



AEROSPACE MATERIAL SPECIFICATION

AMS5666™

REV. K

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Superseding AMS5666J

Nickel Alloy, Corrosion- and Heat-Resistant,
Bars, Forgings, Extrusions, Rings, and Stock for Forgings, Extrusions, and Rings
62Ni - 21.5Cr - 9.0Mo - 3.65Cb (Nb)
Annealed
(Composition similar to UNS N06625)

RATIONALE

AMS5666K is the result of a Five-Year Review and update of the specification. The revision updates the title to match the scope, updates terminology on size (1.1, 3.3.1), revises composition reporting (3.1.1), adds condition (3.2.1), revises testing (3.3.1.1), prohibits unauthorized exceptions (3.3.1.4, 3.7, 4.4.3, 5.2.1.1, 8.6), controls strain rate during testing (3.3.1.1.1), updates definitions (8.3), adds extrusions (8.7), and allows prior revisions (8.5).

1. SCOPE

1.1 Form

This specification covers a corrosion- and heat-resistant nickel alloy in the form of bars, forgings, extrusions, flash welded rings up to 10 inches (254 mm) in diameter, thickness, or for hexagons, least distance between parallel sides, and stock of any size for forgings, extrusions, and rings.

1.2 Application

These products have been used typically for parts requiring both corrosion and oxidation resistance up to 2000 °F (1093 °C) and where such parts may require welding during fabrication, 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

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For more information on this standard, visit
<https://www.sae.org/standards/content/AMS5666K/>

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
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
AS6279	Standard Practice for Production, Distribution, and Procurement of Metal Stock
AS7766	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 E112 Determining Average Grain Size

ASTM E140 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 in accordance with ASTM E354, or by other analytical methods acceptable to purchaser.

Table 1 - Composition

Element	Min	Max
Carbon	--	0.10
Manganese	--	0.50
Silicon	--	0.50
Phosphorus	--	0.015
Sulfur	--	0.015
Chromium	20.00	23.00
Molybdenum	8.00	10.00
Columbium (Niobium)	3.15	4.15
Cobalt	--	1.00
Titanium	--	0.40
Aluminum	--	0.40
Iron		5.00
Nickel	remainder	

3.1.1 Producer may test for any element not listed in Table 1 and include this analysis in the report of 4.4. Reporting of any element not listed in the composition table is not a basis for rejection, unless limits of acceptability are specified by the purchaser.

3.1.2 Check Analysis

Composition variations shall meet the applicable requirements of AMS2269.

3.2 Condition

3.2.1 Bars

The product shall be supplied in the following condition:

3.2.1.1 Hot or cold finished and annealed; round bars shall be ground or turned.

3.2.1.2 Bars shall not be cut from plate (also see 4.4.1.1).

3.2.2 Forgings, Extrusions, and Flash Welded Rings

Annealed.

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, Extruding, or Flash Welded Rings

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

3.3 Properties

The product shall conform to the following requirements:

3.3.1 Bars, Forgings, and Flash Welded Rings

3.3.1.1 Tensile Properties

Shall be as shown in Table 2, determined in accordance with ASTM E8/E8M on specimens taken in the longitudinal direction from product 10 inches (254 mm) and under in diameter, thickness, or for hexagons, least distance between parallel sides.

Table 2 - Minimum tensile properties

Property	Size	
	Up to 4.00 inches (101.6 mm), incl	Over 4.00 inches (101.6 mm) to 10 inches (254 mm), incl
Tensile Strength	120 ksi (827 MPa)	110 ksi (758 MPa)
Yield Strength at 0.2% Offset	60 ksi (414 MPa)	50 ksi (345 MPa)
Elongation in 4D	30%	25%

3.3.1.1.1 Unless otherwise specified, the strain rate shall be set at 0.005 in/in/min (0.005 mm/mm/min) and maintained within a tolerance of ± 0.002 in/in/min (0.002 mm/mm/min) through 0.2% offset yield strain. After the yield strain, the speed of the testing machine shall be set between 0.05 in/in and 0.5 in/in (0.05 mm/mm and 0.5 mm/mm) of the length of the reduced section (or distance between the grips for specimens not having a reduced section) per minute. Alternatively, an extensometer and strain rate indicator may be used to set the strain rate between 0.05 in/in/min and 0.5 in/in/min (0.05 mm/mm/min and 0.5 mm/mm/min). The requirement for compliance becomes effective for material produced 1 year after the publication date of this specification.

3.3.1.2 Hardness

Shall be not higher than 287 HB, or equivalent (see 8.2), determined in accordance with ASTM E10.

3.3.1.3 Average Grain Size

Shall be ASTM No. 5 or finer, determined in accordance with ASTM E112, for product with a diameter, thickness, or for hexagons least distance between parallel sides under 7 inches (177.8 mm). Product 7 to 10 inches (177.8 to 254 mm) in diameter, thickness, or for hexagons, least distance between parallel sides shall have a grain size of ASTM No. 4 or finer.

3.3.1.4 Property requirements for product outside of the range covered by 3.3.1.1 and 3.3.1.3 shall be agreed upon between purchaser and producer and reported per 4.4.3.

3.3.2 Extrusions and Stock for Forging, Extruding, and Flash Welded Rings

Shall have properties as agreed upon by purchaser and vendor.

3.4 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.

3.4.1 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.

3.5 Tolerances

Bars shall conform to all applicable requirements of AMS2261.

3.6 Production, distribution, and procurement of metal stock shall comply with AS6279.

3.7 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.3.

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

Composition (3.1), tensile properties (3.3.1.1), hardness (3.3.1.2), average grain size (3.3.1.3), and tolerances (3.5) are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.2 Periodic Tests

Grain flow of die forgings (3.4.1) is a periodic test and shall be performed at a frequency selected by the vendor unless frequency of test is specified by purchaser.

4.3 Sampling and Testing

Shall be as follows:

4.3.1 Bars, Flash Welded Rings, Extrusions, and Stock for Forging, Extruding, or Flash Welded Rings

In accordance with AMS2371, and the following:

4.3.1.1 Average grain size (3.3.1.3) shall be determined at a location midway between the surface and the center of the product.

4.3.2 Forgings

In accordance with AMS2374.

4.4 Reports

4.4.1 The vendor of product 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 operations) and the results of the composition of each heat and the condition, hardness, tensile properties, and average grain size of each lot, and stating that the product conforms to the other technical requirements. The report shall include the purchase order number, heat and lot numbers, AMS5666K, size, and quantity. If forgings are supplied, the size and melt source of stock used to make the forgings shall also be included.

4.4.1.1 Report the nominal metallurgically worked size and cut size, if different (see 3.2.1.2).

4.4.2 The vendor of forging stock shall furnish with each shipment 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 operations) and showing the results of tests for composition of each heat and the results of any additional property requirements imposed by the purchase order (see 8.7). The report shall include the purchase order number, heat number, AMS5666K, size, and quantity.

4.4.3 When material produced to this specification is beyond the sizes allowed in the scope or tables, or other exceptions are taken to the technical requirements listed in Section 3, the report shall contain a statement "This material is certified as AMS5666K(EXC) because of the following exceptions:" and the specific exceptions shall be listed (also see 5.2.1.1).

4.5 Resampling and Retesting

Shall be as follows:

4.5.1 Bars, Flash Welded Rings, Extrusions, and Stock for Forging, Extruding, or Flash Welded Rings

In accordance with AMS2371.

4.5.2 Forgings

In accordance with AMS2374.

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 lb/ft (37 kg/m), short lengths down to 2 feet (610 mm) may be supplied.