SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 5622B

Issued 5-1-69
Revised 1-1-90

Superseding AMS 5622A

STEEL BARS, WIRE, FORGINGS, TUBING, AND RINGS, CORROSION RESISTANT
16Cr - 4.0Ni - 0.30(Cb + Ta) - 4.0Cu
Solution Heat Treated, Consumable Electrode Melted
Precipitation Hardenable

UNS S17400

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, flash welded rings, or heading.

1.2 Application: Primarily for parts requiring corrosion resistance and high strength up to 600°F (316°C). Certain processing procedures and service conditions may cause these products to become subject to stress-corrosion cracking; ARP1110 recommends practices to minimize such conditions.

1.2.1 For applications, such as bolting, where stress-corrosion is a possibility, the product should be precipitation heat treated for not less than 4 hours at the highest temperature compatible with the strength requirements but in no case lower than 1025°F (552°C).

1.3 Classification: Product covered by this specification is classified as follows:

Type I - Steel multiple melted using vacuum consumable electrode in the final melt.

Type II - Steel multiple melted using electroslag process in the final melting.

1.3.1 Unless a specific type is ordered, either type may be supplied.

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 as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

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 2315 - Determination of Delta Ferrite Content
AMS 2350 - Standards and Test Methods
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 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.

ASTM A 370 - Mechanical Testing of Steel Products
ASTM A 604 - Macroetch Testing of Consumable Electrode Remelted Steel Bars and Billets
ASTM E 340 - Macroetching Metals and Alloys
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 Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

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. Ø determined by wet chemical methods in accordance with ASTM E 353, by spectrochemical methods, or by other analytical methods acceptable to purchaser:

	min		max
Carbon	--		0.07
Manganese	--		1.00
Phosphorus	--		1.00
Sulfur	--		0.025
Chromium	--		0.025
Nickel	15.00	-	17.50
Columbium + Tantalum	3.00	-	5.00
Copper	5XC	-	0.45
Molybdenum	3.00	-	5.00
			0.50

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 and Wire:

3.2.1.1 Rounds: Solution heat treated and centerless ground or, when so ordered, centerless ground and polished or cold drawn, solution heat treated, and descaled.

3.2.1.2 Hexagons: Cold drawn, solution heat treated, and descaled.

3.2.1.3 Squares and Flats: Hot finished, solution heat treated, and descaled.

3.2.2 Forgings and Flash Welded Rings: Solution heat treated and descaled.

3.2.2.1 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 7490.

3.2.3 Mechanical Tubing: Hot finished, solution heat treated, and descaled.

3.2.4 Stock for Forging, Flash Welded Rings, or Heading: As ordered by the forging, flash welded ring, or heading manufacturer.

3.3 Heat Treatment: Bars, wire, forgings, mechanical tubing, and flash welded rings shall be solution heat treated by heating to 1900°F ± 25 (1038°C ± 14), holding at heat for a time commensurate with section thickness and with heating equipment and procedure used, and cooling as required to below 90°F (32°C).

3.3.1 Flash welded rings may, when permitted by purchaser, be given a homogenization heat treatment prior to solution heat treatment. When such treatment is permitted, the rings shall be heated to 2100°F ± 25 (1149°C ± 14), held at heat for not less than 90 minutes, and cooled in air.

3.4 Properties: Product, 8.0 inches (203 mm) and under in nominal diameter or least distance between parallel sides, shall conform to the following requirements; tensile and hardness testing shall be performed in accordance with ASTM A 370. Properties for product over 8.0 inches (203 mm) in nominal diameter or least distance between parallel sides shall be as agreed upon by purchaser and vendor.

3.4.1 All Products: Shall be as follows:

3.4.1.1 Macrostructure: Visual examination of transverse sections as in 4.3.3 from bars, billets, tube rounds or tubes, and stock for forging, flash welded rings, or heading, etched in accordance with ASTM A 604, shall show no pipe or cracks. Except as specified in 3.4.1.1.1, 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 following macrographs of ASTM A 604; macrostructure standards for product over 36 square inches (232 cm^2) 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	A
4	Ring pattern	B

3.4.1.1.1 If tubes are produced directly from ingots or large blooms, transverse sections may be taken from tubes rather than tube rounds. Macrostructure standards for such tubes shall be as agreed upon by purchaser and vendor.

3.4.1.2 Microstructure: The product shall contain not more than 5% free ferrite, determined in accordance with AMS 2315.

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

3.4.2.1 As Solution Heat Treated:

3.4.2.1.1 Hardness:

3.4.2.1.1.1 Bars: Not higher than 363 HB, or equivalent, determined at approximately mid-radius or quarter-thickness.

3.4.2.1.1.2 Forgings, Mechanical Tubing, and Flash Welded Rings: Not higher than 363 HB, or equivalent.

3.4.2.1.2 Tensile Properties: Wire shall have tensile strength not higher than Ø 175,000 psi (1207 MPa).

3.4.2.2 After Precipitation Heat Treatment: The solution heat treated product, precipitation heat treated to a particular condition in accordance with the corresponding temperatures and times shown in Table I and cooled in air, shall have the properties shown in 3.4.2.2.1 and 3.4.2.2.2 for that particular condition. Tensile and hardness tests shall be made in only the H900 precipitation heat treated condition, unless purchaser specifies another heat treated testing condition.

TABLE I

Condition	Temperature	Time
H900	900°F ± 10 (482°C ± 6)	1 hour ± 0.1
H925	925°F ± 10 (496°C ± 6)	4 hours ± 0.3
H1025	1025°F ± 10 (552°C ± 6)	4 hours ± 0.3
H1075	1075°F ± 10 (579°C ± 6)	4 hours ± 0.3
H1100	1100°F ± 10 (593°C ± 6)	4 hours ± 0.3
H1150	1150°F ± 10 (621°C ± 6)	4 hours ± 0.3

3.4.2.2.1 Tensile Properties: Shall be as specified in Table II.

TABLE II

Condition	Specimen Orientation	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation in 2 Inches or 4D %, min	Reduction of area %, min
H900	Longitudinal	190,000	170,000	10	35
	Transverse	190,000	170,000	5	15
H925	Longitudinal	170,000	155,000	10	38
	Transverse	170,000	155,000	6	20
H1025	Longitudinal	155,000	145,000	12	45
	Transverse	155,000	145,000	7	27
H1075	Longitudinal	145,000	125,000	13	45
	Transverse	145,000	125,000	8	28
H1100	Longitudinal	140,000	115,000	14	45
	Transverse	140,000	115,000	9	29
H1150	Longitudinal	135,000	105,000	16	50
	Transverse	135,000	105,000	10	30

TABLE II (SI)

Condition	Specimen Orientation	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 50.8 mm or 4D %, min	Reduction Of area %, min
H900	Longitudinal	1310	1172	10	35
	Transverse	1310	1172	5	15
H925	Longitudinal	1172	1069	10	38
	Transverse	1172	1069	6	20
H1025	Longitudinal	1069	1000	12	45
	Transverse	1069	1000	7	27
H1075	Longitudinal	1000	862	13	45
	Transverse	1000	862	8	28
H1100	Longitudinal	965	793	14	45
	Transverse	965	793	9	29
H1150	Longitudinal	931	724	16	50
	Transverse	931	724	10	30

3.4.2.2.1.1 Longitudinal tensile property requirements apply to specimens taken in the longitudinal direction from bars, wire, and extrusions, to specimens taken from forgings with axis of specimen in the area of gage length varying not more than 15 degrees from parallel to the forging flow lines, and to specimens taken in the circumferential direction from flash welded rings.

3.4.2.2.1.2 Transverse tensile property requirements apply to specimens taken approximately perpendicular to the longitudinal direction of bars and extrusions, to specimens taken from forgings with axis of specimen in the area of gage length varying not more than 15 degrees from perpendicular to the forging flow lines, and to specimens taken in the radial direction from flash welded rings.

3.4.2.2.1.3 Transverse tensile property requirements apply only to products from which a test specimen not less than 2-1/2 inches (63.5 mm) long or 1/2 x 1/2 inch (12.7 x 12.7 mm) cross-section can be obtained.

3.4.2.2.1.4 Products tested in the transverse direction need not be tested in the longitudinal direction.

3.4.2.2.2 Hardness: Should be within the range shown in Table III, or equivalent, for the corresponding precipitation heat treated condition but the product shall not be rejected on the basis of hardness if the tensile property requirements of Table II are met.

TABLE III

Condition	Hardness, HB
H900	388 - 444
H925	375 - 429
H1025	331 - 401
H1075	311 - 375
H1100	302 - 363
H1150	277 - 352

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 or Heading: 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 Ø MAM 2300. It shall be multiple melted using consumable electrode or electroslag 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 Ø 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 rating (3.4.1.1) of each heat.

4.2.1.2 Hardness (3.4.2.1.1) of each lot of bars, forgings, mechanical tubing, and flash welded rings as solution heat treated.

4.2.1.3 Tensile strength of each lot of wire (3.4.2.1.2) as solution heat treated.

4.2.1.4 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 at 900°F ± 10 (482°C ± 6) unless purchaser specifies another precipitation heat treatment temperature.