SAE Aerospace
An SAE International Group

# AEROSPACE MATERIAL SPECIFICATION

SAE AMS 6303G

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Superseding AMS 6303F

## Steel Bars and Forgings, Low Alloy, Heat-Resistant 0.65Si - 1.25Cr - 0.50Mo - 0.85V (0.25 - 0.30C)

(Composition similar to UNS K22770)

RATIONALE

AMS 6303G is a Five Year Review and update of this specification.

## 1. SCOPE

### 1.1 Form

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

### 1.2 Application

These products have been used typically for parts such as turbine discs, compressor discs, and fasteners, for service up to 1050 °F (566 °C), 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 724-776-4970 (outside USA), www.sae.org.

| | |
|---|---|
| AMS 2251 | Tolerances, Low-Alloy Steel Bars |
| AMS 2259 | Chemical Check Analysis Limits, Wrought Low-Alloy and Carbon Steels |
| AMS 2301 | Steel Cleanliness, Aircraft Quality, Magnetic Particle Inspection Procedure |
| AMS 2370 | Quality Assurance Sampling and Testing, Carbon and Low-Alloy Steel, Wrought Products and Forging Stock |
| AMS 2372 | Quality Assurance Sampling and Testing, Carbon and Low-Alloy Steel, Forgings |
| AMS 2806 | Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Corrosion and Heat-Resistant Steels and Alloys |
| AMS 2808 | Identification, Forgings |
| AS1182 | Standard Machining 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 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 |
| 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 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 | 0.25 | 0.30 |
| Manganese | 0.60 | 0.90 |
| Silicon | 0.55 | 0.75 |
| Phosphorus | -- | 0.025 |
| Sulfur | -- | 0.025 |
| Chromium | 1.00 | 1.5 |
| Molybdenum | 0.40 | 0.60 |
| Vanadium | 0.75 | 0.95 |
| Nickel | -- | 0.50 |
| Copper | -- | 0.50 |



3.1.1 Check Analysis

Composition variations shall meet the applicable requirements of AMS 2259.

3.2 Condition

The product shall be supplied in the following condition; hardness and tensile strength shall be determined in accordance with ASTM A 370:

3.2.1 Bars

3.2.1.1 Bars 0.500 Inch (12.50 mm) and Under in Nominal Diameter or Least Distance Between Parallel Sides

Cold finished having tensile strength not higher than 125 ksi (862 MPa) or equivalent hardness (See 8.2).

3.2.1.2 Bars Over 0.500 Inch (12.50 mm) in Nominal Diameter or Least Distance Between Parallel Sides

Hot finished and annealed unless otherwise ordered, having hardness not higher than 241 HB, or equivalent (See 8.3). Bars ordered cold finished may have hardness as high as 248 HB, or equivalent (See 8.3).

3.2.2 Forgings

Annealed having hardness not higher than 241 HB, or equivalent (See 8.3).

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 A 370:

3.3.1 Macrostructure

Visual examination of transverse full cross sections from bars, billets, and forging stock, 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.

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 Allowable decarburization of bars and billets ordered for redrawing or forging or to specified microstructural requirements shall be as agreed upon by purchaser and vendor.

3.3.3.3 Decarburization of bars to which 3.3.3.1 or 3.3.3.2 is not applicable shall be not greater than shown in Table 3.

TABLE 3A - MAXIMUM DECARBURIZATION LIMITS, INCH/POUND UNITS

| Nominal Diameter or Distance Between Parallel Sides Inches | Total Depth of Decarburization Inch |
|---|---|
| Up to 0.375, incl | 0.015 |
| Over 0.375 to 0.500, incl | 0.017 |
| Over 0.500 to 0.625, incl | 0.019 |
| Over 0.625 to 1.000, incl | 0.022 |
| Over 1.000 to 1.500, incl | 0.025 |
| Over 1.500 to 2.000, incl | 0.030 |
| Over 2.000 to 2.500, incl | 0.035 |
| Over 2.500 to 3.000, incl | 0.040 |
| Over 3.000 to 4.000, incl | 0.045 |

TABLE 3B - MAXIMUM DECARBURIZATION LIMITS, SI UNITS

| Nominal Diameter or Distance Between Parallel Sides Millimeters | Total Depth of Decarburization Millimeters |
|---|---|
| Up to 9.52, incl | 0.38 |
| Over 9.52 to 12.70, incl | 0.43 |
| Over 12.70 to 15.88, incl | 0.48 |
| Over 15.88 to 25.40, incl | 0.56 |
| Over 25.40 to 38.10, incl | 0.64 |
| Over 38.10 to 50.80, incl | 0.76 |
| Over 50.80 to 63.50, incl | 0.89 |
| Over 63.50 to 76.20, incl | 1.02 |
| Over 76.20 to 101.60, incl | 1.14 |

3.3.3.4 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 that 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 using the microhardness traverse shall govern.

3.3.3.4.1 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

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 AMS 2301.

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.

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

3.5 Tolerances

Bars shall conform to all applicable requirements of AMS 2251.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The vendor of the product 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 product conforms to specified requirements.