



# AEROSPACE MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.  
TWO PENNSYLVANIA PLAZA, NEW YORK, N. Y. 10001

## AMS 6312B

Superseding AMS 6312A

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STEEL BARS, FORGINGS, AND TUBING  
1.8Ni - 0.25Mo (0.38 - 0.43C) (4640)

### 1. SCOPE:

- 1.1 Form: This specification covers an aircraft-quality, low-alloy steel in the form of bars, forgings, mechanical tubing, and forging stock.
- 1.2 Application: Primarily for parts with sections 0.25 in. (6.35 mm) or less in thickness at the time of heat treatment which require a through-hardening steel capable of developing hardness as high as 50 HRC when properly hardened and tempered and also parts of greater thickness but requiring proportionately lower hardness.

### 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 2253 - Tolerances, Carbon and Alloy Steel Tubing  
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 A255 - End-Quench Test for Hardenability of Steels  
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 Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.

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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	0.60	0.80
Silicon	0.20	0.35
Phosphorus	--	0.025
Sulfur	--	0.025
Nickel	1.65	2.00
Molybdenum	0.20	0.30
Chromium	--	0.20
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; hardness and tensile strength, as applicable, shall be determined in accordance with ASTM A370:

3.2.1 Bars:

3.2.1.1 Bars 0.500 In. (12.7 mm) and Under in Diameter or Distance Between Parallel Sides: Cold finished having tensile strength not higher than 130,000 psi (896 MN/m<sup>2</sup>).

3.2.1.2 Bars Over 0.500 In. (12.7 mm) in Diameter or Distance Between Parallel Sides: Hot finished having hardness not higher than 229 HB or equivalent except that bars ordered cold finished may have hardness as high as 241 HB or equivalent.

3.2.2 Forgings: As ordered.

3.2.3 Mechanical Tubing: Cold finished having hardness not higher than 25 HRC except that tubing ordered hot finished shall have hardness not higher than 99 HRB or equivalent.

3.2.4 Forging Stock: As ordered by the forging manufacturer.

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

3.3.1 Hardenability: Shall be J50=3 min and J35=9 min, determined on the standard end-quench test specimen in accordance with ASTM A255 except that the steel shall be normalized at 1550 F + 10 (843.3 C + 5.6) and the test specimen austenized at 1500 F + 10 (815.6 C + 5.6). The hardenability test is not required on a product that will not yield a suitable specimen but the steel from which the product is made shall conform to the hardenability specified.

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

3.3.3 Macrostructure: Visual examination of transverse sections of bars, tubing, and forging stock which have been etched in accordance with ASTM E381 in hot hydrochloric acid (1:1) at 160 - 180 F (71.1 - 82.2 C) for sufficient time to develop a well-defined macrostructure shall show no injurious imperfections such as pipe, internal 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 232.3, incl)	S2 - R1 - C2
Over .36 to 100, incl	(Over 232.3 to 645.2, incl)	S2 - R2 - C3
Over 100	(Over 645.2)	As agreed upon

3.3.4 Decarburization:

3.3.4.1 Bars and tubing ordered ground, turned, or polished shall be free from decarburization on the ground, turned, or polished surfaces. Inside decarburization of such tubing shall not exceed the maximum depth specified in Table II.

3.3.4.2 Allowable decarburization of bars, billets, and tubing ordered for redrawing or forging or to specified microstructural requirements shall be as agreed upon by purchaser and vendor.

3.3.4.3 Decarburization of bars to which 3.3.4.1 or 3.3.4.2 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
Over 3.000 to 4.000, incl	0.045

TABLE I (SI)

Nominal Diameter or Distance Between Parallel Sides Millimeters	Depth of Decarburization Millimeters
Up to 9.525, incl	0.254
Over 9.525 to 12.700, incl	0.305
Over 12.700 to 15.875, incl	0.356
Over 15.875 to 25.400, incl	0.432
Over 25.400 to 38.100, incl	0.508
Over 38.100 to 50.800, incl	0.635
Over 50.800 to 63.500, incl	0.762
Over 63.500 to 76.200, incl	0.889
Over 76.200 to 101.600, incl	1.143

3.3.4.3.1 Limits for depth of decarburization of bars over 4.000 in. (101.60 mm) in nominal diameter or distance between parallel sides shall be as agreed upon by purchaser and vendor.

3.3.4.4 Decarburization of tubing to which 3.3.4.1 or 3.3.4.2 is not applicable shall be not greater than shown in Table II.

TABLE II

Nominal Wall Thickness Inches	Depth of Decarburization Inch	
	ID	OD
Up to 0.109, incl	0.008	0.015
Over 0.109 to 0.203, incl	0.010	0.020
Over 0.203 to 0.400, incl	0.012	0.025
Over 0.400 to 0.600, incl	0.015	0.030
Over 0.600 to 1.000, incl	0.017	0.035
Over 1.000	0.020	0.040

TABLE II (SI)

Nominal Wall Thickness Millimeters	Depth of Decarburization Millimeters	
	ID	OD
Up to 2.769, incl	0.203	0.381
Over 2.769 to 5.156, incl	0.254	0.508
Over 5.156 to 10.160, incl	0.305	0.635
Over 10.160 to 15.240, incl	0.381	0.762
Over 15.240 to 25.400, incl	0.432	0.889
Over 25.400	0.508	1.016

3.3.4.5 Decarburization shall be measured by the microscopic method or by Rockwell Superficial 30-N scale or equivalent hardness testing method on hardened but untempered specimens protected during heat treatment to prevent changes in surface carbon content. 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.

3.3.4.5.1 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. (0.127 mm) and the width is 0.065 in. (1.651 mm) or less.

3.4 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.

3.4.1 Bars and tubing 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 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 injurious defects exposed to the machined surfaces. Standard machining allowance shall be in accordance with values shown in AS 1182.