AEROSPACE MATERIAL SPECIFICATION

AMS5663™	REV. N

Issued 1965-09
Reaffirmed 2009-06
Revised 2016-06

Superseding AMS5663M

Nickel Alloy, Corrosion and Heat-Resistant, Bars, Forgings, and Rings
52.5Ni - 19Cr - 3.0Mo - 5.1Cb (Nb) - 0.90Ti - 0.50Al - 18Fe
Consumable Electrode or Vacuum Induction Melted
1775 °F (968 °C) Solution and Precipitation Heat Treated
(Composition similar to UNS N07718)

RATIONALE

AMS5663N revises Composition (Table 1), Condition (3.3), Properties (3.5, Tables 2 and 3), added properties for product up to 10 inches (254 mm) in diameter or least distance between parallel sides, adds conformance to AS6279 (3.8), revises 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 up to 10 inches (254 mm) in least cross-sectional dimension, having a maximum cross-sectional area of 78 in^2 (503 cm^2), and stock of any size for forging or flash welded rings (see 8.5).

1.2 Application

These products have been used typically for parts requiring high resistance to creep and stress-rupture up to 1300 °F (704 °C) and oxidation resistance up to 1800 °F (982 °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 +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

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)

SAE WEB ADDRESS:

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

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, Austenitic-Type Iron, Nickel, or Cobalt Alloys, or Precipitation-Hardenable Alloys

ARP1313 Determination of Trace Elements in High Temperature Alloys

ARP1917 Clarification of Terms Used in Aerospace Metals Specifications

AS6279 Standard Practice for Production, Distribution, and Procurement of Metal Stock

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 E21 Elevated Temperature Tension Tests of Metallic Materials

ASTM E103 Rapid Indentation Hardness Testing of Metallic Materials

ASTM E112 Determining Average Grain Size

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

ASTM E140 Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness

ASTM E292 Conducting Time-for-Rupture Notch Tension Tests of 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, by the methods of ARP1313 for lead, bismuth, and selenium, 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	--	0.015
Chromium	17.00	21.00
Nickel	50.00	55.00
Molybdenum	2.80	3.30
Columbium (Niobium)	4.75	5.50
Titanium	0.65	1.15
Aluminum	0.20	0.80
Cobalt	--	1.00
Boron	--	0.006
Copper	--	0.30
Lead	--	0.0005 (5 ppm)
Bismuth	--	0.00003 (0.3 ppm)
Selenium	--	0.0003 (3 ppm)
Iron	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 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

Hot or cold finished, solution and precipitation heat treated, and descaled except as specified in 3.3.1.1 and 3.3.1.2.

3.3.1.1 Hot finished round bars shall be ground or turned; all other hot finished bars shall be as hot finished.

3.3.1.2 Cold finished round bars shall be ground or as cold finished; all other cold finished bars shall be as cold finished.

3.3.1.3 Bars shall not be cut from plate (also see 4.4.1.6).

3.3.2 Forgings and Flash Welded Rings

Solution and precipitation heat treated and descaled.

3.3.2.1 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.

3.3.3 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 and precipitation heat treated in accordance with 3.4.1 and 3.4.2; pyrometry shall be in accordance with AMS2750.

3.4.1 Solution Heat Treatment

Heat to a temperature within the range 1725 to 1850 °F (941 to 1010 °C), hold at the selected temperature within ±25 °F (±14 °C) for a time commensurate with cross-sectional thickness, and cool at a rate equivalent to an air cool or faster.

3.4.1.1 If forgings are not to be machined all over, heat treatment shall be performed in a suitable protective atmosphere or, when permitted by purchaser, a suitable protective coating may be applied to the forgings in lieu of using a protective atmosphere.

3.4.2 Precipitation Heat Treatment

Heat to a temperature within the range 1325 to 1400 °F (718 to 760 °C), hold at the selected temperature within ±15 °F (±8 °C) for approximately 8 hours, cool at 100 °F ± 15 °F (56 °C ± 8 °C) degrees per hour to a temperature within the range 1150 to 1200 °F (621 to 649 °C), hold at the selected temperature within ±15 °F (±8 °C) for approximately 8 hours, and air cool. Instead of the 100 °F (56 °C) degrees per hour cooling rate to 1150 to 1200 °F (621 to 649 °C), the product may be furnace cooled at any rate provided the time at 1150 to 1200 °F (621 to 649 °C) is adjusted to give a total precipitation heat treatment time of approximately 18 hours.

3.5 Properties

The product shall conform to the following requirements:

3.5.1 Bars, Forgings, and Flash Welded Rings

3.5.1.1 Average Grain Size

Shall be as follows, determined in accordance with ASTM E112. In case of disagreement, the intercept (Heyn) procedure shall be used.

3.5.1.1.1 Bars and flash welded rings under 9 in^2 (58 cm^2) in cross-sectional area shall exhibit an average grain size of ASTM No. 5 or finer. Due to the presence of nonrecrystallized grains, up to 20% of the cross section of the product may have an average grain size of ASTM No. 3 to 5, determined by the intercept method of ASTM E112.

3.5.1.1.2 Bars and flash welded rings 9 to 78 in^2 (58 to 503 cm^2), inclusive, in cross-sectional area and all forgings shall exhibit an average grain size of ASTM No. 4 or finer. Due to the presence of nonrecrystallized grains, up to 20% of the cross section of the product may have an average grain size of ASTM No. 2 to 4, determined by the intercept method of ASTM E112.

3.5.1.2 Microstructure

Product shall be free of Laves phase. Banding of acicular phase and amount of acicular phase shall conform to standards acceptable to purchaser.