



AEROSPACE MATERIAL SPECIFICATION

AMS5846™**REV. D**

Issued 1983-04
Revised 2016-10
Reaffirmed 2022-02

Superseding AMS5846C

Alloy, Corrosion- and Heat-Resistant, Bars and Forgings
53Ni - 15Cr - 18.5Co - 5.0Mo - 3.2Ti - 4.2Al - 0.03B
Double Vacuum Melted
Solution, Stabilization, and Precipitation Heat Treated
(Composition similar to UNS N13020)

RATIONALE

AMS5846D revises Condition (3.3.1.1) and Reports (4.4 and 4.4.1), 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, and forging stock.

1.2 Application

These products have been used typically for parts requiring high strength up to 1500 °F (816 °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

AMS2371 Quality Assurance Sampling and Testing Corrosion and Heat-Resistant Steels and Alloys Wrought Products and Forging Stock

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For more information on this standard, visit
<https://www.sae.org/standards/content/AMS5846D/>

AMS2374	Quality Assurance Sampling and Testing Corrosion and Heat-Resistant Steel and Alloy Forgings
AMS2806	Identification Bars, Wire, Mechanical Tubing, and Extrusions Carbon and Alloy Steels and Corrosion and Heat-Resistant Steels and Alloys
AMS2808	Identification Forgings
ARP1313	Determination of Trace Elements in High Temperature Alloys
ARP1917	Clarification of Terms Used in Aerospace Metals Specifications

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 E18	Rockwell Hardness of Metallic Materials
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 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	0.03	0.10
Manganese	--	0.15
Silicon	--	0.20
Sulfur	--	0.015
Chromium	14.00	16.00
Cobalt	17.00	20.00
Molybdenum	4.50	5.50
Titanium	2.75	3.75
Aluminum	3.75	4.75
Boron	0.025	0.035
Iron	--	2.00
Copper	--	0.10
Zirconium	--	0.06
Lead (3.1.1)	--	0.0010 (10 ppm)
Bismuth (3.1.1)	--	0.00005 (0.5 ppm)
Nickel	remainder	

3.1.1 Lead and bismuth shall be determined in accordance with ARP1313.

3.1.2 Check Analysis

Composition variations shall meet the applicable requirements of AMS2269; no variation over maximum will be permitted for lead and bismuth.

3.2 Melting Practice

Alloy shall be produced by vacuum induction melting followed by consumable electrode vacuum arc remelting.

3.3 Condition

The product shall be supplied in the following condition:

3.3.1 Bars

Hot rolled or extruded, solution, stabilization, and precipitation heat-treated, and descaled. Round bars shall be ground or turned.

3.3.1.1 Bars shall not be cut from plate (also see 4.4.1.1).

3.3.2 Forgings

Solution, stabilization, and precipitation heat treated.

3.3.3 Forging Stock

As ordered by the forging manufacturer.

3.4 Heat Treatment

Bars and forgings shall be heat treated as follows:

3.4.1 Solution Heat Treatment

Heat to $2150^{\circ}\text{F} \pm 25^{\circ}\text{F}$ ($1177^{\circ}\text{C} \pm 14^{\circ}\text{C}$), hold at heat for 4 hours ± 0.25 hour, cool in air to room temperature, reheat to $1975^{\circ}\text{F} \pm 25^{\circ}\text{F}$ ($1079^{\circ}\text{C} \pm 14^{\circ}\text{C}$), hold at heat for 4 to 6 hours, and cool at a rate equivalent to an air cool or faster.

3.4.2 Stabilization Heat Treatment

Heat to $1550^{\circ}\text{F} \pm 15^{\circ}\text{F}$ ($843^{\circ}\text{C} \pm 8^{\circ}\text{C}$), hold at heat for 24 hours ± 1 hour, and cool in air.

3.4.3 Precipitation Heat Treatment

Heat to $1400^{\circ}\text{F} \pm 15^{\circ}\text{F}$ ($760^{\circ}\text{C} \pm 8^{\circ}\text{C}$), hold at heat for 16 hours ± 1 hour, and cool in air.

3.5 Properties

The product shall conform to the following requirements:

3.5.1 Bars and Forgings

3.5.1.1 Hardness

Shall be not lower than 36 HRC, or equivalent (see 8.2), determined in accordance with ASTM E18.

3.5.1.2 Grain Size

Shall be substantially uniform, without pronounced segregation of fine and coarse grain areas (see 8.5).

3.5.1.3 Stress-Rupture Properties at 1800 °F (982 °C)

A tensile specimen, maintained at 1800 °F $\pm$ 3 °F (982 °C $\pm$ 2 °C) while a load sufficient to produce an initial axial stress of 18.0 ksi (124 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 lower than 8% in 4D. Tests shall be conducted in accordance with ASTM E139.

3.5.1.3.1 The test of 3.5.1.3 may be conducted using a load higher than required to produce an initial axial stress of 18.0 ksi (124 MPa), but load shall not be changed while test is in progress. Time to rupture and elongation requirements shall be as specified in 3.5.1.3.

3.5.1.3.2 The test of 3.5.1.3 may be conducted using incremental loading. In such cases, the load required to produce an initial axial stress of 18.0 ksi (124 MPa) shall be used to rupture or for 23 hours whichever occurs first. After the 23 hours and at intervals of 8 hours minimum, thereafter, the stress shall be increased in increments of 2.0 ksi (13.8 MPa). Time to rupture and elongation requirements shall be as specified in 3.5.1.3.

3.5.2 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 3.4, specimens taken from the heat treated coupon shall conform to the requirements of 3.5.1.1 and 3.5.1.3. If specimens taken from the stock after heat treatment as in 3.4 conform to the requirements of 3.5.1.1 and 3.5.1.3, the tests shall be accepted as equivalent to tests of a forged coupon.

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

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 Hardness (3.5.1.1), grain size (3.5.1.2), and stress-rupture properties (3.5.1.3) of each lot of bars and forgings.