



AEROSPACE MATERIAL SPECIFICATION	AMS5667	REV. N
	Issued 1947-12 Revised 2015-01	
	Superseding AMS5667M	
Nickel Alloy, Corrosion and Heat-Resistant, Bars, Forgings, and Rings 72Ni - 15.5Cr - 0.95Cb - 2.5Ti - 0.70Al - 7.0Fe Equalized, Precipitation Hardenable (Composition similar to UNS N07750)		

RATIONALE

AMS5667N revises Condition (3.2.1.2), Properties (3.4.1.2.1.1), and Reports (4.4), and is 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, forgings, flash welded rings, and stock for forging, flash welded rings, or heading.

1.1.1 This specification covers products up to 10 inches (254 mm) in nominal thickness or least distance between parallel sides and forging stock of any size (See 8.5).

1.2 Application

These products have been used typically for parts, such as bolts and turbine rotors, requiring high strength in the range of 800 to 1100 °F (427 to 593 °C), 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.

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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
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 E8/E8M	Tension Testing of Metallic Materials
ASTM E10	Brinell Hardness of Metallic Materials
ASTM E354	Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys

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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 E354, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

Table 1 - Composition

Element	min	max
Carbon	--	0.08
Manganese	--	1.00
Silicon	--	0.50
Sulfur	--	0.01
Chromium	14.00	17.00
Nickel	70.00	--
Columbium (Niobium)	0.70	1.20
Titanium	2.25	2.75
Aluminum	0.40	1.00
Iron	5.00	9.00
Cobalt	--	1.00
Tantalum	--	0.05
Copper	--	0.50

3.1.1 Check Analysis

Composition variations shall meet the applicable requirements of AMS2269.

3.2 Condition

The product shall be supplied in the following condition:

3.2.1 Bars

Hot finished or cold finished, and equalized.

3.2.1.1 Round bars shall be ground or turned except that bars under 0.50 inch (12.7 mm) in nominal diameter may be cold drawn.

3.2.1.2 Bars shall not be cut from plate (Also see 4.4.2).

3.2.2 Forgings and Flash Welded Rings

Equalized.

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 AMS7490.

3.2.3 Stock for Forging, Flash Welded Rings, or Heading

As ordered by the forging, flash welded ring, or heading manufacturer.

3.3 Heat Treatment

Bars, forgings, and flash welded rings shall be equalized by heating to 1625 °F ± 25 (885 °C ± 14), holding at heat for 24 hours ± 0.5, and cooling at a rate equivalent to air cooling. Pyrometry shall be in accordance with AMS2750.

3.4 Properties

The product shall conform to the following requirements:

3.4.1 Bars, Forgings, and Flash Welded Rings

3.4.1.1 Hardness After Equalization Heat Treatment

Shall be not higher than 302 HB, or equivalent (See 8.2), determined in accordance with ASTM E10.

3.4.1.2 After Precipitation Heat Treatment

The product shall have the following properties after being precipitation heat treated by heating to 1300 °F ± 25 (704 °C ± 14), holding at heat for 20 hours ± 1, and cooling in air to room temperature.

3.4.1.2.1 Tensile Properties

Shall be as shown in Table 2, determined in accordance with ASTM E8/E8M. Requirements apply in both the longitudinal and transverse directions 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 obtained. Tests in the longitudinal direction are not required on product tested in the transverse direction.

3.4.1.2.1.1 Tensile property requirements for product outside of the range covered by Table 2 shall be agreed upon between purchaser and producer.

Table 2A - Minimum tensile properties, inch/pound units

Nominal Diameter or Least Distance Between Parallel Sides Inches	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 4D %	Reduction of Area %
Up to 4.0, excl	165	105	20	25
4.0 to 10.0, incl	160	100	15	17

Table 2B - Minimum tensile properties, SI units

Nominal Diameter or Least Distance Between Parallel Sides Millimeters	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 4D %	Reduction of Area %
Up to 102, excl	1 138	724	20	25
102 to 254, incl	1 103	689	15	17

3.4.1.2.1.2 When tensile specimens are machined from the center area of disc and hub forgings and this area lies within a 4-inch (102-mm) radius or 25% of the forging radius, whichever is the smaller dimension, elongation may be as low as 10% and reduction of area as low as 12%.

3.4.1.2.2 Hardness

Shall be 302 to 363 HB, or equivalent (See 8.2), determined in accordance with ASTM E10. Product shall not be rejected on the basis of hardness if the tensile properties of 3.4.1.2.1 are acceptable, determined on specimens taken from the same sample as that with nonconforming hardness or from another sample with similar nonconforming hardness.

3.4.2 Forging Stock

When a sample of stock is forged to a test coupon and 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 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 and 3.4.1.2.2, the tests shall be accepted as equivalent to tests of a forged coupon.

3.4.3 Stock for Flash Welded Rings or Heading

Specimens taken from the stock after heat treatment as in 3.3 and 3.4.1.2 shall conform to the requirements of 3.4.1.2.1 and 3.4.1.2.2.

3.5 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.

3.5.1 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 reentrant grain flow.

3.6 Tolerances

Bars shall conform to all applicable requirements of AMS2261.

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 the 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 (3.4.1.1) of each lot of bars, forgings, and flash welded rings as equalized.

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 of bars (3.6).

4.2.2 Periodic Tests

Tests of forging stock (3.4.2) and stock for flash welded rings and heading (3.4.3) to demonstrate ability to develop required properties and grain flow of die forgings (3.5.1) 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

Shall be as follows:

4.3.1 Bars, Flash Welded Rings, and Stock for Forging, Flash Welded Rings, or Heading

In accordance with AMS2371.

4.3.2 Forgings

In accordance with AMS2374.

4.4 Reports

The vendor of the product shall furnish with each shipment a report showing the vendor's name and the country where the metal was melted (e.g., final melt in the case of metal processed by multiple melting operations) and the following results of tests and relevant information:

4.4.1 When the product size is outside the range covered by 1.1.1, the report shall contain a statement to that effect.

4.4.2 If the ship size/shape is cut from a larger cross section, report the nominal metallurgically worked size (Also see 3.2.1.2).

4.4.3 For Each Heat

Composition.

4.4.4 For Each Lot of Bars, Forgings, and Flash Welded Rings

As equalization heat-treated:

Hardness

As precipitation heat treated:

Tensile properties

Hardness.

4.4.5 A statement that the product conforms to the other technical requirements.

4.4.6 Purchase order number

Heat and lot numbers

AMS5667N

Size

Quantity.

4.4.7 If forgings are supplied, the size and melt source of stock used to make the forgings.

4.4.8 The vendor of forging stock shall furnish with each shipment a report showing the vendor's name and country where the metal was melted (e.g., final melt in the case of metal processed by multiple melting) and the results of tests for composition of each heat. This report shall include the purchase order number, heat and lot numbers, AMS5667N, size, and quantity.

4.5 Resampling and Retesting

Shall be as follows:

4.5.1 Bars, Flash Welded Rings, and Stock for Forging, Flash Welded Rings, or Heading

In accordance with AMS2371.

4.5.2 Forgings

In accordance with AMS2374.