



AEROSPACE MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AMS 5753A

Superseding AMS 5753

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UNS NO7500

ALLOY BARS AND FORGINGS, CORROSION AND HEAT RESISTANT
55Ni - 17.5Cr - 16.5Co - 4.0Mo - 2.9Ti - 2.9Al - 0.006B
Vacuum Melted, Solution Heat Treated

1. SCOPE:

- 1.1 Form: This specification covers a corrosion and heat resistant nickel alloy in the form of bars, forgings, and forging stock.
- 1.2 Application: Primarily for parts, such as turbine blades, bolts, and fittings, requiring high strength at temperatures up to 1600°F (871°C) and oxidation resistance up to 1800°F (982°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 Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2261 - Tolerances, Nickel, Nickel Base, and Cobalt Base Alloy Bars and Forging Stock
AMS 2269 - Chemical Check Analysis Limits, Wrought Nickel and Nickel Base Alloys
AMS 2350 - Standards and Test Methods
AMS 2371 - Quality Assurance Sampling of Corrosion and Heat Resistant Alloys, Wrought Products Except Forgings
AMS 2375 - Approval and Control of Critical Forgings
AMS 2808 - Identification, Forgings

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

ASTM E18 - Rockwell Hardness and Rockwell Superficial 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-Base Alloys

- 2.3 Government Publications: Available for 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

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3, TECHNICAL REQUIREMENTS:

- 3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical or methods in accordance with ASTM E354, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other approved analytical methods:

	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: Solution heat treated. Bars 2.750 in. (69.85 mm) and under in nominal diameter or distance between parallel sides shall be cold finished.

- 3.2.2 Forgings: Solution heat treated and descaled.

- 3.2.3 Forging Stock: As ordered by the forging manufacturer.

- 3.3 Heat Treatment: Bars and forgings shall be solution heat treated by heating to $1975^{\circ}\text{F} \pm 25$ ($1079.4^{\circ}\text{C} \pm 14$), holding at heat for $4 \text{ hr} \pm 0.25$, and cooling at a rate equivalent to air cool or faster.

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

- 3.4.1 Bars and Forgings:

- 3.4.1.1 As Solution Heat Treated:

- 3.4.1.1.1 Hardness: Not higher than 34 HRC or equivalent, determined in accordance with ASTM E18.

- 3.4.1.2 After Stabilization and Precipitation Heat Treatment: Product shall meet the requirements of 3.4.1.2.1, 3.4.1.2.2, 3.4.1.2.3, and 3.4.1.2.4 after being stabilization heat treated by heating to $1550^{\circ}\text{F} \pm 25$ ($843.3^{\circ}\text{C} \pm 14$), holding at heat for $24 \text{ hr} \pm 1$, and cooling in air and precipitation heat treated by heating to $1400^{\circ}\text{F} \pm 25$ ($760^{\circ}\text{C} \pm 14$), holding at heat for $16 \text{ hr} \pm 1$, and cooling in air. When permitted by purchaser, the 1550°F (843.3°C) stabilization heat treatment may be omitted.

- 3.4.1.2.1 Tensile Properties at 1200°F (648.9°C): Shall be as follows, determined on specimens
 Ø heated to 1200°F ± 10 (648.9°C ± 5.6), held at heat for 30 min. before testing, and tested in accordance with ASTM E21 at 1200°F ± 10 (648.9°C ± 5.6) at a rate of 0.003 - 0.007 in. per in. per min. (0.003 - 0.007 mm/mm/min.) up to the yield strength:

Tensile Strength,	170,000 psi (1172 MPa)
Yield Strength at 0.2% offset, min	110,000 psi (758 MPa)
Elongation in 2 in. (50.8 mm) or 4D, min	6%
Reduction of Area, min	10%

- 3.4.1.2.2 Hardness: Should be not lower than 30 HRC or equivalent, determined in accordance with
 Ø ASTM E18, but the product shall not be rejected on the basis of hardness if the tensile property requirements are met.

- 3.4.1.2.3 Stress-Rupture Properties at 1650°F (898.9°C): A tensile test specimen, maintained at
 Ø 1650°F ± 3 (898.9°C ± 1.7) while a load sufficient to produce an initial axial stress of 25,000 psi (172 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.

- 3.4.1.2.3.1 The test of 3.4.1.2.3 may be conducted using a load higher than required to produce an
 Ø initial axial stress of 25,000 psi (172 MPa) but load shall not be changed while test is in progress. Time to rupture and elongation requirements shall be as specified in 3.4.1.2.3.

- 3.4.1.2.3.2 When permitted by purchaser, the test of 3.4.1.2.3 may be conducted using incremental
 Ø loading. In such case, the load required to produce an initial axial stress of 25,000 psi (172 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 at 2000 psi (13.8 MPa). Time to rupture and elongation requirements shall be as specified in 3.4.1.2.3.

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

- 3.4.2 Forging Stock: When a sample of stock is forged to a test coupon and heat treated as in 3.3 and 3.4.1.2, specimens taken from the heat treated coupon shall conform to the requirements of 3.4.1.2.1, 3.4.1.2.2, 3.4.1.2.3, and 3.4.1.2.4. If specimens taken from the stock after heat treatment as in 3.3 and 3.4.1.2 conform to the requirements of 3.4.1.2.1, 3.4.1.2.2, 3.4.1.2.3, and 3.4.1.2.4, the tests shall be accepted as equivalent to tests of a forged coupon.

3.5 Quality:

- 3.5.1 Material shall be produced by multiple melting using consumable electrode practice in the remelt
 Ø cycle or shall be induction melted under vacuum, unless otherwise permitted. If consumable electrode remelting is not performed in vacuum, electrodes which have been produced by vacuum induction melting shall be used.
- 3.5.2 The product shall be uniform in quality and condition, clean, sound, and free from foreign materials and from internal and external imperfections detrimental to fabrication or to performance of parts.

3.6 Sizes: Except when exact lengths or multiples of exact lengths are ordered, bars will be acceptable in mill lengths of 6 - 24 ft (1.8 m - 7.3 m) but not more than 25% of any shipment shall be supplied in lengths of 6 - 9 ft (1.8 - 2.7 m) except that for bars weighing over 25 lb per ft (37.2 kg/m), short lengths down to 2 ft (610 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 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 perform such confirmatory testing as he deems necessary to ensure that the product conforms to the requirements of this specification

4.2 Classification of Tests:

4.2.1 Acceptance Tests: The following are classified as acceptance or routine control tests:

4.2.1.1 Tests of the product to determine conformance to composition (3.1) requirements.

4.2.1.2 Tests of bars and forgings in the solution heat treated condition to determine conformance to hardness (3.4.1.1.1) requirements.

4.2.1.3 Tests of bars and forgings after stabilization and precipitation heat treatment to determine conformance to tensile property (3.4.1.2.1), hardness (3.4.1.2.2), and grain size (3.4.1.2.4) requirements.

4.2.1.4 Tests of bars and forging stock to determine conformance to tolerance (3.7) requirements.

4.2.2 Qualification Tests: The following are classified as qualification or periodic control tests:

4.2.2.1 Tests of bars and forgings to determine conformance to stress-rupture (3.4.1.2.3) requirements.

4.2.2.2 Tests of forging stock to demonstrate ability to develop required properties (3.4.2).

4.2.3 For direct U. S. Military procurement, qualification test material and supporting test data shall be submitted to the cognizant qualification agency as directed by the request for procurement, the procuring activity, or the contracting officer.

4.3 Sampling: Shall be as follows:

4.3.1 Bars: In accordance with AMS 2371.

4.3.2 Forgings and Forging Stock: As agreed upon by purchaser and vendor.

4.4 Approval: When specified, approval and control of forgings shall be in accordance with AMS 2375.

4.5 Reports:

4.5.1 The vendor of the product shall furnish with each shipment three copies of a report of the results of tests for chemical composition of each heat in the shipment and the results of tests on each size from each heat to determine conformance to the other acceptance test requirements and stating that the product conforms to the other technical requirements of this specification. This report shall include the purchase order number, heat number, material specification number and its revision letter, size, and quantity from each heat. If forgings are supplied, the part number and the size and melt source of stock used to make the forgings shall also be included.