SAE Aerospace
An SAE International Group

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 5622D

Issued MAY 1969
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Reaffirmed DEC 2004

Superseding AMS 5622C

Steel, Corrosion Resistant, Bars, Wire, Forgings, Tubing, and Rings
16Cr - 4.0Ni - 0.30Cb - 4.0Cu
Solution Heat Treated, Precipitation Hardenable

(Composition similar to 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:

These products have been used typically for parts requiring corrosion resistance and high strength up to 600 °F (316 °C), but usage is not limited to such applications.

1.2.1 Certain processing procedures and service conditions may cause these products to become subject to stress-corrosion cracking; ARP1110 recommends practices to minimize such conditions.

1.2.2 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 melt.

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

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
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SAE WEB ADDRESS: **http://www.sae.org**

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 canceled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or www.sae.org.

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, 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
MAM 2300	Steel Cleanliness, Premium Aircraft-Quality, Magnetic Particle Inspection Procedure, Metric (SI) Measurement
AMS 2315	Determination of Delta Ferrite Content
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 7490	Rings, Flash Welded, Corrosion and Heat-Resistant Austenitic Steels, Austenitic-Type Iron, Nickel, or Cobalt Alloys, or Precipitation-Hardenable Alloys
ARP1110	Minimizing Stress Corrosion Cracking in Wrought Forms of Steels and Corrosion-Resistant Steels and Alloys

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 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 340	Macroetching Metals and Alloys
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	--	0.07
Manganese	--	1.00
Silicon	--	1.00
Phosphorus	--	0.025
Sulfur	--	0.015
Chromium	15.00	17.50
Nickel	3.00	5.00
Columbium	5xC	0.45
Copper	3.00	5.00
Molybdenum	--	0.50

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

3.2 Melting Practice:

The steel shall be multiple melted using consumable electrode practice in the remelt cycle. See 1.3.

3.3 Condition:

The product shall be supplied in the following condition:

3.3.1 Bars and Wire:

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

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

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

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

3.3.2.1 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.

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

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

3.4 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).

3.4.1 Flash welded rings may 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 at a rate equivalent to, or faster than, an air cool.

3.5 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.

3.5.1 All Products: Shall be as follows:

3.5.1.1 Macrostructure: Visual examination of full cross section transverse sections from bars, billets, tube rounds, and stock for forging, flash welded rings, or heading, 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	A
4	Ring pattern	B

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

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

3.5.2.1 As Solution Heat Treated:

3.5.2.1.1 Hardness:

3.5.2.1.1.1 Bars: Not higher than 363 HB, or equivalent (See 8.2), determined at approximately mid-radius or quarter-thickness.

3.5.2.1.1.2 Forgings, Mechanical Tubing, and Flash Welded Rings: Not higher than 363 HB, or equivalent (See 8.2).

3.5.2.1.2 Tensile Properties: Wire shall have tensile strength not higher than 175 ksi (1207 MPa), or equivalent hardness (See 8.3).

3.5.2.2 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 3 and cooled in air, shall have the properties shown in 3.5.2.2.1 and 3.5.2.2.2 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 3 - Precipitation Heat Treatments

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

3.5.2.2.1 Tensile Properties: Shall be as specified in Table 4.

TABLE 4A - Minimum Tensile Strength Properties, Inch/Pound Units

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

TABLE 4B - Minimum Tensile Strength Properties, SI Units

Condition	Specimen Orientation	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50.8 mm or 4D %	Reduction of Area %
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

3.5.2.2.1.1 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.

3.5.2.2.1.2 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.

3.5.2.2.1.3 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.

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

3.5.2.2.2 Hardness: Should be within the range shown in Table 5, or equivalent (See 8.2), 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 4 are acceptable, determined on specimens taken from the same sample as that with nonconforming hardness or from another sample with similar nonconforming hardness.

TABLE 5 - Hardness

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

3.5.3 Forging Stock: When a sample of stock is forged to a test coupon and heat treated as in 3.4 and 3.5.2.2, specimens taken from the heat treated coupon shall conform to the requirements of 3.5.2.2.1 and 3.5.2.2.2. If specimens taken from the stock after heat treatment as in 3.4 and 3.5.2.2 conform to the requirements of 3.5.2.2.1 and 3.5.2.2.2, the tests shall be accepted as equivalent to tests of a forged coupon.

3.5.4 Stock for Flash Welded Rings or Heading: Specimens taken from the stock after heat treatment as in 3.4 and 3.5.2.2 shall conform to the requirements of 3.5.2.2.1 and 3.5.2.2.2.

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 or MAM 2300.

3.6.2 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 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 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) and macrostructure rating (3.5.1.1) of each heat.

4.2.1.2 Hardness (3.5.2.1.1) 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 (3.5.2.1.2) as solution heat treated.

4.2.1.4 Tensile properties (3.5.2.2.1) and hardness (3.5.2.2.2) 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.

4.2.1.5 Tolerances (3.7) of bars, wire, and mechanical tubing.