SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS5854 REV. B

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Revised 2010-05

Superseding AMS5854A

Nickel Alloy, Corrosion and Heat-Resistant, Bars, Wire, Forgings, and Rings
61Ni - 20.5Cr - 8.5Mo - 3.4Cb(Nb) - 1.3Ti - 5.0Fe
Consumable Electrode or Vacuum Induction Melted
Solution Heat Treated

(Composition similar to UNS N07716)

RATIONALE

AMS5854B revises properties to be tested on precipitation heat treated product (3.5.1.2), reports (4.4) and results from a Five Year Review and update of this specification.

1. SCOPE

1.1 Form

This specification covers a corrosion and heat-resistant nickel alloy in the form of bars, wire, forgings, flash welded rings, extrusions, and stock for forging or flash welded rings.

1.2 Application

These products have been used typically for parts requiring both corrosion and oxidation resistance up to 1000 °F (538 °C), and where such parts may require welding during fabrication and are then precipitation heat treated to develop required properties, but usage is not limited to such applications.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AMS2261 Tolerances, Nickel, Nickel Alloy, and Cobalt Alloy Bars, Rods, and Wire
AMS2269 Chemical Check Analysis Limits, Nickel, Nickel Alloys, and Cobalt Alloys
AMS2371 Quality Assurance Sampling and Testing, Corrosion and Heat-Resistant Steels and Alloys, Wrought Products and Forging Stock
AMS2374 Quality Assurance Sampling and Testing, Corrosion and Heat-Resistant Steel and Alloy Forgings

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AMS2750 Pyrometry
AMS2806 Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Corrosion and Heat-Resistant Steels and Alloys
AMS2808 Identification, Forgings
AMS7490 Rings, Flash Welded, Corrosion and Heat-Resistant Austenitic Steels, Austenitic-Type Iron, Nickel, or Cobalt Alloys, or Precipitation-Hardenable Alloys

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM E 8/E 8M Tension Testing of Metallic Materials
ASTM E 10 Brinell Hardness of Metallic Materials
ASTM E 18 Rockwell Hardness of Metallic Materials
ASTM E 112 Determining Average Grain Size
ASTM E 354 Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 354, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - COMPOSITION

Element	min	max
Carbon	--	0.03
Manganese	--	0.20
Silicon	--	0.20
Phosphorus	--	0.015
Sulfur	--	0.010
Chromium	19.00	22.00
Nickel	59.00	63.00
Molybdenum	7.50	9.50
Columbium (Niobium)	2.75	4.00
Titanium	1.00	1.60
Cobalt	--	1.00
Aluminum	--	0.35
Iron	remainder	

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3.1.1 Check Analysis

Composition variations shall meet the applicable requirements of AMS2269.

3.2 Melting Practice

Alloy shall be produced by multiple melting using consumable electrode practice in the remelt cycle or shall be induction melted under vacuum.

3.3 Condition

The product shall be supplied in the following condition:

3.3.1 Bars

Hot finished and solution heat treated; round bars shall be ground or turned.

3.3.2 Wire

Cold drawn and solution heat treated.

3.3.3 Forgings, Extrusions, and Flash Welded Rings

Solution heat treated.

3.3.3.1 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 AMS7490.

3.3.4 Stock for Forging or Flash Welded Rings

As ordered by the forging or flash welded ring manufacturer.

3.4 Heat Treatment

Bars, forgings, and flash welded rings shall be solution heat treated by heating to a temperature within the range 1850 to 1950 °F (1010 to 1066 °C), holding at the selected temperature within ±25 °F (±14 °C) for a time commensurate with cross-sectional thickness, and cooling at a rate equivalent to air cooling. Pyrometry shall be in accordance with AMS2750.

3.5 Properties

The product shall conform to the following requirements:

3.5.1 Bars, Wire, Forgings, and Flash Welded Rings

3.5.1.1 As Solution Heat Treated

3.5.1.1.1 Hardness of Bars, Forgings, and Flash Welded Rings

Shall be not higher than 287 HB, or equivalent (See 8.2).

3.5.1.1.2 Tensile Strength of Wire

Shall be not higher than 135 ksi (931 MPa), determined in accordance with ASTM E 8/E 8M.

3.5.1.1.3 Average Grain Size

ASTM No. 3 or finer, determined in accordance with ASTM E 112, for product with a least cross-section dimension under 2-1/2 inches (63.5 mm).

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3.5.1.2 After Precipitation Heat Treatment

Product, 4-inches (102-mm) and under in nominal diameter or least distance between parallel sides, shall meet the requirements of 3.5.1.2.1 and 3.5.1.2.2 after being precipitation heat treated by heating to a temperature within the range 1325 to 1375 °F (718 to 746 °C), holding at the selected temperature within ±15 °F (±8 °C) for not less than 8 hours, cooling at a rate of 100 F ± 15 (55 C ± 8) degrees per hour to 1150 °F ± 15 (621 °C ± 8), holding at 1150 °F ± 15 (621 °C ± 8) for not less than 8 hours, and cooling at a rate equivalent to air cooling. Instead of the 100 F (55 C) degrees per hour cooling rate to 1150 °F ± 15 (621 °C ± 8), product may be furnace cooled at any rate provided the time at 1150 °F ± 15 (621 °C ± 8) is adjusted to give a total precipitation heat treatment time of not less than 18 hours.

3.5.1.2.1 Tensile Properties

Shall be as shown in Table 2, determined in accordance with ASTM E 8/E 8M on specimens taken from product under 4-inches (102-mm) in least cross-sectional dimension.

TABLE 2 - MINIMUM TENSILE PROPERTIES

Property	Value
Tensile Strength	150 ksi (1034 MPa)
Yield Strength at 0.2% Offset	115 ksi (793 MPa)
Elongation in 4D	25%
Reduction in Area	40%

3.5.1.2.2 Hardness

Shall be not lower than 30 HRC, or equivalent (See 8.2), but the product shall not be rejected on basis of hardness if the tensile properties of 3.5.1.2.1 are acceptable, determined on specimens taken from the same sample as that with nonconforming hardness or from another sample with similar nonconforming hardness.

3.5.2 Forging Stock

When a sample of stock is forged to a test coupon and heat treated as in 3.4 and 3.5.1.2, specimens taken from the heat treated coupon shall conform to the requirements of 3.5.1.2.1. If specimens taken from the stock after heat treatment as in 3.4 and 3.5.1.2 conform to the requirements of 3.5.1.2.1, the test shall be accepted as equivalent to tests of a forged coupon.

3.5.3 Extrusions and Stock for Flash Welded Rings

Shall be as agreed upon by purchaser and vendor.

3.6 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.

3.6.1 Grain flow of die forgings, except in areas which contain flash-line end grain, shall follow the general contour of the forging showing no evidence of reentrant grain flow.

3.7 Tolerances

Shall conform to all applicable requirements of AMS2261 for bars and wire.

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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 performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

The following requirements are 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 (3.5.1.1.1), wire tensile properties (3.5.1.1.2), and average grain size (3.5.1.1.3) of each lot solution heat treated.

4.2.1.3 Tensile properties (3.5.1.2.1), and hardness (3.5.1.2.2) of each lot after precipitation heat treatment.

4.2.1.4 Tolerances (3.7) of each lot.

4.2.2 Periodic Tests

Tests of forging stock (3.5.2) to demonstrate ability to develop required properties and grain flow of die forgings (3.6.1) are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing

4.3.1 Bars, Wire, Flash Welded Rings, Extrusions, and Stock for Forgings and Flash Welded Rings

In accordance with AMS2371.

4.3.2 Forgings

In accordance with AMS2374.

4.4 Reports

4.4.1 Bars, Wire, Flash Welded Rings and Forgings

The vendor of the product shall furnish with each shipment a report showing the results of tests for composition of each heat (3.1), and for hardness (3.5.1.1.1), wire tensile properties (3.5.1.1.2), and average grain size (3.5.1.1.3) as solution heat treated, and for tensile properties (3.5.1.2.1) and hardness (3.5.1.2.2), if applicable regarding product size, after precipitation heat treatment of each lot, and stating that the product conforms to the other technical requirements. This report shall include the purchase order number, heat and lot numbers, AMS5854B, product form, size, and quantity. If forgings are supplied, the size and source of stock used to make the forgings shall also be included.

4.4.2 Extrusions and Stock for Forgings and Flash Welded Rings

The vendor of extrusions and stock for forgings and flash welded rings shall furnish with each shipment a report showing the results of tests for composition of each heat (3.1), and for tensile properties and hardness of forging stock after forging and heat treatment of of coupon (3.5.2), if applicable, This report shall include the purchase order number, heat and lot numbers, AMS5854B, product form, size, and quantity.

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