SAE Aerospace
An SAE International Group

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 6528B

Issued APR 1987
Revised AUG 2002
Reaffirmed APR 2007

Superseding AMS 6528A

Steel, Bars
0.95Cr - 0.20Mo (0.28 - 0.33C) (SAE 4130)
Special Aircraft Quality Cleanliness
Normalized

(Composition similar to UNS G41300)

RATIONALE

This document has been reaffirmed to comply with the SAE 5-year Review policy.

1. SCOPE:

1.1 Form:

This specification covers a special aircraft-quality, low-alloy steel in the form of bars.

1.2 Application:

These bars have been used typically for parts required to meet stringent magnetic inspection criteria, having sections 0.50 inch (12.7 mm) and under in nominal thickness at time of heat treatment, and requiring a through-hardening steel capable of developing hardness as high as 35 HRC when properly hardened and tempered, and also parts of greater thickness but requiring proportionately lower hardness, 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.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: custsvc@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or www.sae.org.

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 2304	Steel Cleanliness, Special Aircraft-Quality, Magnetic Particle Inspection Procedure
MAM 2304	Steel Cleanliness, Special Aircraft-Quality, Magnetic Particle Inspection Procedure, Metric (SI) Measurement
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, Corrosion and Heat Resistant Steels and Alloys
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 or www.astm.org.

ASTM A 255	Determining Hardenability of Steel
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	0.28	0.33
Manganese	0.40	0.60
Silicon	0.15	0.35
Phosphorus	--	0.015
Sulfur	--	0.008
Chromium	0.80	1.10
Molybdenum	0.15	0.25
Nickel	--	0.25
Copper	--	0.35

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

3.2 Condition:

3.2.1 Hot rolled and normalized at 1700 °F ± 25 (927 °C ± 14).

3.2.1.1 When specified, either a cold drawn or cold finished surface shall be supplied.

3.2.1.1.1 Cold finished surface shall be produced by turning, grinding, polishing, or burnishing, or combination thereof; surface hardness shall be not more than 3 points HRC harder than hardness at mid-radius, determined in accordance with ASTM A 370.

3.2.1.2 Cold finished surface may be supplied when cold drawn, hot rolled, or no surface condition is specified.

3.2.1.3 Cold drawn surface may be supplied when hot rolled or no surface condition is specified.

3.3 Properties:

Bars shall conform to the following requirements; hardness testing shall conform to 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

Cross-Sectional Area Square Inches	Cross-Sectional Area 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.

3.3.3 Hardenability: Shall be J5/16 inch (7.9 mm) = 34 HRC minimum and J8/16 inch (12.7 mm) = 27 HRC minimum, determined in accordance with ASTM A 255 except that the normalizing temperature shall be 1700 °F ± 10 (927 °C ± 6) (See 8.2).

3.3.4 Decarburization:

3.3.4.1 Bars ordered ground, turned, or polished shall be free from decarburization on the ground, turned, or polished surfaces.

3.3.4.2 Allowable decarburization of bars and billets ordered for redrawing 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 3.

TABLE 3A - Maximum Decarburization, Inch/Pound Units

Nominal Thickness or Distance Between Parallel Sides 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
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 3B - Maximum Decarburization, SI Units

Nominal Thickness or Distance Between Parallel Sides 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 101.60, incl	1.14

3.3.4.4 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.

3.3.4.4.1 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.

3.4 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 Steel shall be special aircraft-quality conforming to AMS 2304 or MAM 2304 (See 8.3).

3.4.2 Bars, ordered hot rolled or cold 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:

Shall conform to all applicable requirements of AMS 2251 or MAM 2251.

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 the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the bars conform to specified requirements.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Composition (3.1), macrostructure (3.3.1), average grain size (3.3.2), hardenability (3.3.3), decarburization (3.3.4), frequency-severity cleanliness rating (3.4.1), and tolerances (3.5), are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.2 Periodic Tests: Cold finished surface hardness (3.2.1.1.1) is a periodic test and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing:

Shall be in accordance with AMS 2370 and the following:

4.3.1 Samples for frequency-severity cleanliness rating (3.4.1) shall conform to AMS 2304 or MAM 2304.

4.4 Reports:

The vendor of bars shall furnish with each shipment a report showing the results of tests for chemical composition, macrostructure, hardenability, and frequency-severity cleanliness rating of each heat and average grain size of each lot, and stating that the bars conform to the other technical requirements. This report shall include the purchase order number, heat and lot numbers, AMS 6528B, size, and quantity.

4.5 Resampling and Retesting:

Shall be in accordance with AMS 2370 except that resampling for cleanliness shall conform to 4.5.1.

4.5.1 If any specimen fails to meet the specified frequency-severity cleanliness requirements, the entire heat shall be rejected or resampling and retesting shall be performed as follows:

4.5.1.1 Nonconforming Ingot(s): Reject or take additional discard and resample and retest.

4.5.1.2 Ingot(s) Not Originally Sampled: Sample and test material from the respective nonconforming position(s), i.e., top or bottom of two additional ingots for each nonconforming ingot. The ingots selected for additional samples shall be from locations in the pouring plate pattern closest to the nonconforming ingot(s).