

# AEROSPACE MATERIAL SPECIFICATION



**AMS 6317G**

Issued DEC 1939  
Revised JAN 2003

Superseding AMS 6317F

Steel Bars and Forgings  
1.8Ni - 0.25Mo (0.38 - 0.43C) (4640)  
Heat Treated, 125 ksi (862 MPa) Tensile Strength  
(Composition similar to UNS K22440)

## 1. SCOPE:

### 1.1 Form:

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

### 1.2 Application:

These products have been used typically for parts with sections 1.0 inch (25 mm) and under in nominal thickness requiring a minimum tensile strength of 125 ksi (862 MPa) 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, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or [www.sae.org](http://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 |

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#### TO PLACE A DOCUMENT ORDER:

Tel: 877-606-7323 (inside USA and Canada)  
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#### SAE WEB ADDRESS:

## 2.1 (Continued):

|          |                                                                                                                                           |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------|
| 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, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or [www.astm.org](http://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, Steel Bars, Billets, Blooms, and Forgings                                               |
| ASTM E 384 | Microindentation Hardness of Materials                                                                     |

## 3. TECHNICAL REQUIREMENTS:

## 3.1 Composition:

Shall conform to the following 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     | 0.38 | 0.43  |
| Manganese  | 0.60 | 0.80  |
| Silicon    | 0.15 | 0.35  |
| Phosphorus | --   | 0.025 |
| Sulfur     | --   | 0.025 |
| Nickel     | 1.65 | 2.00  |
| Molybdenum | 0.20 | 0.30  |
| Chromium   | --   | 0.20  |
| Copper     | --   | 0.35  |

## 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:

## 3.2.1 Bars:

3.2.1.1 Bars 0.500 Inch (12.70 mm) and Under in Nominal Diameter or Least Distance Between Parallel Sides: Cold finished, hardened, and tempered.

3.2.1.2 Bars Over 0.500 Inch (12.70 mm) in Nominal Diameter or Least Distance Between Parallel Sides: Hot finished, or cold finished when so ordered, hardened, and tempered.

3.2.2 Forgings: Hardened and tempered.

## 3.3 Properties:

The product 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 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<br>Square Inches | Section Size<br>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 (See 8.2).

## 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 3.

TABLE 3A - Maximum Decarburization Limits, Inch/Pound Units

| Nominal Diameter or<br>Distance Between<br>Parallel Sides<br>Inches | Total Depth of<br>Decarburization<br>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                                     |

TABLE 3B - Maximum Decarburization Limits, SI Units

| Nominal Diameter or<br>Distance Between<br>Parallel Sides<br>Millimeters | Total Depth of<br>Decarburization<br>Millimeter |
|--------------------------------------------------------------------------|-------------------------------------------------|
| 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                                            |

3.3.3.3 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 influenced by any decarburization on the adjacent surface. In case of dispute, the depth of decarburization determined using the microhardness traverse method shall govern.

3.3.3.3.1 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 longitudinally from bars 1.00 inch (25.4 mm) and under in nominal diameter or distance between parallel sides and from forgings 1.00 inch (25.4 mm) and under in nominal cross-section with axis of specimen in area of gage length within 15 degrees of parallel to forging flow lines, shall have the properties shown in Table 4:

TABLE 4 - Minimum Tensile Properties

| Property                      | Value             |
|-------------------------------|-------------------|
| Tensile Strength              | 125 ksi (862 MPa) |
| Yield Strength at 0.2% Offset | 100 ksi (689 MPa) |
| Elongation in 4D              | 16%               |
| Reduction of Area             | 50%               |

- 3.3.4.1 When specified, transverse tensile properties and longitudinal tensile properties of bars over 1.00 inch (25.4 mm) in nominal diameter or distance between parallel sides and of forgings over 1.00 inch (25.4 mm) in nominal cross-section shall be as agreed upon by purchaser and vendor.
- 3.3.5 Hardness: Shall be 262 to 311 HB, or equivalent (See 8.3), but the product shall not be rejected on the basis of hardness if the tensile property requirements of 3.3.4 are acceptable, determined on specimens taken from the same sample as that with nonconforming hardness or from another sample with similar nonconforming hardness.

#### 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 crack open to the ground, turned, or polished surfaces.
- 3.4.3 Grain flow of die forgings, except in areas which 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.

##### 4.2 Classification of Tests:

4.2.1 Acceptance Tests: Composition (3.1), macrostructure (3.3.1), average grain size (3.3.2), decarburization (3.3.3), tensile properties (3.3.4), hardness (3.3.5), frequency-severity cleanliness (3.4), and tolerances (3.5) are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.2 Periodic Tests: Grain flow of die forgings (3.4.3) is a periodic test and shall be performed at a frequency selected by the vendor unless a frequency of testing is specified by purchaser.

##### 4.3 Sampling and Testing:

Shall be as follows:

4.3.1 Bars and Forging Stock: In accordance with AMS 2370.

4.3.2 Forgings: In accordance with AMS 2372.

##### 4.4 Reports:

The vendor of the product shall furnish with each shipment a report showing the results of composition, macrostructure, and frequency-severity cleanliness rating for each heat and for average grain size and tensile properties 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, AMS 6317G, size, and quantity. If forgings are supplied, the size and melt source of stock used to make the forgings shall also be included.

##### 4.5 Resampling and Retesting:

Shall be as follows:

4.5.1 Bars and Forging Stock: In accordance with AMS 2370.

4.5.2 Forgings: In accordance with AMS 2372.