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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 5668H

Issued DEC 1947
Revised APR 1993
Reaffirmed SEP 2000

Superseding AMS 5668G

Nickel Alloy, Corrosion and Heat Resistant, Bars, Forgings, and Rings
72Ni - 15.5Cr - 7.0Fe - 2.5Ti - 1.0(Cb+Ta) - 0.70Al
2100 °F (1149 °C) Solution and Precipitation Heat Treated

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, turbine blades, and turbine seals, requiring oxidation resistance and high strength at 1250 to 1500 °F (677 to 816 °C), but usage is not limited to such applications.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2261	Tolerances, Nickel, Nickel Alloy, and Cobalt Alloy Bars, Rods, and Wire
MAM 2261	Tolerances, Metric, Nickel, Nickel Alloy, and Cobalt Alloy Bars, Rods, and Wire
AMS 2269	Chemical Check Analysis Limits, Wrought 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
AMS 2750	Pyrometry

QUESTIONS REGARDING THIS DOCUMENT: (724) 772-7161 FAX: (724) 776-0243
TO PLACE A DOCUMENT ORDER: (724) 776-4970 FAX: (724) 776-0790
SAE WEB ADDRESS: http://www.sae.org

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, 1916 Race Street, Philadelphia, PA 19103-1187.

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 139	Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials
ASTM E 354	Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys

2.3 U. S. Government Publications:

Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-STD-163	Steel Mill Products, Preparation for Shipment and Storage

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 + Cobalt	70.00	--
Columbium + Tantalum	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 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 and precipitation heat treated.

3.2.1.1 Bars shall be hot finished; round bars shall be ground or turned.

3.2.1.2 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 AMS 7490.

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

3.3 Heat Treatment:

Shall be as follows; pyrometry shall be in accordance with AMS 2750:

3.3.1 Solution Heat Treatment:

3.3.1.1 Bars and Forgings Other Than Seamless Rolled Rings: Shall be solution heat treated by heating to 2100 °F ± 25 (1149 °C ± 14), holding at heat for 2 to 4 hours, and cooling in air.

3.3.1.2 Flash Welded Rings and Seamless Rolled Rings: Shall be solution heat treated by heating to a temperature within the range 2000 to 2100 °F (1093 to 1149 °C), holding at the selected temperature within ±25 °F (±14 °C) for 2 to 4 hours, and cooling in air or faster.

3.3.2 Precipitation Heat Treatment: Bars, forgings, and flash welded rings shall be precipitation heat treated by heating to 1550 °F ± 25 (843 °C ± 14), holding at heat for 24 hours ± 1, cooling to 1300 °F (704 °C) or lower in two hours or less, either in air or in the furnace, and then heating to, or continuing at, 1300 °F ± 25 (704 °C ± 14), holding at heat for 20 hours ± 1, and cooling in air.

3.4 Properties:

Product 10.0 inches (254 mm) and under in nominal diameter or distance between parallel sides shall conform to the following requirements:

3.4.1 Bars, Forgings, and Flash Welded Rings:

3.4.1.1 Tensile Properties: Shall be as specified in Table 2, determined in accordance with ASTM E 8 or ASTM E 8M.

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

Property	Flash Welded Rings and Seamless Rolled Rings	Bars and Forgings Other than Seamless Rolled Rings
Tensile Strength	125 ksi	140 ksi
Yield Strength at 0.2% Offset	80.0 ksi	80.0 ksi
Elongation in 4D	8.0%	8.0%
Reduction of Area	8.0%	8.0%

TABLE 2B - Minimum Tensile Properties, SI Units

Property	Flash Welded Rings and Seamless Rolled Rings	Bars and Forgings Other than Seamless Rolled Rings
Tensile Strength	862 MPa	965 MPa
Yield Strength at 0.2% Offset	552 MPai	552 MPa
Elongation in 4D	8.0%	8.0%
Reduction of Area	8.0%	8.0%

3.4.1.2 Hardness: Shall be 262 to 341 HB, or equivalent, determined in accordance with ASTM E 10 (See 8.2).

3.4.1.3 Stress Rupture Properties at 1350 °F (732 °C): A tensile specimen maintained at 1350 °F ± 5 (732 °C ± 3), while a load sufficient to produce an initial axial stress of 52.5 ksi (362 MPa) 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 5% in 4D. Test shall be conducted in accordance with ASTM E 139.

3.4.1.3.1 The test of 3.4.1.3 may be conducted using a load higher than required to produce an initial axial stress of 52.5 ksi (362 MPa) but load shall not be changed while test is in progress. Time to rupture and elongation requirements shall be as specified in 3.4.1.3.

3.4.1.3.2 The test of 3.4.1.3 may be conducted using incremental loading. In such case the load required to produce an initial axial stress of 52.5 ksi (362 MPa) shall be used to rupture or for 23 hours, whichever occurs first. After the 23 hours and at intervals of 8 to 16 hours, preferably 8 to 10 hours, thereafter, the stress shall be increased in increments of 5000 psi (34.5 MPa). Time to rupture and elongation requirements shall be as specified in 3.4.1.3.

3.4.2 Forging Stock: When a sample of stock is forged to a test coupon and heat treated as in 3.3, specimens taken from the heat treated coupon shall conform to the requirements of 3.4.1.1, 3.4.1.2, and 3.4.1.3. If specimens taken from the stock after heat treatment as in 3.3 conform to the requirements of 3.4.1.1, 3.4.1.2, and 3.4.1.3, 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 shall conform to the requirements of 3.4.1.1, 3.4.1.2, and 3.4.1.3.

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 re-entrant grain flow.

3.6 Tolerances:

Bars shall conform to all applicable requirements of AMS 2261 or MAM 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 performing all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests for 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 (3.4.1.1), hardness (3.4.1.2), and stress-rupture properties (3.4.1.3) of each lot of bars, forgings, and flash welded rings.

4.2.1.3 Tolerances (3.7) of bars.

4.2.2 Periodic Tests: Tests of forging stock (3.4.2) and stock for flash welded rings or heading (3.4.3) to demonstrate ability to develop required properties and tests of 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 in accordance with the following:

4.3.1 Bars, Flash Welded Rings, and Stock for Forging, Flash Welded Rings, or Heading: AMS 2371.

4.3.2 Forgings: AMS 2374.

4.4 Reports:

4.4.1 The vendor of bars, forgings, and flash welded rings shall furnish with each shipment a report showing the results of tests for chemical composition of each heat and the results of tests on each lot to determine conformance to the other acceptance test requirements. This report shall include the purchase order number, heat and lot number, AMS 5668H, size, and quantity. If forgings are supplied, the part number and the size and melt source of stock used to make the forgings shall also be included.

4.4.2 The vendor of stock for forging, flash welded rings, or heading shall furnish with each shipment a report showing the results of tests for chemical composition of each heat. This report shall include the purchase order number, heat number, AMS 5668H, size, and quantity.

4.5 Resampling and Retesting:

Shall be in accordance with the following:

4.5.1 Bars, Flash Welded Rings, and Stock for Forging, Flash Welded Rings, or Heading: AMS 2371.

4.5.2 Forgings: AMS 2374.