SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 6378F

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Superseding AMS 6378E

Steel Bars
1.0Cr - 0.20Mo - 0.45Se (0.39 - 0.48C) (4142H Modified)
Die-Drawn, 130 ksi (896 MPa) Yield Strength
Free Machining

(Composition similar to UNS K11542)

1. SCOPE:

1.1 Form:

This specification covers a free-machining, low-alloy steel in the form of round bars 3.50 inches (88.9 mm) and under in nominal diameter.

1.2 Application:

These bars have been used typically for parts, such as shafts, axles, pins, fasteners, gears, and screw machine parts, which are normally used at hardness of 30 to 36 HRC and which do not require a high degree of ductility, 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 canceled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2251	Tolerances, Low-Alloy Steel Bars
MAM 2251	Tolerances, Metric, Low-Alloy Steel Bars
AMS 2259	Chemical Check Analysis Limits, Wrought Low-Alloy and Carbon Steels
AMS 2370	Quality Assurance Sampling and Testing, Carbon and Low-Alloy Steel, Wrought Products and Forging Stock
AMS 2806	Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Corrosion and Heat Resistant Steels and Alloys

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
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SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/AMS6378F

2.1 (Continued):

AS1182 Standard Machining Allowance, Aircraft-Quality and Premium Aircraft-Quality Steel Bars and Mechanical Tubing

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM A 370 Mechanical Testing of Steel Products
ASTM E 112 Determining Average Grain Size
ASTM E 350 Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron
ASTM E 381 Macroetch Testing Steel Bars, Billets, Blooms, and Forgings
ASTM E 384 Microindentation Hardness of Materials

3. TECHNICAL REQUIREMENTS:

3.1 Composition:

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 350, by spectrochemical methods, or by other analytical methods acceptable to purchaser:

TABLE 1 - Composition

Element	min	max
Carbon	0.39	0.48
Manganese	0.70	1.10
Silicon	0.15	0.35
Phosphorus	--	0.040
Sulfur	--	0.040
Chromium	0.75	1.20
Molybdenum	0.15	0.25
Selenium	0.03	0.06
Nickel	--	0.25
Copper	--	0.35

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

3.2 Condition:

Bars shall be elevated-temperature die-drawn.

3.2.1 Temperatures for die drawing shall be selected significantly above room temperature but below the transformation range to produce a uniform structure of deformed pearlite and ferrite providing good machinability.

3.3 Properties:

Bars shall conform to the following requirements; tensile and hardness testing shall be performed in accordance with ASTM A 370:

3.3.1 Macrostructure: Visual examination of transverse full cross-sections from bars and billets, etched in hot hydrochloric acid in accordance with ASTM E 381, shall show no pipe or cracks. Porosity, segregation, inclusions, and other imperfections shall be no worse than the macrographs of ASTM E 381 shown in Table 2.

TABLE 2 - Macrostructure Limits

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

3.3.2 Average Grain Size: Shall be ASTM No. 5 or finer determined in accordance with ASTM E 112 (See 8.2).

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 3.

TABLE 3A - Maximum Decarburization Limits, Inch/Pound Units

Nominal Diameter 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

TABLE 3A - Maximum Decarburization Limits, Inch/Pound Units

Nominal Diameter Inches	Total Depth of Decarburization Inch
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 3.500, incl	0.040

TABLE 3B - Maximum Decarburization Limits, SI Units

Nominal Diameter 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
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
Over 76.20 to 88.90, incl	1.02

3.3.3.3 Decarburization shall be measured by the metallographic method, by the HR30N scale hardness testing method, or by a traverse method using microhardness testing in accordance with ASTM E 384. The hardness method(s) shall be conducted on a hardened but untempered specimen 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 on the adjacent surface. In case of dispute, the depth of decarburization determined using the microhardness traverse method shall govern.

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 inch (0.13 mm) and the width is 0.065 inch (1.65 mm) or less.

3.3.4 Tensile Properties: Specimens, cut from the center of bars 1.50 inches (38.1 mm) and under in nominal diameter and at mid-radius on sizes larger than 1.50 inches (38.1 mm), shall conform to Table 4.

TABLE 4 - Minimum Tensile Properties

Property	Value
Tensile Strength	150 ksi (1034 MPa)
Yield Strength at 0.2% Offset	130 ksi (896 MPa)
Elongation in 4D	5%
Reduction of Area	20%

3.3.5 Hardness: Shall be 302 to 341 HB, or equivalent, (See 8.3) but bars shall not be rejected on the basis of hardness if the tensile properties are acceptable, determined on specimens taken from the same sample as that with nonconforming hardness or from another sample with similar nonconforming hardness.

3.4 Quality:

Bars, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from imperfections detrimental to usage of the bars.

3.4.1 Bars ordered as die drawn, or ground, turned, or polished shall, after removal of the standard machining allowance in accordance with AS1182, be free from seams, laps, tears, and cracks open to the ground, turned, or polished surface.

3.5 Tolerances:

Bars shall conform to all applicable requirements of AMS 2251 or MAM 2251, except that tolerances for diameter shall be as shown in Table 5.

TABLE 5A - Diameter Tolerances, Inch/Pound Units

Nominal Diameter Inches	Tolerance, Inch Minus Only
Up to 0.375, incl	0.003
Over 0.375 to 1.500, incl	0.005
Over 1.500 to 2.500, incl	0.006
Over 2.500 to 3.500, incl	0.007

TABLE 5B - Diameter Tolerances, SI Units

Nominal Diameter Millimeters	Tolerance, Millimeter Minus Only
Up to 9.52, incl	0.08
Over 9.52 to 38.10, incl	0.13
Over 38.10 to 63.50, incl	0.15
Over 63.50 to 88.90, incl	0.18