SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS5846 REV. C

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Superseding AMS5846B

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

AMS5846C revises the interval for uploading of stress rupture tests (3.5.1.3.2), reports (4.4.2) 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 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

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

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 18 Rockwell 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 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.

3.3.2 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, 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), 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 AMS2371.

4.3.2 Forgings

In accordance with AMS2374.

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, AMS5846C, 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 and the results of any additional property requirements imposed by the purchase order (See 8.5). The report shall include the purchase order number, heat number, AMS5846C, size, and quantity.

4.5 Resampling and Retesting

Shall be as follows:

4.5.1 Bars

In accordance with AMS2371.

4.5.2 Forgings and Forging Stock

In accordance with AMS2374.

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).