AEROSPACE MATERIAL SPECIFICATION

AMS5671	REV. G

Issued 1965-09
Revised 2003-01
Reaffirmed 2013-12

Superseding AMS5671F

Nickel Alloy, Corrosion and Heat-Resistant, Bars, Forgings, and Rings
72Ni - 15.5Cr - 0.95Cb - 2.5Ti - 0.70Al - 7.0Fe
Consumable Electrode or Vacuum Induction Melted
1800 °F (982 °C) Solution Heat Treated, Precipitation Hardenable
(Composition similar to UNS N07750)

RATIONALE

AMS5671G has been reaffirmed to comply with the SAE five-year review policy.

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 or flash welded rings.

1.2 Application:

These products have been used typically for parts requiring high strength at temperatures in the range 800 to 1100 °F (427 to 593 °C), particularly those parts which are formed or welded, 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

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**

SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/AMS5671G

2.1 (Continued):

AMS 2374	Quality Assurance Sampling and Testing, Corrosion and Heat-Resistant Steel and Alloy Forgings
AMS 2750	Pyrometry
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	--	0.35
Silicon	--	0.35
Phosphorus	--	0.015
Sulfur	--	0.010
Chromium	14.00	17.00
Nickel	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 Melting Practice:

Alloy shall be multiple melted using consumable electrode practice in the remelt cycle or shall be induction melted under vacuum. If consumable electrode remelting is not performed in vacuum, electrodes which have been produced by vacuum induction melting shall be used for remelting.

3.3 Condition:

The product shall be supplied in the following condition:

3.3.1 Bars, Forgings, and Flash Welded Rings: Solution heat treated.

3.3.1.1 Bars shall be hot finished unless otherwise ordered; round bars shall be ground or turned.

3.3.1.2 Forgings: Shall be descaled.

3.3.1.3 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. During manufacture of flash welded rings, the stock shall not be heated to a temperature higher than 1825 °F (996 °C).

3.3.2 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 1800 °F ± 25 (982 °C ± 14), holding at heat for a time commensurate with cross-sectional thickness, and cooling at a rate equivalent to an air cool or faster. Pyrometry shall be in accordance with AMS 2750.

3.5 Properties:

The product shall conform to the following requirements:

3.5.1 Bars, Forgings, and Flash Welded Rings:

3.5.1.1 As Solution Heat Treated:

3.5.1.1.1 Hardness: Shall be as follows; determined in accordance with ASTM E 10:

3.5.1.1.1.1 Bars: Not higher than 320 HB, or equivalent (See 8.2), determined approximately midway between outer surface and center.

3.5.1.1.1.2 Forgings and Flash Welded Rings: Not higher than 320 HB, or equivalent (See 8.2).

3.5.1.2 Response to Heat Treatment: The product shall have the following properties after being precipitation heat treated by heating to 1350 °F ± 15 (732 °C ± 8), holding at heat for 8 hours ± 0.25, cooling at a rate of 100 F ± 15 (56 C ± 8) degrees per hour to 1150 °F ± 15 (621 °C ± 8), holding at 1150 °F ± 15 (621 °C ± 8) for 8 hours ± 0.25, and air cooling. Instead of the 100 F (56 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 18 hours.

3.5.1.2.1 Room Temperature Tensile Properties: Shall be as follows, determined in accordance with ASTM E 8 or ASTM E 8M.

3.5.1.2.1.1 Shall be as shown in Table 2 for bars under 2.50 inches (63.5 mm) in nominal diameter or thickness, for forgings under 2.50 inches (63.5 mm) in nominal thickness, and for flash welded rings under 2.50 inches (63.5 mm) in nominal radial thickness.

TABLE 2A - Minimum Tensile Properties, Inch/Pound Units

Specimen Orientation	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 4D %	Reduction of Area %
Longitudinal	170	115	18	18
Transverse	165	110	15	15

TABLE 2B - Minimum Tensile Properties, SI Units

Specimen Orientation	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 4D %	Reduction of Area %
Longitudinal	1172	793	18	18
Transverse	1138	758	15	15

3.5.1.2.1.2 Shall be as shown in Table 3 for bars 2.50 to 4.00 inches (63.5 to 101.6 mm), exclusive, in nominal diameter or thickness, for forgings 2.50 to 4.00 inches (63.5 to 101.6 mm), exclusive, in nominal thickness, and for flash welded rings 2.50 to 4.00 inches (63.5 to 101.6 mm) exclusive, in nominal radial thickness.

TABLE 3A - Minimum Tensile Properties, Inch/Pound Units

Specimen Orientation	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 4D %	Reduction of Area %
Longitudinal	170	115	15	15
Transverse	160	105	12	12

TABLE 3B - Minimum Tensile Properties, SI Units

Specimen Orientation	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 4D %	Reduction of Area %
Longitudinal	1172	793	15	15
Transverse	1103	724	12	12

3.5.1.2.1.3 Longitudinal tensile property requirements of 3.5.1.2.1.1 and 3.5.1.2.1.2 apply to specimens taken with the axis approximately parallel to the grain flow, to specimens taken in the radial direction and in the tangential direction at the rim of disc forgings, and to specimens taken in the circumferential direction from flash welded rings. All other specimens shall be considered to be in the transverse direction.

3.5.1.2.1.4 Transverse tensile property requirements of 3.5.1.2.1.1 and 3.5.1.2.1.2 apply only to product from which tensile specimens not less than 2.50 inches (63.5 mm) long can be obtained.

3.5.1.2.1.5 Tensile tests in the longitudinal direction are not required from product tested in the transverse direction.

3.5.1.2.2 Hardness: Shall be 302 to 401 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 3.5.1.2.1 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 and 3.5.1.2.2. If specimens taken from stock after heat treatment as in 3.4 and 3.5.1.2 conform to the requirements of 3.5.1.2.1 and 3.5.1.2.2, the tests shall be acceptable as equivalent to tests of a forged coupon.

3.5.3 Stock for Flash Welded Rings: Specimens taken from the stock after heat treatment as in 3.4 and 3.5.1.2 shall conform to the requirements of 3.5.1.2.1 and 3.5.1.2.2.

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 forgings showing no evidence of reentrant grain flow.

3.7 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 (3.5.1.1.1) of each lot of bars, forgings, and flash welded rings as solution heat treated.

4.2.1.3 Tensile properties (3.5.1.2.1) and hardness (3.5.1.2.2) of each lot of bars, forgings, and flash welded rings after precipitation heat treatment.

4.2.1.4 Tolerances (3.7) of bars.

4.2.2 Periodic Tests: Tests of forging stock (3.5.2) and of stock for flash welded rings (3.5.3) 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:

Shall be as follows:

4.3.1 Bars, Flash Welded Rings, and Stock for Forging or Flash Welded Rings: In accordance with AMS 2371.

4.3.2 Forgings: In accordance with AMS 2374.

4.3.3 Specific location of tensile specimens from forgings and flash welded rings shall be as agreed upon by purchaser and vendor.

4.4 Reports:

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