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AEROSPACE MATERIAL SPECIFICATION

SAE AMS-S-7420

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Submitted for recognition as an American National Standard

Steel Bars, Alloy, Chromium, High Carbon E52100 (Aircraft Quality)

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1. SCOPE:

1.1 Scope:

This specification covers the requirements for high-carbon chromium alloy steel bars of aircraft quality, for bearing applications.

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1.2 Classification:

The bars shall be furnished in one of the following physical and surface conditions, as specified (see 6.2):

Physical condition:

(A) As hot rolled or forged
(B) Annealed
(C) Normalized
(D) Normalized and tempered
(E) Spheroidized

Surface conditions:

(1) Black, as forged or rolled
(2) Pickled or blast cleaned
(3) Rough turned
(4) Cold drawn or cold rolled
(5) Turned, ground, and polished

2. APPLICABLE DOCUMENTS:

The following publications, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

2.1 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-I-6868	Inspection Process, Magnetic Particle
MIL-L-7870	Lubricating Oil, General Purpose, Low Temperature
FED-STD-48	Tolerances for Steel and Iron Wrought Products
FED-STD-66	Steel: Chemical Composition and Hardenability
FED-STD-151	Metals; Test Methods
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-163	Preparation of Steel Products for Domestic Shipment (Storage) and Overseas Shipment
MIL-STD-183	Continuous Identification Marking of Iron and Steel Products

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3. REQUIREMENTS:

3.1 Material:

The steel shall be of aircraft quality satisfactory for the fabrication of parts which may be subject to magnetic inspection in accordance with Specification MIL-I-6868.

3.1.1 Manufacturing process: The steel shall be made by the electric-furnace or vacuum-melting process.

3.1.1.1 Sufficient discard shall be taken from each ingot to insure freedom from piping and undue segregation.

3.2 Chemical composition:

The chemical composition and check analysis tolerances of bars shall be in accordance with FED-STD-66 steel No. E52100. For sizes over 200 sq. in. in cross sectional area, the chemical composition shall be negotiated. (See 6.3).

3.3 Hardness:

3.3.1 As received: Bars in the spheroidized condition shall be supplied with a hardness not higher than Brinell 207 (Rockwell B-94.5), except that if ordered cold finished, the hardness may be as high as Brinell 248 (Rockwell C-24) or equivalent.

3.3.2 Heat-treated: The hardness of the material heat-treated and tested in accordance with 4.4.2 shall be not less than Rockwell C-63, or equivalent.

3.4 Metallographic structure:

Unless otherwise specified, the metallographic structure of material furnished in the spheroidized condition shall consist of spheroidized carbides in a ferritic matrix. The presence of a cementite network or excessive amounts of lamellar pearlite shall be cause for rejection.

3.5 Macrostructure:

Visual examination of deep-acid-etched specimens shall show no evidence of pipes, internal cracks, excessive segregation, or other injurious defects.

3.6 Decarburization:

Unless otherwise specified, the depth of decarburization of products in surface conditions (2) or (4) shall be not greater than the limits specified in table I.

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

3.6.2 Products furnished in surface conditions (3) and (5) shall be free from decarburization.

3.7 Identification of product:

Bars shall be marked in accordance with Standard MIL-STD-183.

TABLE I - Decarburization Limits

Nominal diameter or distance between opposite faces (inches)	Maximum depth of decarburization (inches)[1]
Up to 0.375 incl	0.010
Over 0.375 to 0.500 incl	.012
Over 0.500 to 0.625 incl	.014
Over 0.625 to 1.000 incl	.017
Over 1.00 to 1.50 incl	.020
Over 1.50 to 2.00 incl	.025
Over 2.00 to 2.50 incl	.030
Over 2.50 to 3.00 incl	.035

1/ The value specified as the maximum depth of decarburization is the sum of the complete plus the partial decarburization.

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3.7.1 Bars smaller than 1/2 inch in diameter or 3/8 inch in width of flat shall be bundled and tagged at each end with an extra tag included in the bundle.

3.8 Tolerance:

Unless otherwise specified, tolerances shall conform to the limits specified in Standard FED-STD-48.

3.9 Workmanship:

Material shall be sound, of uniform quality and condition, free from pipe, and shall not contain laps, cracks, twists, seams, and other defects detrimental to the fabrication or performance of parts.

4. QUALITY ASSURANCE PROVISIONS:

4.1 General:

All the tests required herein for the testing of steel are classified as Acceptance tests, for which necessary sampling techniques and methods of testing are specified in this section.

4.2 Examination of product:

Sufficient spot checks will be made to assure compliance with the surface condition, identification, dimensional, and workmanship requirements.

4.3 Chemical analysis:

4.3.1 Sampling: Samples for check chemical analysis shall be selected as described in FED-STD-151 to represent each heat in the shipment. The sample shall consist of not less than 2 ounces of material.

4.3.1.1 Waiver: Samples for check chemical analysis may be waived at the discretion of the Inspector, provided that all of the material under inspection can be identified as being made from a heat previously analyzed and found to be in accordance with the chemical analysis specified herein.

4.3.1.2 Additional samples: If the material is taken from stock and is not identified as to heat, or if the identity of any portion of the shipment is obscure in any respect, the Inspector shall select the necessary additional samples to determine conformance of all portions of the shipment to this specification.

4.3.2 Method: Chemical analysis shall be made by standard wet chemical, spectrographic, or other analytic methods. In the event of dispute, analysis shall be by standard wet chemical methods.

4.4 Hardness:

4.4.1 Hardness as received:

4.4.1.1 Sampling: Not less than five bars from each lot shall be tested to determine conformance with the allowable hardness limits.

4.4.1.2 Method: Hardness testing shall conform to the methods and requirements of FED-STD-151.

4.4.2 Hardness as heat-treated: The specimen shall be 1/2 inch in length and shall embody the full cross section of the material; however, bars or billets greater than 4 inches by 4 inches may be forged down to this size for tests. The specimens shall be austenitized at 1,525° to 1,575 °F for 30 minutes and quenched in oil maintained between 75° and 140 °F. One face of the specimen shall be prepared for a hardness test by careful grinding, using a coolant, to remove any decarburization. The Rockwell C hardness determined at any point on the ground face shall be not less than the value specified.

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4.5 Metallographic examination:

4.5.1 Sampling: One or more samples shall be selected to represent each heat of steel from which material is submitted for acceptance.

4.5.2 Method: Specimens shall be sectioned and polished to appropriate fineness by metallographic methods and suitably etched to reveal the carbide shape and distribution.

4.6 Macrostructure (deep acid etch):

4.6.1 Sampling: One specimen shall be selected from each 100 bars, or less, submitted for acceptance.

4.6.2 Preparation of specimens: Deep-acid-etched specimens shall be cut from the ends of the bars selected as samples and shall represent the entire cross section of the bar. The specimen shall measure 1/2 inch or more in the direction of the axis of the bar. One of the faces of the specimen representing the cross section of the bar shall be finished flat and smooth by a fine machine cut, or by grinding. The finished face of the specimen shall be etched in an aqueous solution containing 50 percent hydrochloric acid by volume and maintained at a temperature approximately 71 °C (160 °F).

4.6.3 Method: Specimens shall be examined by a competent metallographist for the presence of defects.

4.7 Decarburization:

4.7.1 Sampling: If the Inspector has reason to suspect that the decarburization limits specified herein may have been exceeded, samples shall be selected for determination of the depth of decarburization.

4.7.2 Method: Depth of the zone of decarburization below a surface shall be determined by examination of representative metallographic specimens.

4.8 Rejection and retest:

Material not conforming to this specification or to authorized modification shall be subject to rejection. Where failure of any lot of material to meet the requirements of this specification is due to inadequate heat treatment, the material may be reheat-treated and resubmitted for test. Only two such reheat treatments will be allowed.

5. PREPARATION FOR DELIVERY:

5.1 Application:

The requirements of section 5 apply only to direct purchases by or direct shipments to the Government.

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