

**AEROSPACE
MATERIAL
SPECIFICATION**

AMS 5714A
Superseding AMS 5714

Issued 11-1-69
Revised 1-1-82

UNS N07722

ALLOY BARS, FORGINGS, AND RINGS, CORROSION AND HEAT RESISTANT
73Ni - 15.5Cr - 2.5Ti - 0.70Al - 7.0Fe

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 flanges, cases, and turbine rotors, requiring high strength at temperatures in the range 800° - 1200°F (425° - 650°C), particularly where welding is involved.

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

SAE Technical Board rules provide that: "All technical reports, including standards approved and practices recommended, are advisory only. Their use by anyone engaged in industry or trade or their use by governmental agencies is entirely voluntary. There is no agreement to adhere to any SAE standard or recommended practice, and no commitment to conform to or be guided by any technical report. In formulating and approving technical reports, the Board and its Committees will not investigate or consider patents which may apply to the subject matter. Prospective users of the report are responsible for protecting themselves against liability for infringement of patents."

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

- ASTM E8 - Tension Testing of Metallic Materials
- ASTM E10 - Brinell Hardness of Metallic Materials
- ASTM E18 - Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
- ASTM E112 - Estimating the Average Grain Size of Metals
- 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	--	0.08
Manganese	--	1.00
Silicon	--	0.70
Sulfur	--	0.01
Chromium	14.00 -	17.00
Nickel + Cobalt	70.00 -	--
Titanium	2.20 -	2.75
Aluminum	0.50 -	0.90
Iron	5.00 -	9.00
Cobalt (3.1.1)	--	1.00
Copper	--	0.50

3.1.1 Determination not required for routine acceptance.

3.1.2 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: Hot finished, mill annealed, and descaled; round bars shall be ground or turned.

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

3.2.2.1 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 7490. During manufacture of flash welded rings, the stock shall not be heated higher than 1825°F (995°C), unless otherwise agreed upon by purchaser and vendor.

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

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

3.3.1 Bars, Forgings, and Flash Welded Rings:

3.3.1.1 As Received:

3.3.1.1.1 Hardness: Shall be as follows, determined in accordance with ASTM E10:

3.3.1.1.1.1 Bars: Not higher than 277 HB or equivalent.

3.3.1.1.1.2 Forgings and Flash Welded Rings: Not higher than 229 HB or equivalent.

3.3.1.2 After Heat Treatment: The product shall have the following properties after being solution heat treated by heating to 1800°F $\pm$ 25 (980°C $\pm$ 15), holding at heat for 1 hr $\pm$ 0.1, and cooling at a rate equivalent to air cooling or faster, and precipitation heat treated by heating to 1325°F $\pm$ 15 (720°C $\pm$ 8), holding at heat for 8 hr $\pm$ 0.25, cooling at a rate not faster than 25 F (15 C) deg per hr to 1150°F $\pm$ 15 (620°C $\pm$ 8), and cooling in air. Instead of the 25 F (15 C) deg per hr cooling rate to 1150°F $\pm$ 15 (620°C $\pm$ 8), the furnace cooling may be at any rate provided the time at 1150°F $\pm$ 15 (620°C $\pm$ 8) is adjusted to give a total precipitation heat treatment time of 16 hours.

3.3.1.2.1 Tensile Properties: Shall be as specified in Table I, determined in accordance with ASTM E8:

TABLE I

Nominal Diameter or Distance Between Parallel Sides Inches	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation in 4D, %, min	Reduction of Area %, min
Up to 2.50, excl	145,000	95,000	18	20
2.50 to 4.00, excl	145,000	95,000	15	15

TABLE I (SI)

Nominal Diameter or Distance Between Parallel Sides Millimetres	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 4D, %, min	Reduction of Area %, min
Up to 62.5, excl	1000	655	18	20
62.5 to 100.0, excl	1000	655	15	15

3.3.1.2.1.1 Tensile property requirements for product 4.00 in. (100.0 mm) and over in nominal diameter or distance between parallel sides shall be as agreed upon by purchaser and vendor.

3.3.1.2.2 Hardness: Should be not lower than 23 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 of 3.2.1.2.1 are met.

3.3.1.2.3 Grain Size: Bars 4.00 in. (100.0 mm) and under in nominal diameter or least distance between parallel sides, flash welded rings 4.00 in. (100.0 mm) and under in radial thickness, and forgings shall have grain size predominantly 4 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.

3.3.1.2.3.1 Grain size requirements for bars over 4.00 in. (100.00 mm) in nominal diameter or least distance between parallel sides and flash welded rings over 4.00 in. (100.0 mm) in radial thickness shall be as agreed upon by purchaser and vendor.

3.3.2 Forging Stock: When a sample of stock is forged to a test coupon and heat treated as in 3.3.1.2, specimens taken from the heat treated coupon shall conform to the requirements of 3.3.1.2.1, 3.3.1.2.2 and 3.3.1.2.3. If specimens taken from the stock after heat treatment as in 3.3.1.2 conform to the requirements of 3.3.1.2.1, 3.3.1.2.2, and 3.3.1.2.3, the tests shall be accepted as equivalent to tests of a forged coupon.

3.3.3 Stock for Flash Welded Rings: Specimens taken from the stock after heat treatment as in 3.3.1.2 shall conform to the requirements of 3.3.1.2.1, 3.3.1.2.2, and 3.3.1.2.3.

3.5 Quality:

3.5.1 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.

3.5.1.1 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 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.

Ø

4.2.1.2 Hardness (3.3.1.1.1) of each lot of bars, forgings, and flash welded rings as received.

Ø

4.2.1.3 Tensile properties (3.3.1.2.1), hardness (3.3.1.2.2), and grain size (3.3.1.2.3) of each lot of bars, forgings, and flash welded rings after heat treatment.

Ø

4.2.1.4 Tolerances (3.7) of bars and forging stock.

Ø

4.2.2 Periodic Tests: Tests of forging stock (3.3.2) and of stock for flash welded rings (3.3.3) to demonstrate ability to develop required properties are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

Ø

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 on the first-article shipment of a forging to a purchaser, when a change in material or processing requires reapproval as in 4.4, and when purchaser deems confirmatory testing to be required.

Ø

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.

Ø

4.3 Sampling: Shall be in accordance with the following:

4.3.1 Bars, Flash Welded Rings, and Stock for Flash Welded Rings: AMS 2371.

Ø

4.3.2 Forgings and Forging Stock: AMS 2374.

Ø

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

Ø

4.5 Reports:

4.5.1 The vendor of the product shall furnish with each shipment three copies of a report showing the results of tests for chemical composition of each heat and the results of tests on each lot to determine conformance to the other acceptance test requirements of this specification. This report shall include the purchase order number, heat number, AMS 5714A, 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.