AEROSPACE MATERIAL SPECIFICATION

AMS5711	REV. E

Issued 1973-12
Reaffirmed 2007-08
Revised 2015-01

Superseding AMS5711D

Nickel Alloy, Corrosion and Heat-Resistant, Bars, Forgings, and Rings
65Ni - 15.8Cr - 15.2Mo - 0.30Al - 0.05La
Solution Heat Treated
(Composition similar to UNS N06635)

RATIONALE

AMS5711E revises Condition, (3.3), Stress Rupture Testing (3.5.1.3.1), and Reports (4.4), and is 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.

1.2 Application

These products have been used typically for parts, such as turbine rotors and seals, flanges, and fasteners, requiring relatively high strength up to 1800 °F (982 °C) and oxidation resistance up to 2000 °F (1093 °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 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**

SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/AMS5711E

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 and Austenitic-Type Alloys, or Precipitation Hardenable Alloys

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 E139 Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials

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	--	0.02
Manganese	0.30	1.00
Silicon	0.20	0.75
Phosphorus	--	0.020
Sulfur	--	0.015
Chromium	14.50	17.00
Molybdenum	14.00	16.50
Aluminum	0.10	0.50
Lanthanum	0.01	0.10
Cobalt	--	2.00
Tungsten	--	1.00
Boron	--	0.015
Iron	--	3.00
Copper	--	0.35
Nickel	remainder	

3.1.1 Check Analysis

Composition variations shall meet the applicable requirements of AMS2269.

3.2 Melting Practice

Alloy shall be multiple melted using consumable electrode practice in the remelt cycle.

3.3 Condition

The product shall be supplied in the following condition:

3.3.1 Bars, Forgings, and Flash Welded Rings

Solution heat treated and descaled.

3.3.1.1 Bars shall be hot finished. Bars, other than hexagons, over 2.75 inches (69.8 mm) in nominal diameter or least distance between parallel sides shall be hot finished or cold finished. Round bars shall be ground or turned.

3.3.1.2 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.

3.3.1.3 Bar shall not be cut from plate (Also see 4.4.5).

3.3.2 Stock for Forging, Flash Welded Rings, or Heading

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

3.4 Solution Heat Treatment

Bars, forgings, and flash welded rings shall be solution heat treated by heating to 1950 °F ± 25 (1066 °C ± 14), holding at heat for a time commensurate with section thickness, and cooling at a rate equivalent to an air cool or faster. Pyrometry shall be in accordance with AMS2750.

3.5 Properties

The product shall conform to the following requirements:

3.5.1 Bars, Forgings, and Flash Welded Rings

3.5.1.1 Tensile Properties

Shall be as shown in Table 2, determined in accordance with ASTM E8/E8M.

Table 2 - MInimum tensile properties

Property	Value
Tensile Strength	105 ksi (724 MPa)
Yield Strength at 0.2% Offset	40.0 ksi (276 MPa)
Elongation in 4D	48%
Reduction of Area	47%

3.5.1.2 Hardness

Shall be not higher than 241 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 3.5.1.1 are acceptable, determined on specimens taken from the same sample as that with nonconforming hardness or from another sample with similar nonconforming hardness.

3.5.1.3 Stress-Rupture Properties at 1500 °F (816 °C)

A tensile specimen, maintained at 1500 °F ± 3 (816 °C ± 2) while a load sufficient to produce an initial axial stress of 15.0 ksi (103 MPa) or higher is applied continuously, shall not rupture in less than 23 hours. The test shall be continued to rupture without change of load. Elongation after rupture, measured at room temperature, shall be not less than 10% in 4D. Test shall be conducted in accordance with ASTM E139.

3.5.1.3.1 The test of 3.5.1.3 may be conducted using incremental loading. In such case, the load required to produce an initial axial stress of 15.0 ksi (103 MPa) or higher shall be used to rupture or for 23 hours, whichever occurs first. After 23 hours and at intervals of 8 hours minimum, thereafter, the stress shall be increased in increments of 2.0 ksi (14 MPa). Time to rupture and elongation requirements shall be as specified in 3.5.1.3.

3.5.1.4 Average Grain Size

Shall be ASTM No. 4 or finer, determined in accordance with ASTM E112.

3.5.2 Stock for Forging, Flash Welded Rings, and Heading

As agreed upon by purchaser and vendor.

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 AMS2261.

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 Tensile properties (3.5.1.1), hardness (3.5.1.2), stress-rupture properties (3.5.1.3), and average grain size (3.5.1.4) of each lot of bars, forgings, and flash welded rings.

4.2.1.3 Tolerances (3.7) of bars.

4.2.2 Periodic Tests

The following requirements are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser:

4.2.2.1 Ability of stock for forging, flash welded rings, and heading to develop required properties.

4.2.2.2 Grain flow of die forgings (3.6.1).

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 vendor of the 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 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

Tensile properties
Hardness
Stress-rupture properties
Average grain size.

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

Purchase order number
Heat and lot numbers
AMS5711E
Size
Quantity

4.4.4 Report the nominal metallurgically worked cross sectional size and the cut size, if different (See 3.3.1.3)

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 forging stock 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 tests for composition and the results of any additional property requirements imposed by 8.5. This report shall include the purchase order number, heat and lot numbers, AMS5711E, product form and size or part number, and quantity.

4.5 Resampling and Retesting

Shall be as follows: