SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 5846B

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Superseding AMS 5846A

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)

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.

TO PLACE A DOCUMENT ORDER:
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: custsvc@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

Tel: 877-606-7323 (inside USA and Canada)

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2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or 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 2806	Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Corrosion and Heat-Resistant Steels and Alloys
AMS 2808	Identification, Forgings
ARP1313	Determination of Trace Elements in High Temperature Alloys

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, P.O. Box C700,West Conshohocken, PA 19428-2959 or www.astm.org.

ASTM E 18	Rockwell Hardness and Rockwell Superficial 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

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	0.03	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 (3.1.2)	--	0.0010 (10 ppm)
Bismuth (3.1.2)	--	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 AMS 2269; 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.

3.3.2 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 °F ± 25 (1177 °C ± 14), hold at heat for 4 hours ± 0.25, cool in air to room temperature, reheat to 1975 °F ± 25 (1079 °C ± 14), 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 °F ± 15 (843 °C ± 8), hold at heat for 24 hours ± 1, and cool in air.

3.4.3 Precipitation Heat Treatment: Heat to 1400 °F ± 15 (760 °C ± 8), hold at heat for 16 hours ± 1, 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 E 18.

3.5.1.2 Average 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 ± 3 (982 °C ± 2) 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 E 139.

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, preferably 8 to 10 hours, 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 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: 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), average grain size (3.5.1.2), and stress-rupture properties (3.5.1.3) of each lot of bars and forgings.

4.2.1.3 Tolerances (3.7) of bars.

4.2.2 Periodic Tests: Tests of forging stock (3.5.2) to demonstrate ability to develop required properties and grain flow of die forgings (3.6.1) 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 as follows:

4.3.1 Bars and Forging Stock: In accordance with AMS 2371.

4.3.2 Forgings: In accordance with AMS 2374.

4.4 Reports:

4.4.1 The vendor of the product shall furnish with each shipment a report showing the results of tests for composition of each heat and for hardness, average grain size, and stress rupture properties of each lot, and stating that the product conforms to the other technical requirements. This report shall include the purchase order number, heat and lot numbers, AMS 5846B, size, and quantity. If forgings are supplied, the size and melt source of stock used to make the forgings shall also be included.

4.4.2 The vendor of forging stock shall furnish with each shipment a report showing the results of tests for composition of each heat. The report shall include the purchase order number, heat number, AMS 5846B, size, and quantity.

4.5 Resampling and Retesting:

Shall be as follows:

4.5.1 Bars: In accordance with AMS 2371.

4.5.2 Forgings and Forging Stock: In accordance with AMS 2374.

5. PREPARATION FOR DELIVERY:

5.1 Sizes:

Except when exact lengths or multiples of exact lengths are ordered, straight bars will be acceptable in mill lengths of 6 to 24 feet (1.8 to 7.3 m) except that not more than 25% of any shipment shall be supplied in lengths as short as 2 feet (610 mm).

5.2 Identification:

Shall be as follows:

5.2.1 Bars: In accordance with AMS 2806.

5.2.2 Forgings: In accordance with AMS 2808.

5.2.3 Forging Stock: As agreed upon by purchaser and vendor.

5.3 Packaging:

The product shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the product to ensure carrier acceptance and safe delivery.