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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 5880A

Issued APR 1980
Revised AUG 1994

Superseding AMS 5880

Submitted for recognition as an American National Standard

STEEL, CORROSION RESISTANT, BARS, WIRE, AND FORGINGS 17Cr - 0.52Mo (0.95 - 1.20C) (SAE 51440C) For Bearing Applications

UNS S44004

1. SCOPE:

1.1 Form:

This specification covers a corrosion-resistant steel in the form of bars, wire, forgings, and forging stock.

1.2 Application:

These products have been used typically for anti-friction bearing parts requiring resistance to both corrosion and wear with hardness usually not lower than 58 HRC after hardening and tempering, but usage is not limited to such applications.

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.

2.1 SAE Publications:

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

AMS 2241 Tolerances, Corrosion and Heat Resistant Steel, Iron Alloy, Titanium, And Titanium Alloy Bars and Wire
MAM 2241 Tolerances, Metric, Corrosion and Heat Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Bars and Wire
AMS 2248 Chemical Check Analysis Limits, Wrought Corrosion and Heat Resistant Steels and Alloys
AMS 2371 Quality Assurance Sampling and Testing, Corrosion and Heat Resistant Steels and Alloys, Wrought Products and Forging Stock
AMS 2374 Quality Assurance Sampling and Testing, Corrosion and Heat Resistant Steel and Alloy Forgings

Printed in U.S.A.

2.1 (Continued)

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

2.2 ASTM Publications:

Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM A 370 Mechanical Testing of Steel Products
ASTM E 45 Determining the Inclusion Content of Steel
ASTM E 112 Determining the Average Grain Size
ASTM E 353 Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys
ASTM E 381 Macroetch Testing, Inspection, and Rating Steel Products, Comprising Bars, Billets, Blooms, and Forgings

2.3 U.S. Government Publications:

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

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

3. TECHNICAL REQUIREMENTS:

3.1 Composition:
(R)

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 353, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - Composition

Element	min	max
Carbon	0.95	1.20
Manganese	--	1.00
Silicon	--	1.00
Phosphorus	--	0.040
Sulfur	--	0.030
Chromium	16.00	18.00
Molybdenum	0.40	0.65
Nickel	--	0.75
Copper	--	0.75

3.1.1 Check Analysis: Composition variations shall meet the requirements of AMS 2248.

3.2 Condition:

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

3.2.1 Bars: Shall have hardness not higher than 255 HB, or equivalent (See 8.2).

3.2.1.1 Bars 2.750 Inches (69.85 mm) and Under in Nominal Diameter or Distance Between Parallel Sides and All Hexagons: Shall be cold finished.

3.2.1.2 Bars, Other Than Hexagons, Over 2.750 Inches (69.85 mm) in Nominal Diameter or Distance Between Parallel Sides: Shall be hot finished.

3.2.2 Wire: Cold finished having tensile strength not higher than 130 ksi (896 MPa) or equivalent hardness.

3.2.3 Forgings: As ordered.

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 (R) Response to Heat Treatment: Specimens from product 0.375 inch (9.52 mm) and under in nominal thickness and specimens not less than 0.375 inch (9.52 mm) in any dimension cut from larger product shall have hardness not lower than 58 HRC, or equivalent (See 8.2), after being heated to 1925 °F ± 25 (1052 °C ± 14), held at heat for 30 minutes ± 3, and quenched in oil.

3.3.2 (R) Average Grain Size: Shall be ASTM No. 6 or finer, determined in accordance with ASTM E 112 on specimens hardened in accordance with the procedure of 3.3.1 (See 8.3).

3.3.3 Macrostructure:

3.3.3.1 (R) Transverse: Visual examination of transverse full cross-sections from bars, wire, billets, and forging stock, etched in hot hydrochloric acid in accordance with ASTM E 381, shall show no pipe or cracks.

3.3.3.2 (R) Longitudinal: Visual examination of sections as in 4.3.4 from bars, billets, and forging stock over 0.500 inch (12.7 mm) in nominal thickness or diameter, after preparation and etching as in 3.3.3.2.1, shall show no streaks longer than 1/8 inch (3.2 mm) attributable to carbide segregation.

3.3.3.2.1 The surface to be examined, 2 inches (50.8 mm) minimum by diameter or thickness, shall be polished with 180 grit or finer abrasive and etched for sufficient time to produce a dark gray background coloration. The etchant may be 1:1 hydrochloric acid at 150 to 160 °F (66 to 71 °C) or 1:1 hydrochloric acid plus 1% hydrogen peroxide swabbed at room temperature.

3.3.4 Micro-Inclusion Rating: One or more specimens as in 4.3.5 from each ingot tested, as well as two-thirds of the total number of specimens and the average of all specimens, shall not exceed the limits shown in Table 2, determined in accordance with ASTM E 45, Method A, except that the length of any inclusion shall be not greater than 0.025 inch (0.64 mm).

TABLE 2 - Micro-Inclusion Rating Limits

Type	A	B	C	D
Thin	2.0	2.5	2.5	2.0
Heavy	1.5	1.5	2.0	1.5

3.3.5 Decarburization:

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

3.3.5.2 Allowable decarburization of bars, wire, and billets ordered for redrawing or forging or to specified microstructural requirements shall be agreed upon by purchaser and vendor.

3.3.5.3 Decarburization of bars and wire to which 3.3.5.1 or 3.3.5.2 is not applicable shall be not greater than shown in Table 3.

TABLE 3A - Maximum Decarburization, Inch/Pound Units

Nominal Diameter or Distance Between Parallel Sides Inches	Depth of Decarburization Inch
Up to 0.500, incl	0.010
Over 0.500 to 1.000, incl	0.015
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 Between Parallel Sides Millimeters	Depth of Decarburization Millimeter
Up to 12.70, incl	0.25
Over 12.70 to 25.40, incl	0.38
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

3.3.5.3.1 Limits for depth of decarburization of bars over 4.000 inches (101.60 mm) in nominal diameter or distance between parallel sides shall be agreed upon by purchaser and vendor.

3.3.5.4 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 any decarburization or lack of decarburization thereon.

3.3.5.4.1 When determining the depth of decarburization, it is permissible to disregard local areas provided the decarburization of such areas does not exceed the 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 (R) Bars and wire 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.

3.4.2 (R) 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:

Bars and wire shall conform to all applicable requirements of AMS 2241 or MAM 2241.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:
(R)

The vendor of the product shall supply all samples for vendor's tests and shall be responsible for performing all required tests. 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:

All technical requirements are acceptance tests and shall be performed on each heat or lot as applicable.

4.3 Sampling and Testing:
(R)

Shall be as follows:

4.3.1 Bars, Wire, and Forging Stock: In accordance with AMS 2371.

4.3.2 Forgings: In accordance with AMS 2374.

4.3.3 Specimens for response to heat treatment (3.3.1) shall be the full cross-section of the product ground on both faces normal to the axis so that the length is 0.375 inch ± 0.015 (9.52 mm ± 0.38).

4.3.4 Samples for longitudinal macrostructure (3.3.3.2) testing shall be 2 inches (51 mm) long specimens taken through the center of the cross-section of the product supplied.

4.3.5 Samples for micro-inclusion rating (3.3.4) shall consist of not less than six specimens from each heat, selected so that the surface examined will be approximately parallel to the direction of rolling. The method of selection of specimens shall be such that a representative rating is ensured for the heat of steel being evaluated.

4.4 Reports:
(R)

The vendor of the product shall furnish with each shipment a report showing the results of tests for chemical composition of each heat and the results of tests on each lot to determine conformance to the other technical requirements. This report shall include the purchase order number, heat and lot number, AMS 5880A, size, and quantity. If forgings are supplied, the part number and the size and melt source of stock used to make the forgings shall also be included.