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400 COMMONWEALTH DRIVE WARRENDALE PA 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 6426C
Superseding AMS 6426B

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STEEL BARS, FORGINGS, AND TUBING
0.75Si - 1.0Cr - 0.58Mo (0.80 - 0.90C)
Vacuum Consumable Electrode Melted

UNS K18597

1. SCOPE:

1.1 Form: This specification covers a premium aircraft-quality, low-alloy steel in the form of bars, forgings, mechanical tubing, and forging stock.

1.2 Application: Primarily for parts, such as bearing components, for service up to 500°F (260°C) and requiring a through-hardening steel capable of developing hardness not lower than 60 HRC in cross-sections 3 in. (75 mm) and under.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) and Aerospace Standards (AS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2251 - Tolerances, Low-Alloy Steel Bars
AMS 2253 - Tolerances, Carbon and Alloy Steel Tubing
AMS 2259 - Chemical Check Analysis Limits, Wrought Low-Alloy and Carbon Steels
AMS 2300 - Premium-Aircraft-Quality Steel Cleanliness, Magnetic Particle Inspection Procedure
AMS 2350 - Standards and Test Methods
AMS 2370 - Quality Assurance Sampling of Carbon and Low-Alloy Steels, Wrought Products Except Forgings and Forging Stock
AMS 2372 - Quality Assurance Sampling of Carbon and Low-Alloy Steels, Forgings and Forging Stock
AMS 2375 - Control of Forgings Requiring First Article Approval
AMS 2806 - Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Heat and Corrosion Resistant Steels and Alloys
AMS 2808 - Identification, Forgings

2.1.2 Aerospace Standards:

AS 1182 - Standard Machining Allowance, Aircraft Quality and Premium Quality Steel Products

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM A370 - Mechanical Testing of Steel Products
ASTM A604 - Macroetch Testing of Consumable Electrode Remelted Steel Bars and Billets
ASTM E45 - Determining the Inclusion Content of Steel
ASTM E350 - Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

2.3.3 Military Standards:

MIL-STD-163 - Steel Mill Products, Preparation for Shipment and Storage

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E350, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other analytical methods approved by purchaser:

	min	max
Carbon	0.80	0.90
Manganese	0.20	0.50
Silicon	0.60	0.90
Phosphorus	--	0.015
Sulfur	--	0.015
Chromium	0.85	1.15
Molybdenum	0.50	0.65
Nickel	--	0.15
Copper	-	0.15

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 A370:

3.2.1 Bars:

3.2.1.1 Bars 0.500 In. (12.50 mm) and Under in Nominal Diameter or Distance Between Parallel Sides: Hot finished and annealed, with microstructure of spheroidized cementite in ferrite matrix, and having tensile strength not higher than 105,000 psi (725 MPa) or equivalent hardness except that bars ordered annealed and cold finished may have tensile strength as high as 125,000 psi (860 MPa) or equivalent hardness.

3.2.1.2 Bars Over 0.500 In. (12.50 mm) in Nominal Diameter or Distance Between Parallel Sides: Hot finished and annealed, with microstructure of spheroidized cementite in ferrite matrix, and having hardness not higher than 207 HB or equivalent except that bars ordered annealed and cold finished may have hardness as high as 248 HB or equivalent.

3.2.2 Forgings: As ordered.

3.2.3 Mechanical Tubing: Annealed and cold finished, with microstructure of spheroidized cementite in ferrite matrix, and having hardness not higher than 24 HRC or equivalent except that tubing ordered hot finished and annealed shall have hardness not higher than 95 HRB or equivalent.

3.2.4 Forging Stock: As ordered by the forging manufacturer.

3.3 Properties: The product shall conform to the following requirements; tensile and hardness testing shall be performed in accordance with ASTM A370:

3.3.1 Macrostructure: Visual examination of transverse sections as in 4.3.3 Ø from bars, billets, tube rounds or tubes, and forging stock, etched in accordance with ASTM A604 in hot hydrochloric acid (1:1) at 160° - 180°F (70° - 80°C) for sufficient time to develop a well-defined macrostructure, shall show no pipe or cracks. Except as specified in 3.3.1.1, porosity, segregation, inclusions, and other imperfections in product 36 sq in. (230 cm^2) and under in nominal cross-sectional area shall be no worse than the following macrographs of ASTM A604; macrostructure standards for product over 36 sq in. (230 cm^2) in nominal cross-sectional area shall be as agreed upon by purchaser and vendor:

Class	Condition	Severity
1	Freckles	A
2	White Spots	B
3	Radial Segregation	B
4	Ring Pattern	C

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 Micro-Inclusion Rating: No specimen as in 4.3.4 shall exceed the following limits, determined in accordance with ASTM E45, Method D:

	Inclusion Rating			
Type	A	B	C	D
Thin	1.5	1.5	1.5	1.5
Heavy	1.0	1.0	1.0	1.0

3.3.2.1 For types A, B, and C thin combined, there shall be not more than three fields of No. 1.5 A, B, and C types and not more than three other lower rateable A, B, and C type thin fields per specimen. For type D thin, there shall be not more than three No. 1.5 fields and not more than five other lower rateable D type thin fields per specimen. There shall be not more than one field each of No. 1.0 A, B, C, or D type heavy per specimen.

3.3.2.2 A rateable field is defined as one which has a type A, B, C, or D inclusion rating of at least 1.0 thin or heavy in accordance with the Jernkontoret Chart, Plate III, ASTM E45.

3.3.3 Response to Heat Treatment: Specimens as in 4.3.5 shall have substantially uniform hardness not lower than 66 HRC at any point below any permissible decarburization after being hardened as follows:

3.3.3.1 Specimens, protected by suitable means or treated in an atmosphere to minimize scaling and prevent either carburization or decarburization during heat treatment, shall be placed in a furnace which is at 1600°F ±10 (870°C ± 5), allowed to heat to 1600°F ± 10 (870°C ± 5), held at heat for 20 min. ±2, and quenched in commercial paraffin oil (100 SUS at 100°F (38°C)) at room temperature.

3.3.4 Hardness Retention: Specimens as in 4.3.5, hardened as in 3.3.3.1, shall have room temperature hardness not lower than 60 HRC after being heated for 400 hr ± 1 at 500°F ± 10 (260°C ± 5). The specimens may be the same specimens used for the test of 3.3.3.

3.3.5 Decarburization:

3.3.5.1 Bars and tubing ordered ground, turned, or polished shall be free from decarburization on the ground, turned, or polished surfaces. Decarburization on tubing ID shall not exceed the maximum depth specified in 3.3.5.4.

3.3.5.2 Allowable decarburization of bars, billets, and tube rounds ordered for redrawing or forging or to specified microstructural requirements other than spheroidized cementite in a ferrite matrix shall be as agreed upon by purchaser and vendor.

3.3.5.3 Decarburization of bars to which 3.3.5.1 or 3.3.5.2 is not applicable shall be not greater than shown in Table I.

TABLE I

Nominal Diameter or Distance Between Parallel Sides Inches	Depth of Decarburization Inch
Up to 0.500, incl	0.015
Over 0.500 to 1.000, incl	0.020
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	0.045

TABLE I (SI)

Nominal Diameter or Distance Between Parallel Sides Millimetres	Depth of Decarburization Millimetres
Up to 12.50, incl	0.38
Over 12.50 to 25.00, incl	0.50
Over 25.00 to 37.50, incl	0.62
Over 37.50 to 50.00, incl	0.75
Over 50.00 to 62.50, incl	0.88
Over 62.50 to 75.00, incl	1.00
Over 75.00	1.12

3.3.5.4 Decarburization of tubing to which 3.3.5.1 or 3.3.5.2 is not applicable shall be not greater than 0.025 in. (0.62 mm) on the ID and 0.025 in. (0.62 mm) on the outside diameter.

3.3.5.5 Decarburization shall be measured by Rockwell Superficial 30-N 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 any decarburization or lack of decarburization thereon.

3.3.5.5.1 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 in. (0.12 mm) and the width is 0.065 in. (1.65 mm) or less.

3.4 Quality:

3.4.1 Steel shall be premium aircraft-quality conforming to AMS 2300. It shall be multiple melted using vacuum consumable electrode process in the remelt cycle, unless otherwise permitted.

3.4.2 The product, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from internal and external imperfections detrimental to usage of the product.

3.4.2.1 Bars and tubing ordered ground, turned, or polished shall be free from seams, laps, tears, and cracks open to the ground, turned, or polished surfaces.

3.4.2.2 Product ordered to surface conditions other than ground, turned, or polished shall, after removal of the standard machining allowance, be free from seams, laps, tears, cracks, and other defects exposed to the machined surfaces. Standard machining allowance shall be in accordance with AS 1182.

3.5 Sizes: Except when exact lengths or multiples of exact lengths are ordered, straight bars and tubing will be acceptable in mill lengths of 6 - 20 ft (2 - 6 m) but not more than 10% of any shipment shall be supplied in lengths shorter than 10 ft (3 m).

3.6 Tolerances: Unless otherwise specified, tolerances shall conform to all applicable requirements of the following:

3.6.1 Bars: AMS 2251.

3.6.2 Mechanical Tubing: AMS 2253.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the product shall supply all ø samples for vendor's tests and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.5. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to the following ø requirements are classified as acceptance tests and shall be performed on each heat or lot as applicable:

4.2.1.1 Composition (3.1) of each heat.

4.2.1.2 Condition of each lot of bars (3.2.1) and mechanical tubing (3.2.3).

4.2.1.3 Macrostructure (3.3.1), micro-inclusion rating (3.3.2), response to heat treatment (3.3.3), and AMS 2300 frequency-severity rating (3.4.1) of each heat.

4.2.1.4 Decarburization (3.3.5) of each lot of bars and mechanical tubing.

4.2.1.5 Tolerances of bars and mechanical tubing (3.6).

4.2.2 Periodic Tests: Tests to determine conformance to requirements for Ø hardness retention (3.3.4) are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.2.3 Preproduction Tests: Tests of forgings to determine conformance to all Ø applicable technical requirements of this specification when AMS 2375 is specified are classified as preproduction tests and shall be performed prior to or on the first-article shipment of a forging to a purchaser, when a change in material or processing, or both, requires reapproval as in 4.4, and when purchaser deems confirmatory testing to be required.

4.2.3.1 For direct U.S. Military procurement of forgings, substantiating test data and, when requested, preproduction forgings shall be submitted to the cognizant agency as directed by the procuring activity, the contracting officer, or the request for procurement.

4.3 Sampling: Shall be in accordance with the following; a heat shall be the consumable electrode remelted ingots produced from steel originally melted as a single furnace charge:

4.3.1 Bars and Mechanical Tubing: AMS 2370.

4.3.2 Forgings and Forging Stock: AMS 2372.

4.3.3 Samples for macrostructure (3.3.1) testing shall be full cross-sectional specimens obtained from the finished billet or suitable rerolled product representing the top and bottom of at least the first, middle, and last usable ingots of each heat.

4.3.4 Samples for micro-inclusion rating (3.3.2) shall consist of not less than six specimens obtained from the full cross-section of billet stock taken from the top and bottom of at least the first, middle, and last usable ingots from each heat.

4.3.5 Specimens for response to heat treatment (3.3.3) and hardness retention (3.3.4) tests shall be as follows: