



AEROSPACE MATERIAL SPECIFICATION

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

AMS 5664B

Superseding AMS 5664A

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ALLOY BARS, FORGINGS, AND RINGS, CORROSION AND HEAT RESISTANT UNS NO7718
52.5Ni - 19Cr - 3.0Mo - 5.1(Cb+Ta) - 0.90Ti - 0.50Al - 19Fe
Consumable Electrode or Vacuum Induction Melted
1950° F (1065° C) Solution Treated

1. SCOPE:

1.1 **Form:** This specification covers a precipitation-hardenable, 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 rotating and structural parts, such as impellers, flanges, and fasteners, requiring high strength at cryogenic temperatures and for short-time service up to 1000° F (540° 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 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 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

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 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.

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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:

Ø	min	max
Carbon	--	0.08
Manganese	--	0.35
Silicon	--	0.35
Phosphorus	--	0.015
Sulfur	--	0.015
Chromium	17.00	21.00
Nickel	50.00	55.00
Molybdenum	2.80	3.30
Columbium + Tantalum	4.75	5.50
Titanium	0.65	1.15
Aluminum	0.20	0.80
Cobalt	--	1.00
Boron	--	0.006
Copper	--	0.30
Iron	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, Forgings, and Flash Welded Rings: Solution heat treated.

3.2.1.1 Bars shall be hot finished; round bars shall be ground or turned.

3.2.1.2 Forgings shall be rough machined or descaled.

3.2.1.3 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.

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

3.3 Heat Treatment: Unless otherwise specified, bars, forgings and flash welded rings shall be solution heat treated to conform to the requirements of 3.4.1. No specific heat treating instructions are specified but it is recommended that the product be solution heat treated by heating in a suitable protective atmosphere to 1950° F + 25 (1065° C + 15) but in no case lower than 1900° F (1038° C), holding at heat for not more than 2 hr, 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, Forgings, and Flash Welded Rings:

3.4.1.1 As Solution Heat Treated:

3.4.1.1.1 Hardness: Shall be as follows; determined in accordance with ASTM E10:

3.4.1.1.1.1 Bars: Not higher than 248 HB or equivalent, determined approximately midway between \emptyset the outer surface and center.

3.4.1.1.1.2 Forgings and Flash Welded Rings: Not higher than 248 HB or equivalent.

3.4.1.1.2 Grain Size: Shall average 3 or finer, determined by comparison of a polished and \emptyset etched specimen with the chart in ASTM E112.

3.4.1.2 After Precipitation Heat Treatment: The product shall have the following properties after being precipitation heat treated by heating to 1400° F \pm 15 (760° C \pm 8), holding at heat for 10 hr \pm 0.5, furnace cooling to 1200° F \pm 15 (650° C \pm 8), holding at 1200° F \pm 15 (650° C \pm 8) until a total precipitation heat treatment time of 20 hr has been reached, and cooled. The product shall also meet the following requirements after being re-solution heat treated by heating to 1950° F \pm 25 (1065° C \pm 15) in a suitable protective atmosphere, holding at heat for 1 - 2 hr, and cooling at a rate equivalent to air cool or faster and then precipitation heat treated as above.

3.4.1.2.1 Tensile Properties: Product 10 in. (250 mm) and under in least nominal cross-sectional dimension \emptyset shall have properties as specified in 3.4.1.2.1.1 and 3.4.1.2.1.2, determined in accordance with ASTM E8; tensile property requirements for product over 10 in. (250 mm) in least nominal cross-sectional dimension shall be as agreed upon by purchaser and vendor.

3.4.1.2.1.1 Bars:

Tensile Strength, min	180,000 psi (1241 MPa)
Yield Strength at 0.2 Offset, min	150,000 psi (1034 MPa)
Elongation in 4D, min	10%
Reduction of Area, min	12%

3.4.1.2.1.2 Forgings and Flash Welded Rings:

Tensile Strength, min	180,000 psi (1241 MPa)
Yield Strength at 0.2% Offset, min	150,000 psi (1034 MPa)
Elongation in 4D, min	12%
Reduction of Area, min	15%

3.4.1.2.2 Hardness: Should be not lower than 341 HB or equivalent, determined in accordance with \emptyset ASTM E10, but the product shall not be rejected on the basis of hardness if the tensile property requirements of 3.4.1.2.1.1 and 3.4.1.2.1.2 are met.

3.4.2 Stock for Forging or Flash Welded Rings: When a sample of stock is forged to a test coupon and solution and precipitation heat treated as in 3.3 and 3.4.1.2, specimens taken from the heat treated coupon shall conform to the requirements of 3.4.1.2.1.2 and 3.4.1.2.2. If specimens taken from the stock after heat treatment as in 3.3 and 3.4.1.2 conform to the requirements of 3.4.1.2.1.2 and 3.4.1.2.2, the tests shall be accepted as equivalent to tests of a forged coupon.

3.5 Quality:

3.5.1 Alloy shall be produced by multiple melting using consumable electrode practice in the remelt 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, 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.

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 (1.8 - 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 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 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: Tests to determine conformance to requirements for the following 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) and grain size (3.4.1.1.2) of each lot of bars, forgings, and flash welded rings as solution heat treated.

∅ 4.2.1.3 Tensile properties (3.4.1.2.1) and hardness (3.4.1.2.2) of each lot of bars, forgings, and flash welded rings after 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 requirements for the following 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 Tensile properties (3.4.1.2.1) and hardness (3.4.1.2.2) of bars, forgings, and flash welded rings after re-solution and precipitation heat treatment as in 3.4.1.2.

∅ 4.2.2.2 Ability of stock for forging or flash welded rings to develop required properties (3.4.2).

4.2.3 Preproduction Tests: Tests of forgings to determine conformance to all 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.