SAE Aerospace
An SAE International Group

AEROSPACE MATERIAL SPECIFICATION

SAE AMS5670 | REV. F

Issued 1969-05
Revised 2005-08
Reaffirmed 2012-02

Superseding AMS5670E

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

RATIONALE

AMS5670F 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, flash welded rings, or heading.

1.2 Application:

These products have been used typically for parts requiring high strength in the range 800 to 1100 °F (427 to 593 °C), particularly those parts which are formed or welded and then precipitation heat treated to develop required properties, 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

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

2.1 (Continued):

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, P.O. Box C700, 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
Phosphorus	--	0.015
Sulfur	--	0.010
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
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, Forgings, and Flash Welded Rings: Solution heat treated.

3.2.1.1 Bars shall be hot finished; round bars shall be ground or turned except that bars under 0.50 inch (12.7 mm) in nominal diameter, when so ordered, shall be cold drawn.

3.2.1.2 Forgings shall be descaled.

3.2.1.3 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).

3.2.2 Stock for Forging, Flash Welded Rings, or Heading: As ordered by the forging, flash welded ring, or heading manufacturer.

3.3 Solution 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.

3.4 Properties:

The product shall conform to the following requirements:

3.4.1 Bars, Forgings, and Flash Welded Rings:

3.4.1.1 As Solution Heat Treated:

3.4.1.1.1 Hardness: Shall be not higher than 320 HB, or equivalent (See 8.2), determined in accordance with ASTM E 10.

3.4.1.2 After Precipitation Heat Treatment: Specimens from 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 that temperature for 8 hours ± 0.25, and cooling in air. 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.

3.4.1.2.1 Longitudinal Tensile Properties: Bars under 4.00 inches (101.6 mm) in nominal diameter or distance between parallel sides, forgings under 4.00 inches (101.6 mm) in nominal thickness, and flash welded rings under 4.00 inches (101.6 mm) in nominal radial thickness shall meet the properties shown in Table 2, determined in accordance with ASTM E 8 or ASTM E 8M.

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

Nominal Diameter, Thickness, 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 2.50, excl	170	115	18	18
2.50 to 4.00, excl	170	115	15	15

TABLE 2B - Minimum Tensile Properties, SI Units

Nominal Diameter, Thickness, 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 63.5, excl	1172	793	18	18
63.5 to 101.6, excl	1172	793	15	15

3.4.1.2.2 Hardness: Shall be 302 to 401 HB, or equivalent (See 8.2), determined in accordance with ASTM E 10.

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 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: A sample of stock heat treated 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 material 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 (3.4.1.1.1) of each lot of bars, forgings, and flash welded rings as solution 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 (3.6) of bars.

4.2.2 Periodic Tests: Tests of forging stock (3.4.2) and of stock for flash welded rings or 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:

Hardness as solution heat treated
Tensile properties and hardness after precipitation heat treatment.

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

4.4.4 Purchase order number
Heat and lot numbers
AMS 5670F
Size
Quantity.

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

4.4.6 The vendor of stock for forging, flash welded rings, or heading shall furnish with each shipment a report showing the results of tests for composition of each heat. This report shall include the purchase order number, heat number, AMS 5670F, 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 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.