AEROSPACE MATERIAL SPECIFICATION

AMS5891	REV. B

Issued 1992-04
Revised 2007-11
Reaffirmed 2013-12

Superseding AMS5891A

Nickel Alloy, Corrosion and Heat-Resistant, Bars, Forgings, and Rings
60Ni - 22Cr - 2.0Mo - 14W - 0.35Al - 0.03La
Annealed
(Composition similar to UNS N06230)

RATIONALE

AMS5891B 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, such as turbine rotors, shafts, flanges, blades, and bolts, requiring oxidation resistance up to 2100 °F (1149 °C) and relatively high strength 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 724-776-4970 (outside USA), 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
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

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**

2.2 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 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 112	Determining Average Grain Size
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

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	0.05	0.15
Manganese	0.30	1.00
Silicon	0.25	0.75
Phosphorus	--	0.03
Sulfur	--	0.015
Chromium	20.00	24.00
Molybdenum	1.00	3.00
Tungsten	13.00	15.00
Aluminum	0.20	0.50
Lanthanum	0.005	0.05
Cobalt	--	5.00
Titanium	--	0.10
Boron	--	0.015
Iron	--	3.00
Copper	--	0.50
Nickel	remainder	

3.1.1 Check Analysis

Composition variations shall meet the applicable requirements of AMS 2269; check analysis limits for lanthanum shall be 0.002 under minimum and 0.01 over maximum.

3.2 Condition

The product shall be supplied in the following condition:

3.2.1 Bars

Hot finished and annealed; round bars shall be ground or turned.

3.2.2 Forgings and Flash Welded Rings

Annealed.

3.2.2.1 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 AMS 7490.

3.2.3 Stock For Forging, Flash Welded Rings, or Heading

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

3.3 Heat Treatment

Bars, forgings, and flash welded rings shall be solution heat treated by heating within the range 2150 to 2275 °F (1177 to 1246 °C), holding at the selected temperature within ±25 °F (±14 °C) for a time commensurate with section thickness but not less than 20 minutes, and water quenching or otherwise rapidly cooling. 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 Tensile Properties

Specimens taken in the longitudinal direction from bars, in the circumferential direction from parent metal of flash welded rings, and from forgings in locations agreed upon by purchaser and vendor shall have the properties shown in Table 2, determined in accordance with ASTM E 8 or ASTM E 8M.

TABLE 2 - MINIMUM TENSILE PROPERTIES

Property	Value
Tensile Strength	110.0 ksi (758 MPa)
Yield Strength at 0.2%	45.0 ksi (310 MPa)
Elongation in 4D	35%

3.4.1.2 Hardness shall be not higher than 241 HB, or equivalent (See 8.2), determined in accordance with ASTM E 10. Hardness of bars shall be determined at approximately midradius of rounds and at approximately T/4 of other shapes.

3.4.1.3 Stress Rupture Properties at 1700 °F (927 °C)

A tensile specimen, maintained at 1700 °F ± 3 (927 °C ± 2) while a load sufficient to produce an initial axial stress of 9.0 ksi (62 MPa) is applied continuously, shall not rupture in less than 24 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 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 9.0 ksi (62 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 When permitted by purchaser, 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 9.0 ksi (62 MPa) shall be used to rupture or for 24 hours, whichever occurs first. After the 24 hours and at intervals of 8 hours minimum, thereafter, the stress shall be increased in increments of 1.0 ksi (6.9 MPa). Time to rupture and elongation requirements shall be as specified in 3.4.1.3.

3.4.1.4 Average Grain Size

Shall be ASTM No. 3 or finer, determined in accordance with ASTM E 112.

3.4.2 Forging Stock

When a sample of stock is forged to a test coupon having a degree of mechanical working not greater than the forging 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, 3.4.1.3 and 3.4.1.4. 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, 3.4.1.3 and 3.4.1.4, the tests shall be acceptable 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, 3.4.1.3 and 3.4.1.4.

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 Tensile properties (3.4.1.1), hardness (3.4.1.2), stress rupture properties (3.4.1.3), and average grain size (3.4.1.4) of each lot of bars, forgings, and flash welded rings.

4.2.1.3 Tolerances (3.6) of bars.

4.2.2 Periodic Tests

Tests of forging stock (3.4.2), 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.