SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS5719 | REV. D

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Superseding AMS5719C

Steel Bars, Wire, Forgings, Tubing, Rings, and Extrusions, Corrosion-Resistant 11.8Cr - 2.5Ni - 1.8Mo - 0.33V (0.08 - 0.15C) Annealed, Vacuum Arc or Electroslag Remelted (Composition similar to UNS S64152)

RATIONALE

AMS5917D has been reaffirmed to comply with the SAE five-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, flash welded rings, extrusions, and stock for forging, flash welded rings, or extruding.

1.2 Application

These products are used typically for parts, such as compressor wheels and structural members, requiring high strength and oxidation resistance up to 800 °F (427 °C), but usage is not limited to such applications.

1.3 Classification

Steel covered by this specification is classified by melting practice as follows:

Type 1 - Multiple melted using consumable electrode vacuum arc (VAR) practice in the remelt cycle.
Type 2 - Multiple melted using electroslag (ESR) process in the final melting cycle.

1.3.1 Type 1 shall be supplied unless Type 2 is permitted or required by purchaser.

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.

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/AMS5719D

2.1 SAE Publications

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

AMS 2241	Tolerances, Corrosion and Heat-Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Bars and Wire
AMS 2243	Tolerances, 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	Steel Cleanliness, Premium Aircraft-Quality Magnetic Particle Inspection Procedure
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
AMS 7493	Rings, Flash Welded, Ferritic and Martensic, Corrosion-Resistant Steels
AS1182	Standard Machining Allowance, Aircraft-Quality and Premium Aircraft-Quality Steel Bars and Mechanical Tubing

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, or www.astm.org.

ASTM A 370	Mechanical Testing of Steel Products
ASTM A 604	Macroetch Testing of Consumable Electrode Remelted Steel Bars and Billets
ASTM E 112	Determining Average Grain Size
ASTM E 292	Conducting Time-For-Rupture Notch Tensile Tests of Materials
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	0.08	0.15
Manganese	0.50	0.90
Silicon	--	0.35
Phosphorus	--	0.025
Sulfur	--	0.025
Chromium	11.00	12.50
Nickel	2.00	3.00
Molybdenum	1.50	2.00
Vanadium	0.25	0.40
Nitrogen	0.01	0.05
Copper	--	0.50

3.1.1 Check Analysis

Composition variations shall meet the applicable requirements of AMS 2248.

3.2 Melting Practice

Steel shall be multiple melted using consumable electrode vacuum or electroslag process in the remelt cycle (See 1.3).

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

Hardness shall be maximum 311 HBW, or equivalent (See 8.2).

3.3.1.1 Rounds

Annealed and cold finished.

3.3.1.2 Hexagons

Annealed and cold finished.

3.3.1.3 Squares and Rectangles

Hot finished, annealed and descaled.

3.3.2 Wire

Cold drawn, annealed, and cold finished. Shall have tensile strength not higher than 155.0 ksi (1069 MPa), or equivalent hardness (See 8.3).

3.3.3 Forgings, Flash Welded Rings, and Extrusions

Annealed and descaled. Hardness shall be maximum 311 HB, or equivalent (See 8.2).

3.3.3.1 Flash welded rings shall not be supplied unless specified or permitted on purchaser's part drawing. When supplied, rings shall be manufactured in accordance with AMS 7493.

3.3.4 Mechanical Tubing

Cold finished and annealed. Hardness shall be maximum 311 HB, or equivalent (See 8.2).

3.3.5 Stock for Forging, Flash Welded Rings, or Extruding

As ordered by the forging, flash welded ring, or extrusion manufacturer.

3.4 Heat Treatment

Bars, wire, forgings, flash welded rings, extrusions, and mechanical tubing shall be annealed by heating to 1275 °F ± 20 (691 °C ± 11), holding at heat for not less than 6 hours, and cooling in air.

3.5 Properties

The product shall conform to the following requirements; tensile, hardness, and impact testing shall be performed in accordance with ASTM A 370:

3.5.1 Macrostructure

Visual examination of transverse full cross-sections from bars, billets, tube rounds, or forging stock, etched in accordance with ASTM A 604 in hot hydrochloric acid, shall show no pipe or cracks. Porosity, segregation, inclusions, and other imperfections in product 144 square inches (929 cm^2) and under in nominal cross-sectional area shall be no worse than 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

3.5.2 After Hardening and Double Tempering

Product 7.00 inches (177.8 mm) and under in nominal diameter or least distance between parallel sides shall have the following properties after being hardened by heating to 1925 °F ± 25 (1052 °C ± 14), holding at heat for not less than 30 minutes, and quenching in oil and double tempered by heating to a temperature within the range 1040 to 1075 °F (560 to 579 °C), holding at the selected temperature within ±15 °F (±8 °C) for not less than 60 minutes, cooling in air to room temperature, reheating to a temperature within the range 1000 to 1040 °F (538 to 560 °C), holding at the selected temperature within ±15 °F (±8 °C) for not less than three hours, and cooling in air.

3.5.2.1 Tensile Properties

3.5.2.1.1 Smooth Bar

Shall be as shown in Table 3, determined in either the longitudinal or transverse direction except that testing in the transverse direction applies only to product from which a tensile specimen not less than 2.50 inches (63.5 mm) in length can be obtained. Testing in the longitudinal direction is not required on product tested in the transverse direction.

TABLE 3 - MINIMUM TENSILE PROPERTIES

Property	Value
Tensile Strength	155.0 ksi (1069 MPa)
Yield Strength at 0.2% Offset	130.0 ksi (896 MPa)
Elongation in 4D	12%
Reduction of Area	30%

3.5.2.1.2 Notched Bar

Shall be not less than 1.4 times the smooth-bar tensile strength, determined on specimens machined to the dimensions shown in ASTM E 292.

3.5.2.2 Hardness

Should be 341 to 375 HB, or equivalent (See 8.2). Product shall not be rejected on the basis of hardness if the tensile properties determined on specimens taken from the same sample as that with nonconforming hardness or another sample with similar nonconforming hardness, are acceptable.

3.5.2.3 Charpy Impact Value

Shall be not less than 30 foot-pounds (41 J), determined on the V-notched specimen at room temperature.

3.5.2.4 Average Grain Size

Shall be ASTM No. 5 or finer, determined in accordance with ASTM E 112.

3.5.2.5 Forging Stock

When a sample of stock is forged to a test coupon and heat treated as in 3.4 and 3.5.2, specimens taken from the heat treated coupon shall conform to the requirements of 3.5.2.1, 3.5.2.2, and 3.5.2.3. If specimens taken from the stock after heat treatment as in 3.4 and 3.5.2 conform to the requirements of 3.5.2.1, 3.5.2.2, and 3.5.2.3, the tests shall be accepted as equivalent to tests of a forged coupon.

3.5.2.6 Stock for Flash Welded Rings or Extruding

A sample of stock heat treated as in 3.4 and 3.5.2 shall conform to the requirements of 3.5.2.1, 3.5.2.1.3 and 3.5.2.3.

3.6 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.

3.6.1 Steel shall be premium aircraft-quality conforming to AMS 2300.

3.6.2 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 surface.

3.6.3 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.

3.7 Tolerances

Shall be as follows:

3.7.1 Bars and Wire

In accordance with AMS 2241.

3.7.2 Mechanical Tubing

In accordance with AMS 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

Composition (3.1), condition (strength/hardness) (3.3), macrostructure (3.5.1), tensile properties (3.5.2.1), hardness after heat treatment (3.5.2.1.3), average grain size (3.5.2.3) and tolerances (3.7) are acceptance tests and shall be performed on each heat or lot as applicable.