

## SAE-AMS6484

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SAE-AMS6484, "Steel Bars, Forgings, and Tubing 0.80Cr - 1.8Ni - 0.25Mo (0.38 - 0.43C) SAE4340 Normalized and Tempered", was adopted on 22-JUN-95 for use by the Department of Defense (DoD). Proposed changes by DoD activities must be submitted to the DoD Adopting Activity: ASC/ENOSD, Building 125, 2335 Seventh Street, Suite 6, Wright-Patterson AFB, OH 45433-7809. DoD activities may obtain copies of this standard from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094. The private sector and other Government agencies may purchase copies from the Society of Automotive Engineers Inc., 400 Commonwealth Drive, Warrendale, PA 15096-0001.

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# AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

**SAE**

**AMS 6484A**

Issued JUN 1995  
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Superseding AMS 6484

STEEL, BARS, FORGINGS, AND TUBING  
0.80Cr - 1.8Ni - 0.25Mo (0.38 - 0.43C) SAE 4340  
Normalized and Tempered

UNS G43400

## 1. SCOPE:

### 1.1 Form:

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

### 1.2 Application:

These products have been used typically for parts 3.5 inches (89 mm) and under in nominal thickness at time of heat treatment, requiring a through-hardening steel capable of developing a minimum hardness of 40 HRC when properly hardened and tempered and also for parts of greater thickness requiring proportionately lower hardness, but usage is not limited to such applications.

- 1.2.1 Certain design and processing procedures may cause these products to become susceptible to stress-corrosion cracking after heat treatment; ARP1110 recommends practices to minimize such conditions.

## 2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

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## 2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

|          |                                                                                                                                           |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------|
| AMS 2251 | Tolerances, Low-Alloy Steel Bars                                                                                                          |
| MAM 2251 | Tolerances, Metric, Low-Alloy Steel Bars                                                                                                  |
| AMS 2253 | Tolerances, Carbon and Alloy Steel Tubing                                                                                                 |
| MAM 2253 | Tolerances, Metric, Carbon and Alloy Steel Tubing                                                                                         |
| AMS 2259 | Chemical Check Analysis Limits, Wrought Low-Alloy and Carbon Steels                                                                       |
| AMS 2301 | Cleanliness, Aircraft Quality Steel, Magnetic Particle Inspection Procedure                                                               |
| MAM 2301 | Cleanliness, Aircraft Quality Steel, 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 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                              |
| ARP1110  | Minimizing Stress Corrosion Cracking in Wrought Forms of Steels and Corrosion Resistant Steels and Alloys                                 |

## 2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

|            |                                                                                                            |
|------------|------------------------------------------------------------------------------------------------------------|
| ASTM A 255 | End-Quench Test for Hardenability of Steel                                                                 |
| ASTM A 370 | Mechanical Testing of Steel Products                                                                       |
| ASTM E 112 | Determining the 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                                                |

## 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     | 0.38 | 0.43  |
| Manganese  | 0.65 | 0.85  |
| Silicon    | 0.15 | 0.35  |
| Phosphorus | --   | 0.025 |
| Sulfur     | --   | 0.025 |
| Chromium   | 0.70 | 0.90  |
| Nickel     | 1.65 | 2.00  |
| Molybdenum | 0.20 | 0.30  |
| Copper     | --   | 0.35  |

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

3.2 Condition:

The product shall be supplied in the following condition; hardness shall be determined in accordance with ASTM A 370.

3.2.1 Bars: Normalized and tempered having hardness at mid-radius not higher than 322 HB, or equivalent (See 8.2).

3.2.1.1 Unless a surface finish is specified, the surface may be furnished hot finished or cold drawn.

3.2.2 Forgings: Normalized and tempered having hardness not higher than 322 HB, or equivalent (See 8.2).

3.2.3 Mechanical Tubing: Normalized and tempered having hardness not higher than 322 HB, or equivalent (See 8.2). Tubing 1.0 inch (25 mm) and under in nominal OD shall be cold reduced; larger sizes shall be hot rolled.

3.2.4 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, tube rounds or tubes, and forging stock, etched in hot hydrochloric acid in accordance with ASTM E 381, shall show no pipe or cracks. Except as specified in 3.3.1.1, 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

| Form          | Cross-Sectional Area<br>Square Inches | Cross-Sectional Area<br>Square Centimeters | Macrographs  |
|---------------|---------------------------------------|--------------------------------------------|--------------|
| Forging Stock | Up to 36, incl                        | Up to 232, incl                            | S2 - R1 - C2 |
| Forging Stock | Over 36 to 100, incl                  | Over 232 to 645, incl                      | S2 - R2 - C2 |
| Other         | Any                                   | Any                                        | S2 - R1 - C2 |

3.3.1.1 If tubes are produced directly from ingots or large blooms, transverse sections may be taken from tubes rather than tube rounds. Macrostructure standards for such tubes shall be as agreed upon by purchaser and vendor.

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 J53=11 minimum, J50=20 minimum, and J45=32 minimum, determined (R) on the standard end-quench specimen in accordance with ASTM A 255 except that the steel shall be normalized at  $1600\text{ }^{\circ}\text{F} \pm 25$  ( $871\text{ }^{\circ}\text{C} \pm 14$ ) and the specimen austenitized at  $1550\text{ }^{\circ}\text{F} \pm 25$  ( $843\text{ }^{\circ}\text{C} \pm 14$ ).

3.3.4 Decarburization:

3.3.4.1 Bars and tubing 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, billets, and tube rounds ordered for redrawing or forging 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 Diameter or Distance<br>Between Parallel Sides<br>Inches | 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                               |
| Over 3.000 to 4.000, incl                                        | 0.045                               |

TABLE 3B - Maximum Decarburization, SI Units

| Nominal Diameter or Distance<br>Between Parallel Sides<br>Millimeters | Depth of<br>Decarburization<br>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 of tubing to which 3.3.4.1 or 3.3.4.2 is not applicable shall be not greater than shown in Table 4.

TABLE 4A - Maximum Decarburization, Inch/Pound Units

| Nominal Wall Thickness<br>Inches | Depth<br>ID<br>Inch | Depth<br>OD<br>Inch |
|----------------------------------|---------------------|---------------------|
| Up to 0.109, incl                | 0.008               | 0.015               |
| Over 0.109 to 0.203, incl        | 0.010               | 0.020               |
| Over 0.203 to 0.400, incl        | 0.012               | 0.025               |
| Over 0.400 to 0.600, incl        | 0.015               | 0.030               |
| Over 0.600 to 1.000, incl        | 0.017               | 0.035               |
| Over 1.000                       | 0.020               | 0.040               |

TABLE 4B - Maximum Decarburization, SI Units

| Nominal Wall Thickness<br>Millimeters | Depth<br>ID<br>Millimeter | Depth<br>OD<br>Millimeters |
|---------------------------------------|---------------------------|----------------------------|
| Up to 2.77, incl                      | 0.20                      | 0.38                       |
| Over 2.77 to 5.16, incl               | 0.25                      | 0.51                       |
| Over 5.16 to 10.16, incl              | 0.30                      | 0.64                       |
| Over 10.16 to 15.24, incl             | 0.38                      | 0.76                       |
| Over 15.24 to 25.40, incl             | 0.43                      | 0.89                       |
| Over 25.40                            | 0.51                      | 1.02                       |

3.3.4.5 Decarburization shall be measured by the microscopic method or by HR30N scale or equivalent hardness testing method on hardened but untempered specimens 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 decarburization thereon.

3.3.4.5.1 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 or MAM 2301, except specimens (R) containing nonmetallic inclusions over one inch (25 mm) in length shall be subject to rejection.

3.4.2 Bars and mechanical tubing 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 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 re-entrant grain flow.

#### 3.5 Tolerances:

Shall be as follows:

3.5.1 Bars: In accordance with AMS 2251 or MAM 2251.

3.5.2 Mechanical Tubing: In accordance with AMS 2253 or MAM 2253.

#### 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), 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.

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 frequency of testing is specified by purchaser.

## 4.3 Sampling and Testing:

Shall be as follows:

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

4.3.2 Forgings: In accordance with AMS 2372.

## 4.4 Reports:

(R) The vendor of the product 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 for hardness and average grain size of each lot and stating that the product conforms to the other technical requirements. The report shall include the purchase order number, heat and lot numbers, AMS 6484A, size and quantity. If forgings are supplied, the forging part number and 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, Mechanical Tubing, and Forging Stock: In accordance with AMS 2370.

4.5.2 Forgings: In accordance with AMS 2372.

## 5. PREPARATION FOR DELIVERY:

### 5.1 Sizes:

Except when exact lengths or multiples of exact lengths are ordered, straight bars and tubing will be acceptable in mill lengths of 6 to 20 feet (1.8 to 6.1 m) but not more than 10% of any shipment shall be supplied in lengths shorter than 10 feet (3 m).

### 5.2 Identification:

Shall be as follows: