AEROSPACE MATERIAL SPECIFICATION

AMS6300™	REV. H
Issued 1943-04 Revised 2020-10 Superseding AMS6300G	

Steel Bars and Forgings
0.25Mo (0.35 - 0.40C) (SAE 4037)
(Composition similar to UNS G40370)

RATIONALE

AMS6300H results from a Five-Year Review and update of this specification that revises analytical methods (3.1), condition (3.2.2), macrostructure (3.3.1.1) hardenability (3.3.3), and decarburization (3.3.4.4) and prohibits unauthorized exceptions (3.6) and revises quality (3.4.2), reporting and marking (4.4.1, 4.4.4, 5.2.1).

1. SCOPE

1.1 Form

This specification covers an aircraft-quality, low-alloy steel in the form of bars, forgings, and forging stock.

1.2 Application

These products have been used typically for parts, 0.375 inch (9.52 mm) and under in nominal section thickness at time of heat treatment, requiring a through hardening steel capable of developing hardness up to 40 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 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

AMS2301 Steel Cleanliness, Aircraft Quality Magnetic Particle Inspection Procedure

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

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/AMS6300H

AMS2372 Quality Assurance Sampling and Testing Carbon and Low-Alloy Steel Forgings

AMS2761 Heat Treatment of Steel Raw Materials

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

AMS2808 Identification Forgings

ARP1917 Clarification of Terms Used in Aerospace Metals Specifications

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

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 Standard Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

ASTM E112 Determining Average Grain Size

ASTM E140 Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness

ASTM E381 Macroetch Testing, Inspection, and Rating Steel Products Comprising Bars, Billets, Blooms, and Forgings

ASTM E384 Microindentation Hardness of Materials

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	0.35	0.40
Manganese	0.70	0.90
Silicon	0.15	0.35
Phosphorus	--	0.040
Sulfur	--	0.040
Molybdenum	0.20	0.30
Chromium	--	0.20
Nickel	--	0.25
Copper	--	0.35

3.1.1 Aluminum, vanadium and columbium 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 Check Analysis

Composition variations shall meet the applicable requirements of AMS2259.

3.2 Condition

The product shall be supplied in the following condition; hardness and tensile strength shall be determined in accordance with ASTM A370:

3.2.1 Bars

Bar shall not be cut from plate.

3.2.1.1 Bars 0.500 Inch (12.70 mm) and Under in Nominal Diameter or Least Distance Between Parallel Sides

Cold finished having tensile strength not higher than 130.0 ksi (896 MPa), or equivalent hardness (see 8.2).

3.2.1.2 Bars Over 0.500 Inch (12.70 mm) in Nominal Diameter or Least Distance Between Parallel Sides

Hot finished and annealed, unless otherwise ordered, having hardness not higher than 229 HB, or equivalent (see 8.3). Bars ordered cold finished may have hardness as high as 241 HB, or equivalent (see 8.3).

3.2.2 Forgings

Normalized and tempered in accordance with AMS2761.

3.2.3 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 Macrostructure

Visual examination of transverse full cross-sections from bars, billets, and forging stock, etched in accordance with ASTM E381, shall not show pipe or cracks. Porosity, segregation, inclusions, and other imperfections shall not be worse than the macrographs of ASTM E381 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 133, incl	Over 232 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. The purchaser shall have written approval of the agreement from the cognizant engineering organization.

3.3.1.1 Macrostructure examination is not required for bored/hollow forgings (including ring forgings) and tubings that are produced directly from ingots or blooms unless specified by the purchaser, in which case the purchaser shall specify standards to be used.

3.3.2 Average Grain Size of Bars and Forgings

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

3.3.2.1 Shall be ASTM 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 content of 0.02 to 0.05%.

3.3.3 Hardenability of Each Heat

Shall be J 1/16 inch (1.5 mm) = 52 HRC min and J 5/16 inch (7.5 mm) = 30 HRC min, determined on the standard end-quench test specimen in accordance with ASTM A255, except that the steel shall be normalized at 1700 °F ± 10 °F (927 °C ± 6 °C) and the test specimen austenitized at 1550 °F ± 10 °F (843 °C ± 6 °C). Cast specimen does 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 forging 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 - Total depth of decarburization, inch/pound units

Nominal Diameter 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 - Total depth of decarburization, SI units

Nominal Diameter 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 Method

A cross section taken perpendicular to the surface shall be prepared in accordance with ASTM E1077 and visually examined metallographically at a magnification not to exceed 100X. The product shall not show a layer of complete (ferrite) or partial decarburization exceeding the limits of Table 3.

3.3.4.4.2 Hardness Traverse Method

The total depth of decarburization shall be determined by a traverse method using microindentation hardness testing in accordance with ASTM E384 conducted on a hardened but untempered specimen protected during heat treatment to prevent changes in surface carbon content. Tempering is generally not recommended, but if tempered, the tempering temperature shall be not higher than 300 °F (149 °C). Depth of decarburization is defined as the perpendicular distance from the surface to the depth under that surface where there is not 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. 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

The product, 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 product.

3.4.1 Steel shall be aircraft-quality conforming to AMS2301.

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

3.4.2.1 Forgings shall have substantially uniform macrostructure. Standards for acceptance shall be as agreed upon by purchaser and producer.

3.4.2.2 Grain flow of die forgings, except in areas that contain flash-line end grain, shall follow the general contour of the forgings, and show no evidence of reentrant grain flow.

3.5 Tolerances

Bars shall conform to all applicable requirements of AMS2251.

3.6 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.4.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of the product 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 perform any confirmatory testing deemed necessary to ensure that the product conforms to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Composition (3.1), condition (3.2), 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.

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. Uniform macrostructure of forgings (3.4.2.1) and grain flow of die forgings (3.4.2.2) are periodic tests and shall be performed at a frequency selected by the producer unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing

4.3.1 Bars and Forging Stock

In accordance with AMS2370.

4.3.2 Forgings

In accordance with AMS2372.

4.4 Reports

4.4.1 The producer of bar and forgings shall furnish with each shipment a report showing producer identity, country where the metal was melted (e.g., final melt in the case of metal processed by multiple melting operations), the results of tests for composition, macrostructure (except when not required per 3.3.1.1), hardenability and frequency-severity cleanliness rating of each heat and for the tensile strength or hardness as applicable and the condition and, if measured, average grain size of each lot, and stating that the product conforms to the other technical requirements. This report shall include the purchase order number, heat and lot numbers, AMS6300H, product form and size (and/or part number, if applicable), and quantity. If forgings are supplied, the size and melt source of stock used to make the forgings shall also be included. If the grain size requirement of 3.3.3.2 is met by the aluminum, vanadium, and/or columbium content, the aluminum, vanadium, and/or columbium content shall be reported and a statement that the chemistry satisfies the grain size requirement shall be included.

4.4.2 Report the nominal metallurgically worked cross sectional size and the cut size, if different (see 3.2.1).