



# AEROSPACE MATERIAL SPECIFICATIONS

SOCIETY OF AUTOMOTIVE ENGINEERS, Inc.

485 Lexington Ave., New York, N. Y. 10017

## AMS 6412F

Superseding AMS 6412E

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### STEEL BARS AND FORGINGS 0.80Cr - 1.8Ni - 0.25Mo (0.35 - 0.40C) (4337)

1. **ACKNOWLEDGMENT:** A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.
2. **FORM:** Bars, forgings, and forging stock.
3. **APPLICATION:** Parts with sections 0.875 in. or less in thickness at the time of heat treatment which require a through-hardening steel capable of developing hardness as high as Rockwell C 50 when properly hardened and tempered and also parts of greater thickness but requiring proportionately lower hardness. In appropriate section sizes, this material is capable of meeting the requirements of AMS 2310.

4. **COMPOSITION:**

	min	max
Carbon	0.35	0.40
Manganese	0.65	0.84
Silicon	0.20	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

- 4.1 **Check Analysis:** Composition variations shall meet the requirements of the latest issue of AMS 2259, paragraph titled "Low Alloy Steels".
5. **CONDITION:** Unless otherwise ordered, the product shall be supplied in the following condition:
  - 5.1 **Bars:** In a machinable condition and hot finished having hardness not higher than Brinell 229 or equivalent, except that bars ordered cold finished may have a hardness as high as Brinell 248 or equivalent.
  - 5.2 **Forgings:** As ordered.
  - 5.3 **Forging Stock:** As ordered by the forging manufacturer.
6. **TECHNICAL REQUIREMENTS:** When ASTM methods are specified for determining conformance to the following requirements, tests shall be conducted in accordance with the issue of the ASTM method listed in the latest issue of AMS 2350.
  - 6.1 **Hardenability:** The hardenability shall be J50=10 min and J44=18 min when determined on the standard end-quench test specimen in accordance with the Method of Determining Hardenability published in the latest issue of the SAE Handbook, except that the steel shall be normalized at 1700 F  $\pm$  10 (926.7 C  $\pm$  5.6) and the test specimen austenitized at 1500 F  $\pm$  10 (815.6 C  $\pm$  5.6). The hardenability test is not required on a product which will not yield a suitable specimen but the steel from which the product is made shall conform to the hardenability specified.

SAE Technical Board rules provide that: "All technical reports, including standards approved and practices recommended, are advisory only. Their use by anyone engaged in industry or trade is entirely voluntary. There is no agreement to adhere to any SAE standard or recommended practice, and no commitment to conform to or be guided by any technical report. In formulating and approving technical reports, the Board and its Committees will not investigate or consider patents which may apply to the subject matter. Prospective users of the report are responsible for protecting themselves against liability for infringement of patents."

6.2 Grain Size: Predominantly 5 or finer with occasional grains as large as 3 permissible, ASTM E112,  $\emptyset$  McQuaid-Ehn test.

6.3 Decarburization:

6.3.1 Bars ordered ground, turned, or polished shall be free from decarburization on the ground, turned, or polished surfaces.

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

6.3.3 Decarburization of bars to which 6.3.1 or 6.3.2 is not applicable shall be not greater than the following:

Nominal Diameter or Distance Between Parallel Sides Inches	Depth of Decarburization 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

6.3.3.1 Limits for depth of decarburization of bars over 4.000 in. in nominal diameter or distance between  $\emptyset$  parallel sides shall be as agreed upon by purchaser and vendor.

6.3.4 Unless otherwise agreed upon by purchaser and vendor, decarburization shall be measured by the microscopic method or by Rockwell Superficial 30-N scale hardness method, 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 nondecarburized 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 any decarburization or lack of decarburization thereon.

6.3.4.1 When determining the depth of decarburization, it is permissible to disregard local areas provided the decarburization of such areas does not exceed the limits above by more than 0.005 in. and the width is 0.065 in. or less.

7. QUALITY: Steel shall be aircraft quality and shall conform to the latest issue of AMS 2301. The product shall be uniform in quality and condition, clean, sound, and free from foreign materials and from internal and external imperfections detrimental to fabrication or to performance of parts.

8. TOLERANCES: Unless otherwise specified, tolerances shall conform to all applicable requirements of the latest issue of AMS 2251; for all hexagons, tolerances for cold finished shall apply.

9. REPORTS:

9.1 Unless otherwise specified, the vendor of the product shall furnish with each shipment three copies of a report of the results of tests for chemical composition, hardenability, grain size, and AMS 2301 frequency-severity rating of each heat in the shipment. This report shall include the purchase order number, heat number, material specification number, size, and quantity from each heat. If forgings are supplied, the part number and size of stock used to make the forgings shall also be included.