



AEROSPACE MATERIAL SPECIFICATION

AMS5880™**REV. F**

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Superseding AMS5880E

(R) Steel, Corrosion-Resistant, Bars, Wire, Forgings and Forging Stock
17Cr - 0.52Mo (0.95 - 1.20C) (SAE 51440C)
for Bearing Applications
(Composition similar to UNS S44004)

RATIONALE

AMS5880F is the result of a request to reactivate and update the document. The revision updates the Title to match the Scope, addresses changes in testing and reporting requirements (see 3.1 and 3.1.1), allows alternate finishes (see 3.2.1.2), prohibits bar cut from plate (see 3.2.1.3 and 4.4.2), removes requirements for longitudinal macrostructure (see 3.3.1, 4.3.4, Revision E, 4.4.1, and 4.4.4), revises decarburization test methods (see 3.3.5.4), removes wire finish requirements (see 3.4.1 and 8.6), permits the use of alternate, premium-quality material (see 3.6, 4.2.3, 4.4.1.1, 4.4.4.1, and 5.2.1.2), prohibits unauthorized exceptions (see 3.7, 4.4.3, 5.2.1.1, and 8.6), updates reporting, including country of origin and forging stock requirements (see 4.4 and 8.8), and allows the use of prior revisions (see 8.7).

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 issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS2241 Tolerances, Corrosion- and Heat-Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Bars and Wire

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<https://www.sae.org/standards/content/AMS5880F>

AMS2248	Chemical Check Analysis Limits, Corrosion- and Heat-Resistant Steels and Alloys, Maraging and Other Highly Alloyed Steels, and Iron Alloys
AMS2371	Quality Assurance Sampling and Testing, Corrosion and Heat-Resistant Steels and Alloys, Wrought Products and Forging Stock
AMS2374	Quality Assurance Sampling and Testing , Corrosion- and Heat-Resistant Steel and Alloy Forgings
AMS2806	Identification, Bars, Wire, Mechanical Tubing , and Extrusions, Carbon and Alloy Steels and Corrosion and Heat-Resistant Steels and Alloys
AMS2808	Identification, Forgings
AMS5618	Steel, Corrosion-Resistant, Bars, Wire, and Forgings, 17Cr - 0.52Mo (0.95 - 1.20C), (440C), Consumable Electrode Vacuum Melted
AS1182	Standard Stock Removal Allowance, Aircraft-Quality and Premium Aircraft-Quality Steel Bars and Mechanical Tubing
AS7766	Terms Used in Aerospace Metals Specifications

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM A370	Mechanical Testing of Steel Products
ASTM A751	Chemical Analysis of Steel
ASTM E45	Determining the Inclusion Content of Steel
ASTM E112	Determining Average Grain Size
ASTM E140	Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness
ASTM E381	Macroetch Testing Steel Bars, Billets, Blooms, and Forgings
ASTM E1077	Estimating the Depth of Decarburization of Steel Specimens

2.3 Definitions

Terms used in AMS are defined in AS7766.

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM A751 or by other analytical methods acceptable to the 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 The producer may test for any element not listed in Table 1 and include this analysis in the report of 4.4. Reporting of any element not listed in the composition table is not a basis for rejection unless limits of acceptability are specified by the purchaser.

3.1.2 Check Analysis

Composition variations shall meet the applicable requirements of AMS2248.

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

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 Least 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 Least Distance Between Parallel Sides

Shall be hot finished or cold finished.

3.2.1.3 Bar shall not be cut from plate (see 4.4.2).

3.2.2 Wire

Cold finished having tensile strength not higher than 130 ksi (896 MPa), or equivalent hardness (see 8.3).

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 A370:

3.3.1 Macrostructure

Visual examination of transverse full cross sections from bars, wire, billets, and forging stock, etched in hot hydrochloric acid in accordance with ASTM E381, shall show no pipe or cracks. Standards for porosity, segregation, inclusions, and other imperfections as defined in the macrographs of ASTM E381 may be agreed upon by the purchaser and supplier.

3.3.2 Micro-Inclusion Rating

At least one specimen 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 E45, 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

3.3.3 Response to Heat Treatment

Specimens as in 4.3.3, protected by suitable means or treated in a neutral atmosphere to minimize scaling and prevent either carburization or decarburization, shall have hardness not lower than 58 HRC, or equivalent (see 8.2), after being heated to 1925 °F ± 25 °F (1052 °C ± 14 °C), held at heat for 30 minutes ± 3 minutes, and quenched in oil.

3.3.3.1 Subzero cooling to -100 °F ± 20 °F (-73 °C ± 11 °C), holding at that temperature for 2 hours ± 0.25 hour, and warming in air to room temperature, after heating as in 3.4.5, is optional.

3.3.4 Average Grain Size

Shall be ASTM No. 6 or finer, determined in accordance with ASTM E112 on specimens hardened in accordance with the procedure of 3.3.3.

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 the purchaser and producer.

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	Total Depth of Decarburization Inches
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	Total Depth of Decarburization Millimeters
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

3.3.5.4 Decarburization shall be evaluated by one of the two methods of 3.3.5.4.1 or 3.3.5.4.2.

3.3.5.4.1 Metallographic (Microscopic) Method

A cross section taken perpendicular to the surface shall be etched and examined metallographically at a magnification not to exceed 200X in accordance with ASTM E1077. The sample shall not show a layer of complete ferrite or partial decarburization exceeding the limits of Table 3.

3.3.5.4.2 Hardness Traverse (Microindentation) Method

The total depth of decarburization shall be determined by a traverse method using microindentation hardness testing in accordance with ASTM E1077. Samples shall be hardened and protected during heat treatment to prevent changes in surface carbon content. Samples may be tempered at the option of the producer. Measurements shall be far enough away from any adjacent surface to be uninfluenced by decarburization on the adjacent surface. Acceptance shall be as listed in Table 3.

3.3.5.4.3 In case of dispute, the depth of decarburization determined using the microhardness traverse method shall govern.

3.3.5.4.4 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 the 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 Bars 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 surface (see 8.5).

3.4.2 Grain flow of die forgings, except in areas that contain flash-line end grain, shall follow the general contour of the forgings showing no evidence of reentrant grain flow.

3.5 Tolerances

Bars and wire shall conform to all applicable requirements of AMS2241.

3.6 Premium Aircraft Quality Material

Premium aircraft quality material produced to AMS5618 may be used when AMS5880 is required.

3.7 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.3

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of the product shall supply all samples for the producer's tests and shall be responsible for the performance of all required tests. The purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Composition (see 3.1), condition (see 3.2), macrostructure (see 3.3.1), micro-inclusion rating (see 3.3.2), response to heat treatment (see 3.3.3), average grain size (see 3.3.4), decarburization (see 3.3.5), and tolerances (see 3.5) are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.2 Periodic Tests

Grain flow of die forgings (see 3.4.2) is a periodic test and shall be performed at a frequency selected by the producer unless frequency of testing is specified by the purchaser.

4.2.3 Premium Aircraft Quality Tests

When material produced to AMS5618 (see 3.6) is used, acceptance tests performed on a heat or lot basis (see 4.2.1) shall be performed in accordance with AMS5618.

4.3 Sampling and Testing

Shall be as follows:

4.3.1 Bars, Wire, and Forging Stock

In accordance with AMS2371.

4.3.2 Forgings

In accordance with AMS2374.

4.3.3 Specimens for response to heat treatment (see 3.3.3) of bars, wires, and billets shall be not less than 0.375 inch (9.52 mm) in thickness. Minimum dimensions in other directions shall be either those of the product thickness or 1.125 x 1.125 inches (28.58 x 28.58 mm).

4.4 Reports

4.4.1 The producer of bar, wire, or forgings shall furnish with each shipment a report showing the producer's name and country where the metal was melted (e.g., final melt in the case of metal processed by multiple melting operations); the results of tests for composition, macrostructure, and micro-inclusion rating of each heat and for condition, response to heat treatment (stating if subzero cooling was used), and average grain size of each lot; and stating that the product conforms to the other technical requirements. This report shall include the purchase order number, heat and lot numbers, AMS5880F, size, and quantity. If forgings are supplied, the size and melt source of stock used to make the forgings shall also be included.

4.4.1.1 When bar, wire, and forgings that are produced to AMS5618 (see 3.6) are supplied, the producer shall furnish with each shipment the applicable report. The report shall make the statement "This material is certified as AMS5880F and AMS5618(current revision) in accordance with 3.6."

4.4.2 Report the nominal metallurgically worked cross-sectional size and the cut size, if different (see 3.2.1.3).

4.4.3 When material produced to this specification has exceptions taken to the technical requirements listed in Section 3, the report shall contain a statement "This material is certified as AMS5880F(EXC) because of the following exceptions:" and the specific exceptions shall be listed (see 5.2.1.1).

4.4.4 The producer of forging stock shall furnish with each shipment a report showing the producer's name, country where the metal was melted (e.g., final melt in the case of metal processed by multiple melting operations), the results of tests for composition, macrostructure, micro-inclusion rating, and response to heat treatment (stating if subzero cooling was used) for each heat, and the results of any additional property requirements imposed by 8.8. This report shall include the purchase order number, heat and lot numbers, AMS5880F, product form and size or part number, and quantity.

4.4.4.1 When forging stock that is produced to AMS5618 (see 3.6) is supplied, the producer shall furnish with each shipment the applicable report. The report shall make the statement "This material is certified as AMS5880F and AMS5618(current revision) in accordance with 3.6."

4.5 Resampling and Retesting

Shall be as follows:

4.5.1 Bars, Wire, and Forging Stock

In accordance with AMS2371.

4.5.2 Forgings

In accordance with AMS2374.

5. PREPARATION FOR DELIVERY

5.1 Sizes

Except when exact lengths or multiples of exact lengths are ordered, straight bars and wire will be acceptable in mill lengths of 6 to 20 feet (1.8 to 6.1 m), but not more than 10% of any shipment shall be supplied in lengths shorter than 10 feet (3 m).