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400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 6378D

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Superseding AMS 6378C

STEEL BARS
1.0Cr - 0.20Mo - 0.015Te (0.39 - 0.48C) (4142H Modified)
Die-Drawn, 130,000 psi (896 MPa) Yield Strength
Free Machining

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: Primarily for parts, such as shafts, axles, pins, fasteners, gears, and screw machine parts, which are normally used at hardness of 30 - 36 HRC and which do not require a high degree of ductility.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

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 2350 - Standards and Test Methods
AMS 2370 - Quality Assurance Sampling of Carbon and Low-Alloy Steels, Wrought Products Except Forgings and Forging Stock
AMS 2806 - Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Corrosion and Heat Resistant Steels and Alloys

2.1.2 Aerospace Standards:

AS1182 - Standard Machining Allowance, Aircraft Quality and Premium Quality Steel Products

2.2 ASTM Publications: Available from ASTM, 1916 Race Street, Philadelphia, PA 19103.

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, Inspection, and Rating Steel Products, Comprising Bars, Billets, Blooms, and Forgings

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

2.3.1 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 Ø by wet chemical methods in accordance with ASTM E 350, by spectrochemical methods, or by other analytical methods acceptable to purchaser:

	min	max
Carbon	0.39	0.48
Manganese	0.70	1.10
Silicon	0.15	0.35
Phosphorus	--	0.040
Sulfur (3.1.1)	0.04	0.060
Chromium	0.75	1.20
Molybdenum	0.15	0.25
Tellurium (3.1.1)	0.01	0.02
Nickel	--	0.25
Copper	--	0.35

3.1.1 Selenium may be substituted for tellurium. In such event, selenium shall be 0.03 - 0.06 and sulfur shall be 0.040 maximum.

3.1.2 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; hardness and tensile testing shall be performed in accordance with ASTM A 370:

3.3.1 Macrostructure: Visual examination of transverse sections from bars and billets, etched in accordance with ASTM E 381, shall show no pipe or cracks. Porosity, segregation, inclusions, and other imperfections shall be no worse than the following macrographs of ASTM E 381:

Section Size		
Square Inches	Square Centimetres	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
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 E 112.

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 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 3.500, incl	0.040

TABLE I (SI)

Nominal Diameter Millimetres	Depth of Decarburization Millimetres
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 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.

3.3.3.3.1 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 the following:

Tensile Strength, minimum	150,000 psi (1034 MPa)
Yield Strength at 0.2% Offset, minimum	130,000 psi (896 MPa)
Elongation in 4D, minimum	5%
Reduction of Area, minimum	20%

3.3.5 Hardness: Should be 302 - 341 HB, or equivalent, across the cross-section but bars shall not be rejected on the basis of hardness if the tensile property requirements are met.

3.4 Quality:

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

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

3.4.3 Bars 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 surface. Standard machining allowance shall be in accordance with AS1182.

3.5 Sizes: Except when exact lengths or multiples of exact lengths are ordered, straight bars will be acceptable in mill lengths of 6 - 20 feet (1.8 - 6.1 m) but not more than 10% of any shipment shall be supplied in lengths shorter than 10 feet (3 m).

3.6 Tolerances: Bars shall conform to all applicable requirements of AMS 2251 or MAM 2251, except that tolerances for diameter shall be as follows:

TABLE II

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 II (SI)

Nominal Diameter Millimetres	Tolerance, Millimetre 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

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of bars shall supply all samples for vendor's tests and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.4. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the bars conform to the requirements of this specification.

4.2 Classification of Tests: Tests for all technical requirements are acceptance tests and shall be performed on each heat or lot as applicable.

4.3 Sampling and Testing: Shall be in accordance with AMS 2370 and the following; Ø the number of specimens to be sampled shall be the minimum number of specimens tested: