Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10000

AEROSPACE MATERIAL SPECIFICATION

AMS 6321A
Superseding AMS 6321

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STEEL BARS, FORGINGS, AND TUBING
0.43Cr - 0.30Ni - 0.12Mo - 0.003B (0.38 - 0.43C) (81B40)

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, mechanical tubing, and forging stock.

3. APPLICATION: Primarily for parts with sections 0.375 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 with thinner sections which require proportionately higher hardness.

4. COMPOSITION:

	min	max
Carbon	0.38	- 0.43
Manganese	0.75	- 1.00
Silicon	0.20	- 0.35
Phosphorus	--	0.025
Sulfur	--	0.025
ø Chromium	0.30	- 0.55
Nickel	0.20	- 0.40
Molybdenum	0.08	- 0.15
Boron	0.0005	- 0.005
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 hardness as high as Brinell 241 or equivalent.

5.2 Forgings: As ordered.

5.3 Mechanical Tubing: In a machinable condition and cold finished having hardness not higher than ø Rockwell C 25 or equivalent, except that tubing ordered hot finished shall have hardness not higher than Rockwell B 99 or equivalent.

5.4 Forging Stock: As ordered by the forging manufacturer.

6. TECHNICAL REQUIREMENTS: When ASTM methods are specified for determining conformance to ø 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: Shall be J60=1 max and J50=5 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 ± 10 (926.7 C ± 5.6) and the test specimen austenitized at 1550 F ± 10 (843.3 C ± 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.

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

6.3 Decarburization:

6.3.1 Bars and tubing ordered ground, turned, or polished shall be free from decarburization on the ground, turned, or polished surfaces. Inside decarburization of such tubing shall not exceed the maximum depth specified in 6.3.4.

6.3.2 Allowable decarburization of bars, billets, and tubing ordered for redrawing or forging or to specified microstructural 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 parallel sides shall be as agreed upon by purchaser and vendor.

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

Nominal Wall Thickness Inches	Depth of Decarburization Inch	
	Inside	Outside
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

6.3.5 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.

6.3.5.1 When determining the depth of decarburization, it is permissible to disregard local areas provided the decarburization of such areas does not exceed the 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 following:

8.1 Bars: The latest issue of AMS 2251; for all hexagons, tolerances for cold finished shall apply.

8.2 Mechanical Tubing: The latest issue of AMS 2253.

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 and its revision letter, 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.

9.2 Unless otherwise specified, the vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, material specification number and its revision letter, contractor or other direct supplier of material, part number, and quantity. When material for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of material to determine conformance to the requirements of this specification, and shall include in the report a statement that the material conforms, or shall include copies of laboratory reports showing the results of tests to determine conformance.

10. IDENTIFICATION: Unless otherwise specified, the product shall be identified as follows:

10.1 Bars and Tubing:

10.1.1 Each straight bar and tube 0.500 in. and over in OD or least width of flat surface shall be marked in a row of characters recurring at intervals not greater than 3 ft with AMS 6321A, heat number, and manufacturer's identification. The characters shall be of such size as to be clearly legible, shall be applied using a suitable marking fluid, and shall be capable of being removed in hot alkaline cleaning solution without rubbing. The markings shall have no deleterious effect on the material or its performance and shall be sufficiently stable to withstand normal handling.

10.1.2 Straight bars and tubes less than 0.500 in. in OD or least width of flat surface shall be securely bundled and identified by a metal or plastic tag embossed with the purchase order number, AMS 6321A, heat number, nominal size, and manufacturer's identification and attached to each bundle or shall be boxed and the box marked with the same information.

10.1.3 Coiled bars shall be securely bundled and identified by a metal or plastic tag embossed with the purchase order number, AMS 6321A, heat number, nominal size, and manufacturer's identification and attached to each coil or shall be boxed and the box marked with the same information.