

AEROSPACE MATERIAL SPECIFICATION



AMS 5667L

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Superseding AMS 5667K

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)

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.

1.2 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, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or www.sae.org.

AMS 2261	Tolerances, Nickel, Nickel Alloy, and Cobalt Alloy Bars, Rods, and Wire
AMS 2269	Chemical Check Analysis Limits, Nickel, Nickel Alloys, and Cobalt Alloys
AMS 2371	Quality Assurance Sampling and Testing, Corrosion and Heat-Resistant Steels and Alloys, Wrought Products and Forging Stock
AMS 2374	Quality Assurance Sampling and Testing, Corrosion and Heat-Resistant Steel and Alloy Forgings

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2.1 (Continued):

- AMS 2806 Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Corrosion and Heat-Resistant Steels and Alloys
- AMS 2808 Identification, Forgings
- AMS 7490 Rings, Flash Welded, Corrosion and Heat-Resistant Austenitic Steels and Austenitic-Type Alloys, or Precipitation Hardenable Alloys

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or www.astm.org.

- ASTM E 8 Tension Testing of Metallic Materials
- ASTM E 8M Tension Testing of Metallic Materials (Metric)
- ASTM E 10 Brinell Hardness of Metallic Materials
- 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	--	0.08
Manganese	--	1.00
Silicon	--	0.50
Sulfur	--	0.01
Chromium	14.00	17.00
Nickel + Cobalt	70.00	--
Columbium	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 AMS 2269.

3.2 Condition:

The product shall be supplied in the following condition:

3.2.1 Bars: Hot 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.

3.2.2 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 AMS 7490.

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.

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 E 10.

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 E 8 or ASTM E 8M. 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.

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

- 3.4.1.2.1.1 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 E 10. 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 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 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 equalization 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 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 AMS 2371.

4.3.2 Forgings: In accordance with AMS 2374.

4.4 Reports:

The vendor of the product shall furnish with each shipment a report showing the following results of tests and relevant information:

4.4.1 For each heat:

Composition.

4.4.2 For each lot of bars, forgings, and flash welded rings:

As equalization heat-treated:

Hardness

As precipitation heat treated:

Tensile properties

Hardness.

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

4.4.4 Purchase order number

Heat and lot numbers

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Size

Quantity.

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

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 AMS 2371.

4.5.2 Forgings: In accordance with AMS 2374.

5. PREPARATION FOR DELIVERY:

5.1 Sizes:

Except when exact lengths or multiples of exact lengths are ordered, straight bars will be acceptable in mill lengths of 6 to 24 feet (1.8 to 7.3 m) but not more than 25% of any shipment shall be supplied in lengths of 6 to 9 feet (1.8 to 2.7 m) except that for bars weighing over 25 pounds per foot (37 kg/m), short lengths down to 2 feet (610 mm) may be supplied.