G-4713

SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®

400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 5751D

Issued 6-30-60
Revised 4-1-88

ALLOY BARS, FORGINGS, AND RINGS, CORROSION AND HEAT RESISTANT 54Ni - 17.5Cr - 16.5Co - 4.0Mo - 2.9Ti - 2.9Al - 0.006B Solution, Stabilization, and Precipitation Heat Treated Consumable Electrode or Vacuum Induction Melted

UNS N07500

This specification has been declared "NONCURRENT" by the Aerospace Materials Division, SAE, as of 16 October 1987. It is recommended, therefore, that this specification not be specified for new designs.

This cover sheet should be attached to the "D" revision of the subject specification.

"NONCURRENT" refers to those materials which have previously been widely used and which may be required on some existing designs in the future. The Aerospace Materials Division, however, does not recommend these as standard materials for future use in new designs. Each of these "NONCURRENT" specifications is available from SAE upon request.

This specification is under the jurisdiction of AMS Committee "F".

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Superseding AMS 5751C

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ALLOY BARS, FORGINGS, AND RINGS, CORROSION AND HEAT RESISTANT
54Ni - 17.5Cr - 16.5Co - 4.0Mo - 2.9Ti - 2.9Al - 0.006B
Solution, Stabilization, and Precipitation Treated
Consumable Electrode or Vacuum Induction Melted

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1. SCOPE:

1.1 Form: This specification covers a corrosion and heat resistant nickel alloy in the form of bars, forgings, flash welded rings, and stock for forging or flash welded rings.

1.2 Application: Primarily for parts, such as turbine components, requiring high strength up to 1600°F (870°C) and oxidation resistance up to 1800°F (980°C).

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) 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 2261 - Tolerances, Nickel, Nickel Alloy, and Cobalt Alloy Bars and Forging Stock
AMS 2269 - Chemical Check Analysis Limits, Wrought Nickel Alloys and Cobalt Alloys
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 7490 - Rings, Flash Welded, Corrosion and Heat Resistant Austenitic Steels and Austenitic-Type Alloys

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

ASTM E10 - Brinell Hardness of Metallic Materials
ASTM E21 - Elevated Temperature Tension Tests of Metallic Materials
ASTM E112 - Estimating the Average Grain Size of Metals
ASTM E139 - Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials
ASTM E354 - Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt 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 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

2.3.2 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 E354, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other analytical methods approved by purchaser:

	min	max
Carbon	--	0.15
Manganese	--	0.75
Silicon	--	0.75
Sulfur	--	0.015
Chromium	15.00	20.00
Cobalt	13.00	20.00
Molybdenum	3.00	5.00
Titanium	2.50	3.25
Aluminum	2.50	3.25
Boron	0.003	0.010
Iron	--	4.00
Copper	--	0.15
Nickel	remainder	

3.1.1 Check Analysis: Composition variations shall meet the requirements of AMS 2269.

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

3.2.1 Bars, Forgings, and Flash Welded Rings: Solution, stabilization, and precipitation heat treated.

3.2.1.1 Bars shall be hot finished; round bars shall be ground or turned, except that bars under 0.50 in. (12.5 mm) in nominal diameter shall be cold drawn when so ordered.

3.2.1.2 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 7490.

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

3.3 Heat Treatment: Bars, forgings, and flash welded rings shall be solution heat treated by heating to 1975°F ± 25 (1080°C ± 15), holding at heat for 4 hr ± 0.25 and cooling at a rate equivalent to air cool or faster; stabilization heat treated by heating to 1550°F ± 25 (845°C ± 15), holding at heat for 24 hr ± 1, and cooling in air; and precipitation heat treated by heating to 1400°F ± 25 (760°C ± 15), holding at heat for 16 hr ± 1, and cooling in air.

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

3.4.1 Bars, Forgings, and Flash Welded Rings:

3.4.1.1 Tensile Properties at 1200°F (649°C): Shall be as follows, determined in accordance with ASTM E21 on specimens heated to 1200°F ± 5 (649°C ± 3), held at heat for 20 - 30 min. before testing, and tested at 1200°F ± 5 (649°C ± 3):

Tensile Strength, min	170,000 psi (1170 MPa)
Yield Strength at 0.2% Offset, min	110,000 psi (760 MPa)
Elongation in 4D, min	6%
Reduction of Area, min	10%

3.4.1.2 Hardness: Should be not lower than 285 HB or equivalent, determined in accordance with ASTM E10, but the product shall not be rejected on the basis of hardness if the tensile property requirements are met.

3.4.1.3 Stress Rupture Properties at 1650°F (899°C): A tensile test specimen, maintained at 1650°F ± 3 (899°C ± 2) while a load sufficient to produce an initial axial stress at 25,000 psi (170 MPa) is applied continuously, shall not rupture in less than 24 hours. The test shall be continued to rupture without change of load. Elongation after rupture, measured at room temperature, shall be not less than 5% in 4D. Test shall be conducted in accordance with ASTM E139.

3.4.1.3.1 The test of 3.4.1.3 may be conducted using a load higher than required to produce an initial axial stress of 25,000 psi (170 MPa) but load shall not be changed while test is in progress. Time to rupture and elongation requirements shall be as specified in 3.4.1.3.

3.4.1.3.2 When permitted by purchaser, the test of 3.4.1.3 may be conducted using incremental loading. In such case, the load required to produce an initial axial stress of 25,000 psi (170 MPa) shall be used to rupture or for 24 hr, whichever occurs first. After the 24 hr and at intervals of 8 - 16 hr, preferably 8 - 10 hr, thereafter, the stress shall be increased in increments of 2000 psi (14 MPa). Time to rupture and elongation requirements shall be as specified in 3.4.1.3.

3.4.1.4 Grain Size: Shall be predominantly 2 or finer with occasional grains as large as 1 permissible, determined by comparison of a polished and etched specimen with the chart in ASTM E112.

3.4.2 Stock for Forging or Flash Welded Rings: When a sample of stock is forged to a test coupon and heat treated as in 3.3, specimens taken from the heat treated coupon shall conform to the requirements of 3.4.1.1, 3.4.1.2, 3.4.1.3, and 3.4.1.4. If specimens taken from the stock after heat treatment as in 3.3 conform to the requirements of 3.4.1.1, 3.4.1.2, 3.4.1.3, and 3.4.1.4, the tests shall be accepted as equivalent to tests of a forged coupon.

3.5 Quality:

3.5.1 Alloy shall be produced by multiple melting using consumable electrode practice in the remelt cycle or shall be induction melted under vacuum, unless otherwise permitted.

3.5.2 The product, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from internal and external imperfections detrimental to usage of the product.

3.6 Sizes: Except when exact lengths or multiples of exact lengths are ordered, straight bars will be acceptable in mill lengths of 6 - 24 ft (2 - 7.5 m) but not more than 25% of any shipment shall be supplied in lengths of 6 - 9 ft (2 - 3 m) except that for bars weighing over 25 lb per ft (37 kg/m), short lengths down to 2 ft (600 mm) may be supplied.

3.7 Tolerances: Unless otherwise specified, tolerances for bars and forging stock shall conform to all applicable requirements of AMS 2261.

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 the following requirements are classified as acceptance tests and shall be performed on each heat or lot as applicable:

4.2.1.1 Composition (3.1) of each heat.

4.2.1.2 Tensile properties (3.4.1.1), hardness (3.4.1.2), and grain size (3.4.1.4) of bars, forgings, and flash welded rings.

4.2.1.3 Tolerances (3.7) of bars and forging stock.

4.2.2 Periodic Tests: Tests to determine conformance to the following requirements are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of teting is specified by purchaser:

4.2.2.1 Stress-rupture properties (3.4.1.3) of bars, forgings, and flash welded rings.

4.2.2.2 Ability of stock for forging or flash welded rings to develop specified properties (3.4.2).