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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 5925

Issued MAY 1999

Submitted for recognition as an American National Standard

Steel, Corrosion Resistant, Bars, Wire, and Forgings
15.5Cr - 1.8Mo - 0.20N (0.37 - 0.45 C)
Electroslag Remelted

UNS S42025

1. SCOPE:

1.1 Form:

This specification covers a premium aircraft-quality, 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 components requiring resistance to both corrosion and wear with hardness 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, Corrosion and Heat Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels, and Iron Alloys
AMS 2300	Premium Aircraft-Quality Steel Cleanliness, Magnetic Particle Inspection Procedure
MAM 2300	Premium Aircraft-Quality Steel Cleanliness, Magnetic Particle Inspection Procedure, Metric (SI) Measurement

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2.1 (Continued):

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 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, 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 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

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	0.37	0.45
Manganese	--	0.60
Silicon	--	0.60
Phosphorus	--	0.020
Sulfur	--	0.005
Chromium	15.00	16.50
Molybdenum	1.50	1.90
Vanadium	0.20	0.40
Nitrogen	0.16	0.25
Nickel	--	0.30

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

3.2 Melting Practice:

Steel shall be multiple melted using the electroslag remelt practice in the final melting cycle.

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 8.1).

3.3.1.1 Bars 2.750 Inches (69.85 mm) and Under in Nominal Diameter or Least Distance Between Parallel Sides and All Hexagons: Cold finished.

3.3.1.2 Bars, Other than Hexagons, Over 2.750 Inches (69.85) in Nominal Diameter or Least Distance Between Parallel Sides: Hot finished.

3.3.2 Wire: Annealed and cold finished having tensile strength not higher than 130 ksi (896 MPa).

3.3.3 Forgings: As ordered.

3.3.4 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 Bars, Wire and Forgings:

3.4.1.1 Macrostructure: Visual examination of transverse sections form bars, wire, billets, 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 36 square inches (232 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

3.4.1.2 Micro-Inclusion Rating: No specimens shall exceed the limits of Table 3, determined in accordance with ASTM E 45, Method D.

TABLE 3 - Micro-Inclusion Rating Limits

	A Thin	A Heavy	B Thin	B Heavy	C Thin	C Heavy	D Thin	D Heavy
Worst Field Severity	1.5	1.0	1.5	1.0	1.0	1.0	1.5	1.0
Worst Field Frequency, max	a	1	a	1	a	1	3	1
Total Rateable Fields, Frequency, max	b	1	b	1	b	1	b	1

[a] Combined A+B+C; not more 3 fields

[b] Combined A+B+C; not more 8 fields
A+B+C+D; not more 16 fields

3.4.1.2.1 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.

3.4.1.3 Microstructure: The product shall be free of carbide network. For the products of sections between 0.15 and 12.4 square inches (1 and 80 cm^2), the maximum carbide size allowed is: .0014 inch (35 µm) for isolated carbides, .0010 inch (25 µm) for grouped carbides [distance between carbides < .0020 inch (50 µm)]. The examination shall be carried out at mid-radius (or equivalent) on a surface which is parallel to the grain flow.

3.4.1.4 Average Grain Size: Shall be ASTM No. 6 or finer, determined in accordance with ASTM E 112.

3.4.2 Decarburization and Denitridation:

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

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

3.4.2.3 Decarburization and/or denitridation of bars and wire, to which 3.4.2.1 or 3.4.2.2 is not applicable, shall be not greater than shown in Table 4.

TABLE 4A - Maximum Decarburization/Denitridation, Inch/Pound Units

Nominal Diameter or Distance Between Parallel Sides Inches	Depth of Decarburization/Denitridation 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 to 4.000, incl	0.045

TABLE 4B - Maximum Decarburization/Denitridation, SI Units

Nominal Diameter or Distance Between Parallel Sides Millimeters	Depth of Decarburization/Denitridation Millimeters
Up to 12.70, incl	0.38
Over 12.70 to 25.40, incl	0.51
Over 25.40 to 38.10, incl	0.64
Over 38.10 to 50.80, incl	0.76
Over 50.80 to 63.50, incl	0.89
Over 63.50 to 76.20, incl	1.02
Over 76.20 to 101.60, incl	1.14

3.4.2.4 Decarburization and denitridation shall be measured by the microscopic method, by HR30N scale hardness testing method, or by the microhardness traverse method on a hardened but untempered specimen protected during heat treatment to prevent changes in surface carbon and nitrogen content. Depth of decarburization or denitridation, 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 decarburization/denitridation on the adjacent surface. In case of dispute, the microhardness traverse method shall govern.

3.4.2.4.1 When determining the depth of decarburization/denitridation it is permissible to disregard local areas provided the decarburization/denitridation 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.

3.4.3 Response to Heat Treatment: Specimens as in 4.3.3, protected by suitable means or treated in neutral atmosphere to minimize scaling and prevent either carburization or decarburization, shall have hardness not lower than 58 HRC, or equivalent (See 8.1), after being heated to 1920 °F ± 25 (1049 °C ± 14), held at heat for 30 minutes ± 3, quenched in oil, sub-zero cooled to -100 °F ± 20 (-73 °C ± 11), held for 2 hours ± 0.25, warmed in air to room temperature and tempered at 350 °F ± 10 (177 °C ± 6) for 60 minutes ± 5.

3.5 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.

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

3.5.2 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 surface.

3.5.3 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:

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

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: Composition (3.1), condition (3.3), macrostructure (3.4.1.1), microinclusion rating (3.4.1.2), microstructure (3.4.1.3), average grain size (3.4.1.4), decarburization and denitridation (3.4.5), response to heat treatment (3.4.6), frequency-severity cleanliness rating (3.5.1), and tolerances (3.6) are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.2 Periodic Tests: Grain flow of die forgings (3.5.3) is a periodic test and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.