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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 5749D

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Superseding AMS 5749C

Submitted for recognition as an American National Standard

Steel, Corrosion Resistant, Bars, Wire, Forgings, and Tubing
14.5Cr - 4.0Mo - 1.2V (1.10-1.20C)
Premium Quality for Bearing Applications, Double Vacuum Melted

UNS S42700

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 parts requiring a through-hardening, corrosion-resistant steel, operating under heavy loads at high speeds, requiring resistance to wear and softening at elevated temperatures, and subject to rigid inspection standards, 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 2243 Tolerances, Corrosion and Heat Resistant Steel Tubing
MAM 2243 Tolerances, Metric, Corrosion and Heat Resistant Steel Tubing

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2.1 (Continued):

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
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	Macrotech Testing of Consumable Electrode Remelted Steel Bars and Billets
ASTM E 45	Determining the Inclusion Content of Steel
ASTM E 112	Determine 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	1.10	1.20
Manganese	0.30	0.60
Silicon	0.20	0.40
Phosphorus	-	0.015
Sulfur	-	0.010
Chromium	14.00	15.00
Molybdenum	3.75	4.25
Vanadium	1.10	1.30
Nickel	-	0.40
Copper	-	0.35

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

3.2 Melting Practice:

Steel shall be double vacuum 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 269 HB, or equivalent (See 8.2).

3.3.1.1 All hexagons and other bars 2.750 inches (69.85 mm) and under in nominal diameter or distance between parallel sides shall be cold finished.

3.3.1.2 Bars, other than hexagons, over 2.750 inches (69.85 mm) in nominal diameter or distance between parallel sides shall be hot finished.

3.3.2 Wire: Cold finished and annealed having tensile strength not higher than 130 ksi (896 MPa), or equivalent hardness except that for wire 0.062 inch (1.59 mm) and under in nominal diameter tensile strength shall not apply unless agreed upon by purchaser and vendor (See 8.2).

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 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 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

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

TABLE 3 - Micro-Inclusion Rating Limits

Type	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, maximum	x	1	x	1	x	1	3	1
Total Rateable Fields, Frequency, maximum	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 Decarburization:

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

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

3.4.3.3 Decarburization of bars and wire to which 3.4.3.1 or 3.4.3.2 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	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	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

3.4.3.4 Decarburization of tubing to which 3.4.3.1 or 3.4.3.2 is not applicable shall be not greater than shown in Table 5.

TABLE 5A - Maximum Decarburization, Inch/Pound Units

Nominal Outside Diameter Inches	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	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

3.4.3.5 Decarburization shall be measured by the microscopic method, BY HR30N scale hardness testing method, or by the microchardness traverse method on a hardened but untempered specimen protected during heat treatment to prevent changes in surface carbon content. Depth of decarburization, when measured by 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 on the adjacent surface. In case of dispute, the depth of decarburization determined using the microhardness traverse method shall govern.

3.4.3.5.1 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.

3.4.4 Response to Heat Treatment:

Specimens as in 4.3.3, taken from bars or billets and ground on both faces normal to the axis of the specimen, shall have hardness not lower than 60 HRC, or equivalent (See 8.2), after being heat treated as follows:

3.4.4.1 Harden by heating to 2050 °F ± 25 (1121 °C ± 14), holding at heat for one hour per inch (25 mm) of maximum cross section but not less than 30 minutes, and quenching in oil or quenching for 5 to 6 minutes in a salt bath maintained at 1050 °F ± 15 (566 °C ± 8), and cooling in air.

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

3.4.4.3 Cold treat by cooling to -100 °F ± 10 (-73 °C ± 6), holding at that temperature for not less than 15 minutes, and warming in air.

3.4.4.4 Double temper by heating to 975 °F ± 15 (524 °C ± 8), holding at heat for two hours ± 0.25, cooling in air, cooling in air, reheating to 975 °F ± 15 (524 °C ± 8), holding at heat for 2 hours ± 0.25, and cooling in air.

3.4.5 Average Grain Size: Shall be ASTM No. 7 or finer, determined in accordance with ASTM E 112 after austenitizing and quenching as in 3.4.4 (See 8.3).

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 mechanical 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 surfaces.

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:

Shall conform to all applicable requirements of the following:

3.6.1 Bars and Wire: AMS 2241 or MAM 2241; for sizes not covered by AMS 2241 or MAM 2241, tolerances shall be as agreed upon by purchaser and vendor.

3.6.2 Mechanical Tubing: AMS 2243 or 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 requirements are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.1.1 Composition (3.1) of each heat.

4.2.1.2 Macrostructure (3.4.1), micro-inclusion rating (3.4.2), and frequency-severity cleanliness rating (3.5.1) of each heat.

4.2.1.3 Decarburization (3.4.3), hardness (3.4.4) after austenitizing, quenching, stress relieving, cold treating, and double tempering, and average grain size (3.4.5) after austenitizing and quenching, of each lot.

4.2.1.4 Tolerances (3.7) of bars.

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.

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 (3.4.4) shall be taken midway between surface and center of full cross-section specimens obtained from the finished billet or suitable rerolled product.