



400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 5773C

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Superseding AMS 5773B

STEEL BARS, WIRE, FORGINGS, TUBING, AND RINGS, CORROSION RESISTANT
 15Cr - 6.5Ni - 0.75Mo - 0.30(Cb + Ta) - 1.5Cu
 Consumable Electrode Melted, Solution Heat Treated
 Precipitation Hardenable

UNS S45000

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, and stock for forging or flash welded rings.
- 1.2 Application: Primarily for parts requiring corrosion resistance approximating that of 18-8 type steels and high strength exceeding that of 12Cr martensitic type steels up to 700°F (371°C). This steel can be used in the solution heat treated condition and is capable of being precipitation heat treated to tensile strengths as high as 180,000 psi (1241 MPa) with good ductility and strength in the transverse directions in large section sizes. Although this steel is relatively immune to stress-corrosion cracking, reference should be made to ARP1110 for recommended practices to minimize such conditions.

- 1.3 Classification: Products covered by this specification are classified as follows:

Type I - Steel multiple melted using electroslog process in the remelt cycle.

Type II - Steel multiple melted using consumable electrode vacuum practice in the remelt cycle.

- 1.3.1 Type I shall be supplied unless Type II is permitted by purchaser.

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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.

2.1.1 Aerospace Material Specifications:

- 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
- AMS 2248 - Chemical Check Analysis Limits, Wrought 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 of Corrosion and Heat Resistant Steels and Alloys, Wrought Products Except Forgings and Forging Stock
- AMS 2374 - Quality Assurance Sampling of Corrosion and Heat Resistant Steels and Alloys, Forgings and Forging Stock
- AMS 2750 - Pyrometry
- 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 7490 - Rings, Flash Welded, Corrosion and Heat Resistant Austenitic Steels and Austenitic-Type Alloys

2.1.2 Aerospace Recommended Practices:

- ARP1110 - Minimizing Stress Corrosion Cracking in Heat Treatable Wrought Low Alloy and Martensitic Corrosion Resistant Steels

2.2 ASTM Publications: Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

- ASTM A 370 - Mechanical Testing of Steel Products
- ASTM A 604 - Macroetch Testing of Consumable Electrode Remelted Steel Bars and Billets
- ASTM E 353 - Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys

2.3 U.S. Government Publications: Available from Naval Publications and Forms Center, Attn: NPODS, 5801 Tabor Avenue, Philadelphia, PA 19120-5099.

2.3.1 Military Standards:

MIL-STD-163 - Steel Mill Products, Preparation for Shipment and Storage

3. TECHNICAL REQUIREMENTS:

- 3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E353, by spectrochemical methods, or by other analytical methods acceptable to purchaser:

	min	max
Carbon	--	0.05
Manganese	--	1.00
Silicon	--	1.00
Phosphorus	--	0.020
Sulfur	--	0.015
Chromium	14.00 -	16.00
Nickel	6.00 -	7.00
Molybdenum	0.50 -	1.00
Columbium + Tantalum	8xC	--
Copper	1.25 -	1.75

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

- 3.2 Condition: The product shall be supplied in the following condition:

- 3.2.1 Bars, Wire, Mechanical Tubing, Forgings, and Flash Welded Rings: Solution heat treated.

- 3.2.1.1 Bars:

- 3.2.1.1.1 Rounds: Centerless ground after solution heat treatment.

- 3.2.1.1.2 Squares, Hexagons, and Flats: Hot finished before solution heat treatment and descaled, or cold drawn after solution heat treatment or descaling, as ordered.

- 3.2.1.2 Wire: Cold drawn after solution heat treatment.

- 3.2.1.3 Mechanical Tubing: Cold finished and solution heat treated.

- 3.2.1.4 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 7490.

- 3.2.2 Stock for Forging or Flash Welded Rings: As ordered by the forging or flash welded ring manufacturer.

3.3 Solution Heat Treatment: Bars, wire over 3/16 inch (4.8 mm) in nominal diameter, forgings, mechanical tubing, and flash welded rings shall be solution heat treated by heating to $1900^{\circ}\text{F} \pm 25$ ($1038^{\circ}\text{C} \pm 14$), holding at heat for not less than 1 hour, and cooling rapidly. Pyrometry shall be in accordance with AMS 2750.

3.3.1 Wire 3/16 inch (4.8 mm) and under in nominal diameter shall be solution heat treated by heating to $1900^{\circ}\text{F} \pm 25$ ($1038^{\circ}\text{C} \pm 14$), holding at heat for a time commensurate with the wire size, and cooling rapidly.

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

3.4.1 All Products:

3.4.1.1 Macrostructure: Visual examination of transverse sections as in 4.3.3 from bars, billets, extrusions, and stock for forging or flash welded rings, etched in accordance with ASTM A 604, shall show no pipe or cracks. Porosity, segregation, inclusions, and other imperfections for product 80 square inches (516 cm²) and under in nominal cross-sectional area shall be no worse than the following macrographs of ASTM A 604; macrostructure standards for product over 80 square inches (516 cm²) in nominal cross-sectional area shall be as agreed upon by purchaser and vendor:

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

3.4.2 Bars, Wire, Forgings, Mechanical Tubing, and Flash Welded Rings:

3.4.2.1 As Solution Treated:

3.4.2.1.1 Tensile Properties:

3.4.2.1.1.1 Bars, Forgings, Tubing, and Flash Welded Rings:

Tensile Strength, minimum	125,000 psi (862 MPa)
Yield Strength at 0.2% Offset, minimum	95,000 psi (655 MPa)
Elongation in 4D, minimum	10%
Reduction of Area, minimum	40%

3.4.2.1.1.2 Wire: Not higher than 165,000 psi (1138 MPa).

3.4.2.1.2 Hardness:

3.4.2.1.2.1 Bars: Not higher than 311 HB, or equivalent, determined midway between surface and center.

3.4.2.1.2.2 Tubing, Flash Welded Rings, and Forgings: Not higher than 311 HB, or equivalent.

- 3.4.2.2 After Precipitation Heat Treatment: The solution heat treated product, precipitation heat treated to a particular condition by heating to the corresponding temperature shown in Table I, holding at heat for not less than 4 hours, and cooling in air, shall have the mechanical properties shown in Table II and Table III for that particular condition. Tensile and hardness tests shall be made in only the H900 precipitation heat treated condition, unless a different condition is specified by purchaser.

TABLE I

Condition	Temperature
H 900	900°F $\pm$ 15 (482°C $\pm$ 8)
H 950	950°F $\pm$ 15 (510°C $\pm$ 8)
H1000	1000°F $\pm$ 15 (538°C $\pm$ 8)
H1050	1050°F $\pm$ 15 (566°C $\pm$ 8)
H1100	1100°F $\pm$ 15 (593°C $\pm$ 8)
H1150	1150°F $\pm$ 15 (621°C $\pm$ 8)

- 3.4.2.2.1 Tensile Properties: The following properties apply to product 12.0 inches (305 mm) and under, in nominal diameter or least distance between parallel sides; tensile property requirements for product over 12.0 inches (305 mm) in nominal diameter or least distance between parallel sides shall be as agreed upon by purchaser and vendor:

TABLE II

Condition	Specimen Orientation	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation in 4D %, min	Reduction of Area %, min
H 900	Longitudinal	180,000	170,000	10	40
	Transverse	180,000	170,000	6	20
H 950	Longitudinal	170,000	160,000	10	40
	Transverse	170,000	160,000	7	22
H1000	Longitudinal	160,000	150,000	12	45
	Transverse	160,000	150,000	8	27
H1050	Longitudinal	145,000	135,000	12	45
	Transverse	145,000	135,000	9	30
H1100	Longitudinal	130,000	105,000	16	50
	Transverse	130,000	105,000	11	30
H1150	Longitudinal	125,000	75,000	18	55
	Transverse	125,000	75,000	12	35

TABLE II (SI)

Condition	Specimen Orientation	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 4D %, min	Reduction of Area %, min
H 900	Longitudinal	1241	1172	10	40
	Transverse	1241	1172	6	20
H 950	Longitudinal	1172	1103	10	40
	Transverse	1172	1103	7	22
H1000	Longitudinal	1103	1034	12	45
	Transverse	1103	1034	8	27
H1050	Longitudinal	1000	931	12	45
	Transverse	1000	931	9	30
H1100	Longitudinal	896	724	16	50
	Transverse	896	724	11	30
H1150	Longitudinal	862	517	18	55
	Transverse	862	517	12	35

3.4.2.2.1.1 Longitudinal tensile requirements apply to specimens taken in the longitudinal direction from bars and wire, to specimens taken from forgings with axis of specimen in the area of gage length within 15 degrees of parallel to the forging flow lines, and to specimens taken in the circumferential direction from parent metal of flash welded rings; transverse tensile requirements apply to all other specimens.

3.4.2.2.2 Hardness: Should be not lower than shown in Table III for the corresponding precipitation heat treatment condition but the product shall not be rejected on the basis of hardness if the tensile property requirements of Table II for that condition are met.

TABLE III

Condition	Hardness, Brinell min
H 900	363
H 950	341
H1000	331
H1050	321
H1100	285
H1150	262

3.4.3 Forging Stock: When a sample of stock is forged to a test coupon and heat treated as in 3.3 and 3.4.2.2, specimens taken from the heat treated coupon shall conform to the requirements of 3.4.2.2.1 and 3.4.2.2.2. If specimens taken from the stock after heat treatment as in 3.3 and 3.4.2.2 conform to the requirements of 3.4.2.2.1 and 3.4.2.2.2, the tests shall be accepted as equivalent to tests of a forged coupon.

3.4.4 Stock for Flash Welded Rings: Specimens taken from the stock after heat treatment as in 3.3 and 3.4.2.2 shall conform to the requirements of 3.4.2.2.1 and 3.4.2.2.2.

3.5 Quality:

3.5.1 Steel shall be premium aircraft-quality conforming to AMS 2300 or MAM 2300; it shall be multiple melted using either electroslag process or consumable electrode vacuum practice in the remelt cycle.

3.5.2 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.

3.5.3 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 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 - 20 feet (1.8 - 6.1 m) but not more than 10% of any shipment shall be supplied in lengths shorter than 10 feet (3 m).

3.7 Tolerances: Shall conform to all applicable requirements of the following:

3.7.1 Bars and Wire: AMS 2241 or MAM 2241.

3.7.2 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 performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.4. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests for the following requirements are acceptance tests and shall be performed on each heat or lot as applicable:

- 4.2.1.1 Composition (3.1) and macrostructure (3.4.1.1) of each heat.
- 4.2.1.2 Tensile properties (3.4.2.1.1) and hardness (3.4.2.1.2) of each lot of bars, wire, forgings, mechanical tubing, and flash welded rings as solution treated.
- 4.2.1.3 Tensile properties (3.4.2.2.1) and hardness (3.4.2.2.2) of each lot of bars, wire, forgings, mechanical tubing, and flash welded rings after precipitation heat treatment as in 3.4.2.2.
- 4.2.1.4 Tolerances (3.7) of bars, wire, and mechanical tubing.
- 4.2.2 Periodic Tests: Tests for frequency-severity cleanliness rating (3.5.1) and of forging stock (3.4.3) and stock for flash welded rings (3.4.4) to demonstrate ability to develop required properties are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.
- 4.2.3 When specified by purchaser, tests on bars, wire, forgings, mechanical tubing, and flash welded rings for tensile properties and hardness after precipitation heat treatment to other than the H900 testing condition are preproduction tests and shall be performed prior to or on the first-article shipment of a product to a purchaser and when purchaser deems confirmatory testing to be required.
- 4.3 Sampling and Testing: Shall be in accordance with the following; a heat shall be the consumable electrode remelted ingots produced from steel originally melted as a single furnace charge.
- 4.3.1 Bars, Wire, Mechanical Tubing, Flash Welded Rings, and Stock for Flash Welded Rings: AMS 2371.
- 4.3.2 Forgings and Forging Stock: AMS 2374.
- 4.3.3 Samples for macrostructure rating (3.4.1.1) shall be full cross-sectional specimens obtained from the finished billet or suitable rerolled product representing the top and bottom of each usable ingot of each heat.
- 4.4 Reports:
- 4.4.1 The vendor of bars, wire, forgings, mechanical tubing, and flash welded rings shall furnish with each shipment a report showing the results of tests for chemical composition and macrostructure of each heat and the results of tests on each lot to determine conformance to the other acceptance test requirements and, when performed, to the periodic test requirements. This report shall include the purchase order number, lot number, AMS 5773C, type number, size, and quantity. If forgings are supplied, the part number and the size and melt source of stock used to make the forgings shall also be included.