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400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 5714B

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Superseding AMS 5714A

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

UNS N07722

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 (427° - 649°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 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
MAM 2261 - Tolerances, Metric, Nickel, Nickel Alloy, and Cobalt Alloy Bars and Forging Stock
AMS 2269 - Chemical Check Analysis Limits, Wrought Nickel Alloys and Cobalt Alloys
AMS 2316 - Metallographic Evaluation of Grain Size in Wrought Nickel and Heat Resistant 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 2750 - Pyrometry
AMS 2806 - Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Corrosion and Heat 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 E8 - Tension Testing of Metallic Materials
ASTM E8M - Tension Testing of Metallic Materials (Metric)
ASTM E10 - Brinell Hardness of Metallic Materials
ASTM E18 - Rockwell Hardness and Rockwell Superficial Hardness 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 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, Ø determined by wet chemical methods in accordance with ASTM E354, by spectrochemical methods, or by other analytical methods acceptable to purchaser:

	min	max
Carbon	--	0.08
Manganese	--	1.00
Silicon	--	0.70
Phosphorus	--	0.015
Sulfur	--	0.010
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 AMS2269.

3.2 Condition: The product shall be supplied in the following condition; Ø pyrometry shall be in accordance with AMS 2750:

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, rings shall be manufactured in accordance with AMS 7490. During manufacture of flash welded rings, the stock shall not be heated higher than 1825°F (996°C).

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 Response to Heat Treatment: The product shall have the following properties after being solution heat treated by heating to 1800°F ± 25 (982°C ± 14), holding at heat for 60 minutes ± 5, and cooling at a rate equivalent to air cool or faster, and precipitation heat treated by heating to 1325°F ± 15 (718°C ± 8), holding at heat for 8 hours ± 0.25, cooling at a rate not faster than 25 F (15 C) degrees per hour to 1150°F ± 15 (621°C ± 8), and cooling in air. Instead of the 25 F (15 C) degrees per hour cooling rate to 1150°F ± 15 (621°C ± 8), the furnace cooling may be at any rate provided the time at 1150°F ± 15 (621°C ± 8) is adjusted to give a total precipitation heat treatment time of 16 hours.

3.3.1.2.1 Ø Tensile Properties: Shall be as specified in Table I, determined in accordance with ASTM E8 or ASTM E8M: requirements apply in both the longitudinal and transverse direction but tests in the transverse direction need be made only on product from which a specimen not less than 2.50 inches (63.5 mm) in length can be taken. Tests in the longitudinal direction are not required on product tested in the transverse direction.

TABLE I

Nominal Diameter or Distance Between Parallel Sides Inches	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, minimum	Elongation in 4D, %, minimum	Reduction of Area %, minimum
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, minimum	Elongation in 4D, %, minimum	Reduction of Area %, minimum
Up to 63.5, excl	1000	655	18	20
63.5 to 101.6, excl	1000	655	15	15

3.3.1.2.1.1 Tensile property requirements for product 4.00 inches (101.6 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 Ø Grain Size: Bars 4.00 inches (101.6 mm) and under in nominal diameter or least distance between parallel sides, flash welded rings 4.00 inches (101.6 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 in accordance with of AMS 2316, Class A.

3.3.1.2.3.1 Grain size requirements for bars over 4.00 inches (101.6 mm) in nominal diameter or least distance between parallel sides and flash welded rings over 4.00 inches (101.06 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.

3.4 Quality: 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.

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

3.4.2 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 grain flow.

3.5 Sizes: Except when exact lengths or multiples of exact lengths are ordered, straight bars will be acceptable in mill lengths of 6 - 24 feet (1.8 - 7.3 m) but not more than 25% of any shipment shall be supplied in lengths of 6 - 9 feet (1.8 - 2.7 m) except that for bars weighing over 25 pounds per foot (37 kg/m), short lengths down to 2 feet (610 mm) may be supplied.

3.6 Tolerances: Bars and forging stock shall conform to all applicable requirements of AMS 2261 or MAM 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 (3.3.1.1.1) of each lot of bars, forgings, and flash welded rings as received.

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.

4.2.1.4 Tolerances (3.6) of bars and forging stock.

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.

4.2.3 Preproduction Tests: Tests of forgings to determine conformance to all applicable technical requirements of this specification when AMS2375 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, contracting officer, or request for procurement.

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.

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.

4.5 Reports:

4.5.1 The vendor of bars, forgings, and flash welded rings shall furnish with each shipment 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, lot number, AMS 5714B, size, and quantity. If forgings are supplied, the part number and the size and melt source of stock used to make the forgings shall also be included.