



# AEROSPACE MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.  
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

**AMS 6317D**

Superseding AMS 6317C

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## STEEL BARS AND FORGINGS

1.8Ni - 0.25Mo (0.38 - 0.43C) (4640)

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 with sections 1.0 in. (25 mm) and under in nominal 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., 400 Commonwealth Drive, Warrendale, PA 15096.

#### 2.1.1 Aerospace Material Specifications:

- AMS 2251 - Tolerances, Low-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 and Forging Stock
- AMS 2372 - Quality Assurance Sampling of Carbon and Low-Alloy Steels, Forgings and Forging Stock
- AMS 2375 - Control of Forgings Requiring First Article Approval
- AMS 2806 - Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Heat and Corrosion Resistant Steels and Alloys
- 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, PA 19103.

- ASTM A370 - Mechanical Testing of Steel Products
- ASTM E112 - Estimating the 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

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

2.3.1 Federal Standards:

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

2.3.2 Military Standards:

MIL-STD-163 - Steel Mill Products, Preparation for Shipment and Storage

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	0.60	0.80
Silicon	0.15	0.35
Phosphorus	--	0.025
Sulfur	--	0.025
Nickel	1.65	2.00
Molybdenum	0.20	0.30
Chromium	--	0.20
Copper	--	0.35

Ø 3.1.1 Check Analysis: Composition variations shall meet the applicable requirements of AMS 2259.

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 Nominal Diameter or Distance Between Parallel Sides:  
Ø Cold finished, hardened, and tempered.

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

3.2.2 Forgings: Hardened and tempered.

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

- 3.3.1 Macrostructure: Visual examination of transverse sections from bars, billets, and forgings, etched in accordance with ASTM E381 in hot hydrochloric acid (1:1) at 160° - 180° F (71° - 82° C) for sufficient time to develop a well-defined macrostructure, shall show no 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 Centimetres)	
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

- 3.3.2 Grain Size: Predominantly 5 or finer with occasional grains as large as 3 permissible, determined in accordance with ASTM E112.

3.3.3 Decarburization

- 3.3.3.1 Bars ordered ground, turned, or polished shall be free from decarburization on the ground, turned, or polished surfaces.
- 3.3.3.2 Decarburization of bars to which 3.3.3.1 is not applicable shall be not 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
Over 1.500 to 2.000, incl	0.025
Over 2.000 to 2.500, incl	0.030
Over 2.500 to 3.000, incl	0.035

TABLE I (SI)

Nominal Diameter or Distance Between Parallel Sides Millimetres	Depth of Decarburization Millimetre
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 50.80, incl	0.64
Over 50.80 to 63.50, incl	0.76
Over 63.50 to 76.20, incl	0.89

3.3.3.2.1 Limits for depth of decarburization of bars over 3.000 in. (76.20 mm) in nominal diameter or distance between parallel sides shall be as agreed upon by purchaser and vendor.

3.3.3.3 Decarburization shall be measured by the microscopic method or by Rockwell Superficial 30-N scale or equivalent hardness testing methods 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.

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

3.3.4 Tensile Properties: Test specimens cut longitudinally from bars 1.00 in. (25.4 mm) and under in nominal diameter or distance between parallel sides and from forgings 1.00 in. (25.4 mm) and under in nominal cross-section with axis of specimen in the area of gage length within 15 deg of parallel to the forging flow lines shall have the following properties:

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

3.3.4.1 Transverse tensile properties and longitudinal tensile properties of bars over 1.00 in. (25.4 mm) in nominal diameter or distance between parallel sides and of forgings over 1.00 in. (25.4 mm) in nominal cross-section shall be as agreed upon by purchaser and vendor.

3.3.5 Hardness: Should be 262 - 311 HB or equivalent but the product shall not be rejected on the basis of hardness if the tensile property requirements of 3.3.4 are met.

#### 3.4 Quality:

3.4.1 Steel shall be aircraft quality conforming to AMS 2301.

3.4.2 The product, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from internal and external imperfections detrimental to usage of the product.

3.4.2.1 Bars ordered ground, turned, or polished shall be free from seams, laps, tears, and cracks open to the ground, turned, or polished surfaces.

3.4.2.2 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.