SOCIETY OF AUTOMOTIVE ENGINEERS, Inc. 485 Lexington Ave., New York, N.Y. 10017

AEROSPACE MATERIAL SPECIFICATIONS

AMS 5661A

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ALLOY BARS AND FORGINGS, CORROSION AND HEAT RESISTANT
Nickel Base - 12.5Cr - 5.8Mo - 2.9Ti - 34Fe
Consumable Electrode or Vacuum Induction Melted

1. ACKNOWLEDGMENT: A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.

2. FORM: Bars, forgings, and forging stock.

3. APPLICATION: Primarily for parts, such as turbine rotors, shafts, buckets, and blades, requiring high strength up to 1400 F (760 C) and oxidation resistance up to 1600 F (871 C).

4. COMPOSITION:

	min	max
Carbon	--	0.10
Manganese	--	0.50
Silicon	--	0.40
Phosphorus	--	0.030
Sulfur	--	0.030
Chromium	11.00	14.00
Nickel	40.00	45.00
Cobalt	--	1.00
Molybdenum	5.00	6.50
Titanium	2.70	3.10
Aluminum	--	0.35
Boron	0.010	0.020
Copper	--	0.50
Iron	remainder	

4.1 Check Analysis: Composition variations shall meet the requirements of the latest issue of AMS 2269.

5. CONDITION:

5.1 Bars: Hot finished and solution, stabilization, and precipitation heat treated, unless otherwise specified. Rounds shall be rough-turned or ground.

5.2 Forgings: Solution, stabilization, and precipitation heat treated, unless otherwise specified.

5.3 Forging Stock: As ordered by the forging manufacturer.

6. TECHNICAL REQUIREMENTS:

6.1 Bars and Forgings:

6.1.1 Heat Treatment: Unless otherwise specified, bars and forgings shall be heat treated at temperatures, within the following ranges, which will produce the properties specified in 6.1.2, 6.1.3, and 6.1.4.

6.1.1.1 Solution Heat Treatment: Heat to 2000 F ± 25 (1093.3 C ± 14), hold at heat for 2 hr, and cool at a rate equivalent to air cool or faster.

6.1.1.2 Stabilization Heat Treatment: Heat to a temperature within the range of 1425 - 1475 F (773.9 - 801.7 C), hold at the selected temperature within ± 15 F (±8.3 C) for 2 - 4 hr, and cool in air or quench in water.

6.1.1.3 Precipitation Heat Treatment: Heat to a temperature within the range of 1300 - 1375 F (704.4 - 746.1 C), hold at the selected temperature within ± 15 F (± 8.3 C) for 24 hr, and cool in air.

6.1.2 Tensile Properties: Tensile test specimens cut from the product and tested at room temperature, shall conform to the following requirements:

Tensile Strength, psi	165,000 min
Yield Strength at 0.2% Offset or at 0.0120 in. in 2 in. Extension Under Load (E = 29,900,000), psi	120,000 min
Elongation, % in 2 in. or 4D	12 min
Reduction of Area, %	15 min

6.1.2.1 When tensile test specimens are machined from approximately the center of large disc forgings (over 50 sq in. cross sectional area), the elongation may be as low as 10% and the reduction of area as low as 12%. Specimens shall be cut with axis of specimens in any plane perpendicular to the axis of the forging and perpendicular to a radius in the selected plane. When size and shape permit, additional specimens shall be cut with axis of specimen approximately parallel to the axis of the forging. Specific locations of test specimens shall be as agreed upon by purchaser and vendor.

6.1.3 Hardness: Shall be Brinell 302 - 388 or equivalent.

6.1.4 Stress-Rupture Test at 1200 F (648.9 C): A combination smooth and notched test specimen machined to the dimensions shown in Fig. 1 and Table I, maintained at 1200 F ± 3 (648.9 C ± 1.7) while an axial stress of 90,000 psi is applied continuously, shall not rupture in less than 23 hours. The test shall be continued to rupture. After the 23 hr, if rupture occurs in the notch, the smooth section shall, by suitable means, be continued to rupture, or a separate smooth specimen shall be tested to rupture in not less than 23 hours. Elongation of the smooth section after rupture, measured at room temperature, shall be not less than 5% in 4D if the specimen ruptures in 48 hr or less and not less than 4% in 4D if the specimen ruptures in more than 48 hours. Tests shall be conducted in accordance with the issue of ASTM E139 specified in the latest issue of AMS 2350.

6.1.4.1 As an alternate procedure, separate smooth and notched test specimens, machined from adjacent sections of the same piece, with gage sections conforming to the respective dimensions of Table I may be tested individually under the above conditions. The smooth specimen shall not rupture in less than 23 hr and elongation after rupture, measured at room temperature, shall be not less than 5% in 4D. The notched specimen shall not rupture in less than 23 hr but need not be tested to rupture.

6.1.4.2 The tests of 6.1.4 and 6.1.4.1 may be conducted at a stress higher than 90,000 psi but stress shall not be changed while the test is in process, unless otherwise specified or permitted. Time to rupture and elongation requirements shall be as specified in 6.1.4 and 6.1.4.1.

6.2 Forging Stock: When a sample of stock is forged to a test coupon as agreed upon by purchaser and vendor and heat treated as in 6.1.1, test specimens taken from the heat treated coupon shall have properties not lower than those specified in 6.1.2, 6.1.3, and 6.1.4. If test specimens taken from the stock after heat treatment as in 6.1.1 have properties not lower than those specified in 6.1.2, 6.1.3, and 6.1.4, the test shall be accepted as equivalent to the test of a forged coupon.

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

8. TOLERANCES: Unless otherwise specified, tolerances shall conform to all applicable requirements of the latest issue of AMS 2261; round bars, and forging stock ordered to specified dimensions, shall conform to Table VI, except that spot ground areas on forging stock may be under the minimum diameter (nominal diameter minus maximum negative tolerance) by as much as 3% of the nominal diameter.

9. REPORTS:

9.1 Unless otherwise specified, 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 technical requirements of this specification. This report shall include the purchase order number, material specification number, heat number, size, quantity from each heat, and a statement of specific heat treating temperatures and cycles used to provide reported properties. If forgings are supplied, the part number and size of stock used to make the forgings shall also be included.

9.2 Unless otherwise specified, the vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, material specification number, contractor or other direct supplier of material, part number, and quantity. When material for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of material to determine conformance to the requirements of this specification, and shall include in the report a statement that the material conforms, or shall include copies of laboratory reports showing the results of tests to determine conformance.

10. IDENTIFICATION:

10.1 Bars: Individual pieces or bundles shall have attached a metal tag stamped with the purchase order number, AMS 5661A, nominal size, and heat number (or ingot lot number, when available), or shall be boxed and the box marked with the same information. In addition to the above identification, flats 2 x 1 in. and larger and other bars 1 in. and over in diameter or distance between parallel sides shall be stamped with the heat number within 2 in. of one end.

10.2 Forgings: Unless otherwise specified, forgings shall be identified in accordance with the latest issue of AMS 2808.

10.3 Forging Stock: Ingots, billets, and shapes for forging shall be identified as to heat number (or ingot lot number, when available) and vendor's identification.

11. REJECTIONS: Material not conforming to this specification or to authorized modifications will be subject to rejection.