and shall include in the report a statement that the material conforms, or shall include copies of laboratory reports showing the results of tests to determine conformance.