



AEROSPACE MATERIAL SPECIFICATION	AMS5749™	REV. G
	Issued 1973-12 Reaffirmed 2008-05 Revised 2023-03	
Superseding AMS5749F		
Steel, Corrosion-Resistant, Bars, Wire, Forgings, Forging Stock and Mechanical Tubing 14.5Cr - 4.0Mo - 1.2V (1.10-1.20C) Premium Quality for Bearing Applications, Double Vacuum Melted (Composition similar to UNS S42700)		

RATIONALE

AMS5749G is the result of a Five-Year Review and update. This revision updates the title to match the scope, prohibits unauthorized exceptions (3.7, 4.4.4, 5.2.1, 8.6), updates compositional analysis methods and reporting (3.1, 3.1.1), adds acceptable finish (3.3.1.2), revises decarburization methods (3.4.3.5), revises micro-inclusion evaluation (3.4.2.1), revises acceptance, periodic testing, and associated sampling methods (4.2.1, 4.2.2, 4.3.3), adds forging stock options (4.4.3, 8.7), and allows for the use of prior revisions (8.5).

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 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.

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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
AMS2243	Tolerances, Corrosion- and Heat-Resistant Steel Tubing
AMS2248	Chemical Check Analysis Limits, Corrosion- and Heat-Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels, and Iron Alloys
AMS2300	Steel Cleanliness, Premium Aircraft-Quality, Magnetic Particle Inspection Procedure
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
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 A604	Macroetch Testing of Consumable Electrode Remelted Steel Bars and Billets
ASTM A751	Chemical Analysis of Steel Products
ASTM E45	Determining the Inclusion Content of Steel
ASTM E112	Determine 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 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, in accordance with ASTM A751, 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 Producer may test for any element not listed in Table 1 and include this analysis in the report of 4.5. 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 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 A370:

3.3.1 Bars

Annealed having hardness not higher than 269 HBW, or equivalent (see 8.2). Bar shall not be cut from plate (see 4.4.2).

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

3.3.2 Wire

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

3.3.3 Forgings

As ordered.

3.3.4 Mechanical Tubing

Annealed and cold finished having hardness not higher than 293 HBW, 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 A370:

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 A604, shall show no pipe or cracks. Porosity, segregation, inclusions, and other imperfections shall be no worse than the macrographs of ASTM A604 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 E45, Method D.

Table 3 - Micro-inclusion rating limits

Type	A		B		C		D	
	Thin	Heavy	Thin	Heavy	Thin	Heavy	Thin	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 three fields.

y - Combined A+B+C, not more than eight 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 ASTM E45.

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 producer.

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	Total Depth of Decarburization Inches
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

3.4.3.4 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	Total Depth of Decarburization Inches
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

3.4.3.5 Decarburization shall be evaluated by one of the two methods of 3.4.3.5.1 or 3.4.3.5.2.

3.4.3.5.1 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 4 or 5.

3.4.3.5.2 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 heat treated in a protective atmosphere 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 any decarburization on the adjacent surface. Acceptance shall be as listed in Table 4 or 5.

3.4.3.5.3 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.

3.4.3.5.4 In case of dispute, the total depth of decarburization determined using the microindentation traverse method shall govern.

3.4.4 Response to Heat Treatment

Specimens as in 4.3.3, taken from bars or billets 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 °F (1121 °C ± 14 °C), holding at heat for 1 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 °F (566 °C ± 8 °C), and cooling in air.

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

3.4.4.3 Cold treat by cooling to -100 °F ± 10 °F (-73 °C ± 6 °C), 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 °F (524 °C ± 8 °C), holding at heat for 2 hours ± 0.25 hour, cooling in air, reheating to 975 °F ± 15 °F (524 °C ± 8 °C), holding at heat for 2 hours ± 0.25 hour, and cooling in air.

3.4.5 Average Grain Size

Shall be ASTM No. 7 or finer, determined in accordance with ASTM E112 after austenitizing and quenching as in 3.4.4.

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 AMS2300.

3.5.2 Bars and mechanical tubing shall be free from seams, laps, tears, and cracks after removal of the standard stock removal allowance in accordance with AS1182. Superficial surface imperfections such as scratches or pits shall not exceed applicable tolerances.

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 reentrant grain flow.

3.6 Tolerances

3.6.1 Shall conform to all applicable requirements of the following:

3.6.2 Bars and Wire

AMS2241; for sizes not covered by AMS2241, tolerances shall be as agreed upon by purchaser and producer.

3.6.3 Mechanical Tubing

AMS2243.

3.7 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.4.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of the product shall supply all samples for producer'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), macrostructure (3.4.1), micro-inclusion rating (3.4.2), hardness (3.4.4), and average grain size (3.4.5) after response to heat treatment of each heat.

4.2.1.2 Condition (3.3), and decarburization (3.4.3) of each lot.

4.2.1.3 Tolerances (3.6) of bars.

4.2.2 Periodic Tests

Frequency-severity cleanliness rating (3.5.1) and grain flow of die forgings (3.5.3) are periodic tests and shall be performed at a frequency selected by the producer unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing

Shall be as follows:

4.3.1 Bars, Wire, Mechanical Tubing, and Forging Stock

In accordance with AMS2371.

4.3.2 Forgings

In accordance with AMS2374.

4.3.3 Specimens for response to heat treatment (3.4.4) shall be taken midway between surface and center of samples obtained from semi-finished or finished product. The surface to be tested shall be ground sufficiently to remove any surface condition, scale, carburization, or decarburization that might affect readings.