

AEROSPACE MATERIAL SPECIFICATION

SAE

AMS 5753C

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Superseding AMS 5753B

Submitted for recognition as an American National Standard

Alloy Bars and Forgings, Corrosion and Heat Resistant
5.5Ni - 17.5Cr - 16.5Co - 4.0Mo - 2.9Ti - 2.9Al - 0.006B
Vacuum Melted, Solution Heat Treated

CANCELLATION NOTICE

This specification has been "CANCELLED" by the Aerospace Materials Division, SAE, as of March 1999. By this action, this document will remain listed in the Numerical Section of the Index of Aerospace Material Specifications.

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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, and stock for forging or heading.

1.2 Application:

Primarily for parts, such as turbine blades, bolts, and fittings, 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 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

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 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: Solution heat treated. Bars 2.75 in. (70.0 mm) and under in nominal diameter or distance between parallel sides shall be cold finished. Larger size bars shall be hot finished and descaled.

3.2.2 Forgings: Solution heat treated and descaled.

3.2.3 Stock for Forging or Heading: As ordered by the forging or heading manufacturer.

3.3 Heat Treatment:

Bars and forgings shall be solution heat treated by heating to $1975^{\circ}\text{F} \pm 25$ ($1080^{\circ}\text{C} \pm 15$), 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°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. When permitted by purchaser, the 1550°F (845°C) stabilization heat treatment may be omitted.

3.4.1.2.1 Tensile Properties at 1200°F (650°C): Shall be as follows, determined in accordance with ASTM E21 on specimens heated to 1200°F ± 5 (650°C ± 3), held at heat for 20 - 30 min. before testing, and tested at 1200°F ± 5 (650°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%

3.4.1.2.2 Hardness: Should be not lower than 30 HRC or equivalent, determined in accordance with 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 (900°C): A tensile test specimen, maintained at 1650°F ± 3 (900°C ± 2), while a load sufficient to produce an initial axial stress of 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.

3.4.1.2.3.1 The test of 3.4.1.2.3 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 3.4.1.2.3.

3.4.1.2.3.2 When permitted by purchaser, the test of 3.4.1.2.3 may be conducted using incremental 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 (15 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 permissible, 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.

3.4.3 Heading Stock: Specimens taken from stock after heat treatment as in 3.3 and 3.4.1.2 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.

3.5 Quality:

3.5.1 Alloy shall be produced by vacuum induction melting followed by vacuum consumable electrode remelting.

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.

3.5.2.1 Forgings shall have substantially uniform macrostructure and grain flow. Standards for acceptance shall be as agreed upon by purchaser and vendor.

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 Hardness (3.4.1.1.1) of each lot of bars and forgings as solution treated.

4.2.1.3 Tensile properties (3.4.1.2.1), hardness (3.4.1.2.2), and grain size (3.4.1.2.4) of each lot of bars and forgings after stabilization and precipitation heat treatment.

4.2.1.4 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 testing is specified by purchaser.

4.2.2.1 Stress-rupture properties (3.4.1.2.3) of bars and forgings after stabilization and precipitation heat treatment.

4.2.2.2 Ability of forging stock (3.4.2) and heading stock (3.4.3) to develop required properties.

4.2.3 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 and/or processing requires reapproval as in 4.4, and when purchaser deems confirmatory testing to be required.

4.2.3.1 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, the contracting officer, or the request for procurement.

4.3 Sampling:

Shall be in accordance with the following; a heat shall be the consumable electrode remelted ingots produced from alloy originally melted as a single vacuum induction melt:

4.3.1 Bars and Heading Stock: AMS 2371.

4.3.2 Forgings and Forging Stock: AMS 2374.

4.4 Approval:

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