AEROSPACE MATERIAL SPECIFICATION

AMS6528™	REV. E

Issued 1987-04
Reaffirmed 2007-04
Revised 2022-10

Superseding AMS6528D

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

(Composition similar to UNS G41300)

RATIONALE

AMS6528E is the result of a Five-Year Review and update of the specification. The revision updates the composition spec and reporting requirements (3.1, 3.1.2), deletes engineering approval (3.3.1), modifies Jominy testing requirements (3.3.3), updates decarburization requirements (3.4.4), prohibits unauthorized exceptions (3.6, 4.4.3 8.7), incorporates updates to AMS2304 (4.2.1, 4.4.1 4.4.4), updates bar from plate requirement (4.4.2), standardizes retesting (4.5.1), adds information on surface finish (8.4), and permits prior revisions (8.5).

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 for parts of greater thickness, but requiring proportionately lower hardness. Usage is not limited to such applications.

2. APPLICABLE DOCUMENTS

The issue of the following document 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 cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS2251 Tolerances, Low-Alloy Steel Bars

AMS2259 Chemical Check Analysis Limits, Wrought Low-Alloy and Carbon Steels

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
SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/AMS6528E/

AMS2304 Steel Cleanliness, Special Aircraft-Quality Magnetic Particle Inspection Procedure

AMS2370 Quality Assurance Sampling and Testing, Carbon and Low-Alloy Steel Wrought Products and Forging Stock

AMS2806 Identification, Bars, Wire, Mechanical Tubing, and Extrusions Carbon and Alloy Steels and Corrosion- and Heat-Resistant Steels and Alloys

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

AS7766 Terms Used in Aerospace Metals Specifications

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM A255 Determining Hardenability of Steel

ASTM A370 Mechanical Testing of Steel Products

ASTM A751 Chemical Analysis of Steel Products

ASTM E112 Determining Average Grain Size

ASTM E381 Macroetch Testing Steel Bars, Billets, Blooms, and Forgings

ASTM E1077 Estimating the Depth of Decarburization of Steel Specimens

2.3 Definitions

Terms used in AMS are defined in AS7766.

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1, determined in accordance with ASTM A751 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 Aluminum, vanadium, and columbium (niobium) are optional grain refining elements and need not be determined or reported unless used to satisfy the average grain size requirements of 3.3.2.2.

3.1.2 Producer may test for any element not listed in Table 1 and include this analysis in the report of 4.4. Reporting of any element not listed in the composition table is not a basis for rejection unless limits of acceptability are specified by the purchaser.

3.1.3 Check Analysis

Composition variations shall meet the applicable requirements of AMS2259.

3.2 Condition

Bar shall not be cut from plate (also see 4.4.2).

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

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 A370.

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 A370:

3.3.1 Macrostructure

Visual examination of transverse full cross-sections from bars and billets, etched in hot hydrochloric acid in accordance with ASTM E381, shall show no pipe or cracks. Porosity, segregation, inclusions, and other imperfections shall be no worse than the macrographs of ASTM E381 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 - C2
Over 100 to 133, incl	Over 645 to 858, incl	S2 - R2 - C3
Over 133	Over 858	Note 1

Note 1: Limits for larger sizes shall be agreed upon by purchaser and producer.

3.3.2 Average Grain Size

Average grain size shall be determined by either 3.3.2.1 or 3.3.2.2.

3.3.2.1 Shall be ASTM No. 5 or finer, determined in accordance with ASTM E112.

3.3.2.2 The product of a heat shall be considered to have an ASTM No. 5 or finer austenitic grain size if one or more of the following are determined by heat analysis (see 8.6):

3.3.2.2.1 A total aluminum content of 0.020 to 0.050%.

3.3.2.2.2 An acid soluble aluminum content of 0.015 to 0.050%.

3.3.2.2.3 A vanadium content of 0.02 to 0.08%.

3.3.2.2.4 A columbium (niobium) content of 0.02 to 0.05%.

3.3.3 Hardenability of Each Heat

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 A255 except that the normalizing temperature shall be 1700 °F ± 10 °F (927 °C ± 6 °C). Cast specimens do not need to be normalized.

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 producer.

3.3.4.3 Decarburization of bars that 3.3.4.1 or 3.3.4.2 is not applicable shall be not greater than shown in Table 3.

Table 3A - Maximum depth of decarburization, inch/pound units

Nominal Thickness or Distance Between Parallel Sides Inches	Total Depth of Decarburization Inches
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 depth of 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 evaluated by one of the two methods of 3.3.4.4.1 or 3.3.4.4.2.

3.3.4.4.1 Metallographic (Microscopic) Method

A cross section taken perpendicular to the surface shall be prepared, etched, and examined metallographically at a magnification not to exceed 200X in accordance with ASTM E1077. The sample shall not show a layer of complete (ferrite) or partial decarburization exceeding the limits of Table 3.

3.3.4.4.2 Hardness Traverse (Microindentation) Method

The total depth of decarburization shall be determined by a traverse method using microindentation hardness testing in accordance with ASTM E1077. Samples shall be hardened, in a protective atmosphere to prevent changes in surface carbon content. Samples may be tempered at the option of the producer. Measurements shall be far enough away from any adjacent surface to be uninfluenced by any decarburization on the adjacent surface. Acceptance shall be as listed in Table 3.

3.3.4.4.3 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.

3.3.4.4.4 In case of dispute, the total depth of decarburization determined using the microindentation hardness traverse method shall govern.

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 AMS2304 (see 8.2).

3.4.2 Bars shall be free from seams, laps, tears, and cracks after removal of the standard stock removal allowance in accordance with AS1182.

3.5 Tolerances

Shall conform to all applicable requirements of AMS2251.

3.6 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.3.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of bars shall supply all samples for producer'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. If grain refining elements (3.3.2.2) are not present, the ASTM E112 grain size test (3.3.2.1) shall be conducted on each lot. If process qualification in accordance with AMS2304 has been met, the frequency-severity cleanliness rating shall be conducted on a periodic basis as defined in AMS2304.

4.2.2 Periodic Tests

If grain refining elements (3.3.2.2) are present, the ASTM E112 grain size test (3.3.2.1) shall be conducted on a periodic basis and shall be performed at a frequency selected by the producer (not to exceed 1 year), unless frequency of testing is specified by purchaser. Cold finished surface hardness (3.2.1.1.1) is a periodic test and shall be performed at a frequency selected by the producer unless frequency of testing is specified by purchaser.