AEROSPACE MATERIAL SPECIFICATION

AMS5900	REV. B

Issued 1981-01
Revised 2000-02
Reaffirmed 2013-08

Superseding AMS5900A

Steel Bars, Forgings, and Tubing, Corrosion Resistant 14Cr - 2.1Mo - 0.30Cb - 1.0V (1.05 - 1.15C) Premium Aircraft Quality for Bearing Applications, Double Vacuum Melted (Composition similar to UNS S42800)

RATIONALE

AMS5900B has been reaffirmed to comply with the SAE 5-year Review policy.

1. SCOPE

1.1 Form

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

1.2 Application

These products have been used typically for critical bearing components requiring a through-hardening, corrosion-resistant steel operating under heavy loads and high speeds at moderate temperatures and subject to very rigid inspection standards, 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 form 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 canceled and no superseding document has been specified, the last published issue of that document shall apply.

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

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/AMS5900B

AMS 2243 Tolerances, Corrosion and Heat Resistant Steel Tubing

MAM 2243 Tolerances, Metric, Corrosion and Heat Resistant Steel Tubing

AMS 2248 Chemical Check Analysis Limits, Corrosion and Heat Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels, and Iron Alloys

AMS 2300 Cleanliness, Premium Aircraft-Quality Steel, Magnetic Particle Inspection Procedure

MAM 2300 Cleanliness, Premium Aircraft-Quality Steel, Magnetic Particle Inspection Procedure, Metric (SI) Measurement

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

AMS 2806 Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels, 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, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM A 370 Mechanical Testing of Steel Products

ASTM A 604 Macroetch Testing of Consumable Electrode Remelted Steel Bars and Billets

ASTM E 45 Determining the Inclusion Content of Steels

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

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 E 353, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - COMPOSITION

Element	min	max
Carbon	1.05	1.15
Manganese	0.25	0.50
Silicon	0.20	0.40
Phosphorus	--	0.015
Sulfur	--	0.010
Chromium	13.75	14.75
Molybdenum	1.90	2.25
Columbium	0.25	0.35
Vanadium	0.90	1.15
Nickel	--	0.35
Copper	--	0.35

3.1.1 Check Analysis

Composition variations shall meet the applicable requirements of AMS 2248.

3.2 Melting Practice

Product shall be multiple melted using vacuum induction melting practice followed by vacuum consumable electrode remelting.

3.3 Condition

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

3.3.1 Bars

Annealed having hardness not higher than 255 HB, or equivalent (See 8.2).

3.3.1.1 All hexagons and other bars 2.75 inches (69.8 mm) and under in nominal diameter or distance between parallel sides shall be cold finished.

3.3.1.2 Bars, other than hexagons, over 2.75 inches (69.8 mm) in nominal diameter or distance between parallel sides shall be hot finished.

3.3.2 Wire

Cold finished and annealed having a tensile strength not higher than 130 ksi (896 MPa) except that for wire 0.062 inch (1.57 mm) and under in nominal diameter tensile strength shall be as agreed upon by purchaser and vendor.

3.3.3 Forgings

As ordered.

3.3.4 Mechanical Tubing

Annealed and cold finished having hardness not higher than 293 HB, or equivalent (See 8.2).

3.3.5 Forging Stock

As ordered by the forging manufacturer.

3.4 Properties

The product shall conform to the following requirements; hardness testing shall be performed in accordance with ASTM A 370.

3.4.1 Macrostructure

Visual examination of transverse full cross-sections from bars, billets, tube rounds, and forging stock, etched in hot hydrochloric acid in accordance with ASTM A 604, shall show no pipe or cracks. Porosity, segregation, inclusions, and other imperfections for product 225 square inches (1452 cm^2) and under in nominal cross-sectional area shall be no worse than the macrographs of ASTM A 604 shown in Table 2.

TABLE 2 - MACROSTRUCTURE LIMITS

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

3.4.2 Micro-Inclusion Rating

No specimen shall exceed the limits shown in Table 3, determined in accordance with ASTM E 45, Method D.

TABLE 3 - MICRO-INCLUSION LIMITS

	A Thin	A Heavy	B Thin	B Heavy	C Thin	C Heavy	D Thin	D Heavy
Worst Field Severity	1.5	1.0	1.0	1.0	1.0	1.0	1.5	1.0
Worst Field Frequency, max	x	1	x	1	x	1	3	1
Total Rateable Fields, Frequency, max	y	1	y	1	y	1	8	1

[x] Combined A+B+C; not more than 3 fields
[y] Combined A+B+C; not more than 8 fields

3.4.2.1 A rateable field is defined as one which has a type A, B, C, or D inclusion rating of at least No. 1.0 thin or heavy in accordance with the Jernkontoret chart, Plate III, ASTM E 45.

3.4.3 Response to Heat Treatment

Specimens (See 4.3.3) shall have hardness not lower than 60 HRC, or equivalent (See 8.2), after being treated as follows in a neutral atmosphere or neutral salt to minimize scale and prevent either carburization or decarburization:

3.4.3.1 Preheat at 1500 °F ± 10 (816 °C ± 6) for not less than 15 minutes.

3.4.3.2 Heat to 2100 °F ± 25 (1149 °C ± 14), hold at heat for 7 to 10 minutes. Oil quench to room temperature or, preferably, quench into salt maintained at 1050 to 1150 °F (566 to 621 °C), hold at temperature for 2 minutes ± 0.2, and cool in air to room temperature.

3.4.3.3 Stress relieve by heating to 300 °F ± 15 (149 °C ± 8), holding at temperature for 60 minutes ± 5, and cooling in air to room temperature.

3.4.3.4 Subzero cool to -100 °F ± 10 (-73 °C ± 6), hold at temperature for not less than 15 minutes, and allow to return to room temperature in air.

3.4.3.5 Temper within 4 hours after the subzero cool by heating to 975 °F ± 15 (524 °C ± 8), holding at heat for 2 hours ± 0.25, and cooling in air to room temperature.

3.4.4 Decarburization

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

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

3.4.4.3 Decarburization of bars to which 3.4.4.1 or 3.4.4.2 is not applicable shall be not greater than shown in Table 4.

TABLE 4A - MAXIMUM DECARBURIZATION, INCH/POUND UNITS

Nominal Diameter or Distance Between Parallel Sides Inches	Total Depth of Decarburization Inch
Up to 0.500, incl	0.015
Over 0.500 to 1.000, incl	0.030
Over 1.000 to 2.000, incl	0.040
Over 2.000 to 3.000, incl	0.050
Over 3.000 to 4.000, incl	0.065
Over 4.000 to 5.000, incl	0.095

TABLE 4B - MAXIMUM DECARBURIZATION, SI UNITS

Nominal Diameter or Distance Between Parallel Sides Millimeters	Total Depth of Decarburization Millimeters
Up to 12.70, incl	0.38
Over 12.70 to 25.40, incl	0.76
Over 25.40 to 50.80, incl	1.02
Over 50.80 to 76.20, incl	1.27
Over 76.20 to 101.60, incl	1.65
Over 101.60 to 127.00, incl	2.41

3.4.4.4 Decarburization of tubing to which 3.4.4.1 or 3.4.4.2 is not applicable shall be not greater than shown in Table 5.

TABLE 5A - MAXIMUM DECARBURIZATION, INCH/POUND UNITS

Nominal Outside Diameter Inches	Total Depth of Decarburization Inch
Up to 1.000, incl	0.025
Over 1.000 to 2.000, incl	0.035
Over 2.000 to 3.000, incl	0.045
Over 3.000 to 4.000, incl	0.055
Over 4.000 to 5.000, incl	0.080

TABLE 5B - MAXIMUM DECARBURIZATION, SI UNITS

Nominal Outside Diameter Millimeters	Total Depth of Decarburization Millimeters
Up to 25.40, incl	0.64
Over 25.40 to 50.80, incl	0.89
Over 50.80 to 76.20, incl	1.14
Over 76.20 to 101.60, incl	1.40
Over 101.60 to 127.00, incl	2.03

3.4.4.5 Decarburization shall be measured by the microscopic method, by HR30N scale hardness testing method, or by the microhardness traverse method on hardened and sub-zero cooled 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 an adjacent surface to be uninfluenced by decarburization on the adjacent surface. In case of dispute, the depth of decarburization determined using the microhardness traverse method shall govern.

3.4.4.5.1 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 inch (0.13 mm) and the width is 0.065 inch (1.65 mm) or less.

3.4.5 Average Grain Size

Shall be ASTM 7 or finer determined in accordance with ASTM E 112 (See 8.4).

3.5 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.

3.5.1 Steel shall be premium aircraft-quality conforming to AMS 2300 or MAM 2300.

3.5.2 Bars and tubing 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 surface.

3.5.3 Forgings shall have substantially uniform macrostructure. Standards for acceptance shall be as agreed upon by purchaser and vendor.

3.5.4 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.

3.6 Tolerances

Shall conform to all applicable requirements of the following:

3.6.1 Bars and Wire

AMS 2241 and MAM 2241.

3.6.2 Mechanical Tubing

AMS 2243 and MAM 2243.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

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

The following are acceptance tests and shall be performed on each heat or lot as applicable: composition (3.1), condition (3.2), macrostructure rating (3.4.1), micro-inclusion rating (3.4.2), response to heat treatment (3.4.3), decarburization (3.4.4), average grain size (3.4.5), quality (3.5.2), and tolerances (3.6).

4.2.2 Periodic Tests

Frequency-severity cleanliness rating (3.5.1), and grain flow of die forgings (3.5.2.4) are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing

Shall be in accordance with the following:

4.3.1 Bars, Wire, Mechanical Tubing and Forging Stock

AMS 2371.

4.3.2 Forgings

AMS 2374.

4.3.3 Samples for response to heat treatment (3.4.3) of bars and billets shall be the full cross section of the product ground on both faces normal to the axis so that the length is 0.375 to 0.500 inch (9.52 to 12.70 mm). Specimens from mechanical tubing shall be full sections of the tubing, shall have wall thickness of 0.625 inch (15.88 mm) or less with wall thicknesses over 0.625 inch (15.88 mm) being turned to 0.625 inch ± 0.010 (15.88 mm ± 0.25) and shall be ground on both faces normal to the axis so that length is 0.375 to 0.500 inch (9.52 to 12.70 mm).

4.4 Reports

The vendor of the product shall furnish with each shipment a report showing the results of tests for chemical composition, macrostructure and micro-inclusion rating for each heat and for condition, response to heat treatment 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, AMS 5900B, size, and quantity. If forgings are supplied, the size and melt source of stock used to make the forgings shall also be included.

4.5 Resampling and Retesting

Shall be as follows:

4.5.1 Bars, Wire, Mechanical Tubing and Forging Stock

In accordance with AMS 2371.

4.5.2 Forgings

In accordance with AMS 2374.

5. PREPARATION FOR DELIVERY

5.1 Sizes

Except when exact lengths or multiples of exact lengths are ordered, straight bars, wire, and tubing 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).

5.2 Identification

Shall be as follows:

5.2.1 Bars, Wire, and Mechanical Tubing

In accordance with AMS 2806.