

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 5616H

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Superseding AMS 5616G

STEEL BARS, FORGINGS, TUBING, AND RINGS, CORROSION AND MODERATE HEAT RESISTANT
13Cr - 2.0Ni - 3.0W
Annealed

UNS S41800

1. SCOPE:

- 1.1 Form: This specification covers a corrosion and moderate heat 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, such as compressor wheels and blades, requiring oxidation resistance up to 1000°F (540°C). Strength at the higher temperature is superior to that of the standard 12Cr type.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications shall apply. The applicable issue of other documents 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 2303 - Aircraft Quality Steel Cleanliness, Martensitic Corrosion-Resistant Steels, Magnetic Particle Inspection Procedure
- MAM 2303 - Aircraft Quality Steel Cleanliness, Martensitic Corrosion-Resistant Steels, Magnetic Particle Inspection Procedure, Metric (SI) Measurement

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2.1.1 Aerospace Material Specifications (Cont'd.):

- 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 2375 - Control of Forgings Requiring First Article Approval
- AMS 2806 - Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Heat and Corrosion Resistant Steels and Alloys
- AMS 2808 - Identification, Forgings
- AMS 7493 - Rings, Flash Welded, Non-Austenitic Corrosion Resistant Steels

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

- ASTM A370 - Mechanical Testing of Steel Products
- ASTM E353 - 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, determined by wet chemical methods in accordance with ASTM E353 or by spectrographic or other analytical methods approved by purchaser:

	min	max
Carbon	0.15 -	0.20
Manganese	--	0.50
Silicon	--	0.50
Phosphorus	--	0.040
Sulfur	--	0.030
Chromium	12.00 -	14.00
Nickel	1.80 -	2.20
Tungsten	2.50 -	3.50
Molybdenum	--	0.50
Aluminum	--	0.15
Copper	--	0.50
Tin	--	0.05
Nitrogen	--	0.08

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; hardness and tensile strength shall be determined in accordance with ASTM A370:

3.2.1 Bars: Annealed having hardness not higher than 311 HB, or equivalent.

3.2.1.1 Bars over 0.500 to 2.750 in. (12.50 to 70 mm), incl, in nominal diameter or distance between parallel sides and all hexagons shall be cold finished.

3.2.1.2 Bars, other than hexagons, over 2.750 in. (70 mm) in nominal diameter or distance between parallel sides shall be hot finished.

3.2.2 Wire: Annealed and cold finished having tensile strength not higher than 155,000 psi (1070 MPa) or equivalent hardness.

3.2.3 Forgings: Annealed having hardness not higher than 311 HB, or equivalent.
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3.2.4 Mechanical Tubing: Annealed and cold finished having hardness not higher than 311 HB, or equivalent.

3.2.5 Flash Welded Rings: Annealed having hardness not higher than 311 HB, or equivalent.

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

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

3.3 Properties: The product shall conform to the following requirements:

3.3.1 Response to Heat Treatment: Product 0.375 in. (9.50 mm) and under in nominal thickness and 0.375-in. + 0.010 (9.50-mm + 0.25) thick specimens cut from larger product shall have hardness not lower than 45 HRC, or equivalent, determined in accordance with ASTM A370, after being heated to 1750°F + 10 (955°C + 5), held at heat for 25 - 30 min., and quenched in commercial paraffin oil [approximately 100 SUS at 100°F (38°C)] at room temperature.

3.4 Quality:

3.4.1 Steel shall be aircraft quality and, when specified, shall conform to AMS 2303 or MAM 2303.

3.4.2 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.

- 3.4.3 Forgings shall have substantially uniform macrostructure. Standards for acceptance shall be as agreed upon by purchaser and vendor.
- 3.4.4 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 flow.
- 3.5 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 ft (2 - 6 m) but not more than 10% of any shipment shall be supplied in lengths shorter than 10 ft (3 m).
- 3.6 Tolerances: Shall conform to all applicable requirements of the following:
- 3.6.1 Bars and Wire: AMS 2241 or MAM 2241.
- 3.6.2 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 4.5. 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 to determine conformance to all technical requirements of this specification are classified as acceptance tests and shall be performed on each heat or lot as applicable.
- 4.2.2 Preproduction Tests: Tests of forgings to determine conformance to all applicable technical requirements of this specification when AMS 2375 is specified are classified as preproduction tests and shall be performed prior to or on the first-article shipment of a forging to a purchaser, when a change in material, processing, or both requires reapproval as in 4.4, and when purchaser deems confirmatory testing to be required.
- 4.2.2.1 For direct U.S. Military procurement of forgings, substantiating test data and, when requested, preproduction forgings shall be submitted to the cognizant agency as directed by the procuring activity, contracting officer, or request for procurement.
- 4.3 Sampling: Shall be in accordance with the following:
- 4.3.1 Bars, Wire, Mechanical Tubing, Flash Welded Rings, and Stock for Flash Welded Rings or Heading: AMS 2371.
- 4.3.2 Forgings and Forging Stock: AMS 2374.