AEROSPACE MATERIAL SPECIFICATION

AMS5667™	REV. P

Issued 1947-12
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Superseding AMS5667N

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

AMS5667P prohibits unauthorized exceptions (3.7), revises Reports (4.4) and Identification (5.2.1.1), 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, 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.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (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

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/AMS5667P/

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

ARP1917 Clarification of Terms Used in Aerospace Metals Specifications

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 E140 Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness

ASTM E354 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 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 °F (885 °C ± 14 °C), holding at heat for 24 hours ± 0.5 hours, 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 Response to Precipitation Heat Treatment

A sample from the product shall have the following properties after being precipitation heat treated by heating to 1300 °F ± 25 °F (704 °C ± 14 °C), holding at heat for 20 hours ± 1 hour, 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	1138	724	20	25
102 to 254, incl	1103	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.

3.7 Exceptions

Any exception shall be authorized by purchaser and reported as in 4.4.8.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of the product shall supply all samples for producer'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 producer 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 producer of the product shall furnish with each shipment a report showing the producer’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