Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 5843

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Revised

ALLOY BARS, WORK STRENGTHENED, CORROSION AND HEAT RESISTANT
19Cr - 36Co - 25Ni - 7.0Mo - 0.50Cb - 2.9Ti - 0.20Al - 9.0Fe
Solution Heat Treated, Cold Drawn, and Aged

1. SCOPE:

1.1 Form: This specification covers a high strength, corrosion and heat resistant cobalt-chromium-nickel alloy in the form of bars.

1.2 Application: Primarily for applications requiring high strength up to 1100°F (595°C), good tension-tension fatigue strength, toughness, and ductility. This alloy exhibits exceptionally good resistance to corrosion, crevice-corrosion, stress-corrosion cracking, and elevated temperature relaxation.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2261 - Tolerances, Nickel, Nickel Base, and Cobalt Base Alloy Bars and Forging Stock
AMS 2269 - Chemical Check Analysis Limits, Wrought Nickel and Cobalt Alloys
AMS 2350 - Standards and Test Methods
AMS 2371 - Quality Assurance Sampling of Corrosion and Heat Resistant Alloys, Wrought Products Except Forgings
AMS 2806 - Identification, Bars, Wire, Extrusions, and Mechanical Tubing, Carbon and Alloy Steels and Heat and Corrosion Resistant Steels and Alloys

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM E8 - Tension Testing of Metallic Materials
ASTM E18 - Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E21 - Elevated Temperature Tension Testing of Metallic Materials
ASTM E112 - Estimating the Average Grain Size of Metals
ASTM E139 - Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials
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-Base Alloys

2.3 Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

Printed in U.S.A.

2.3.2 Military Standards:

MIL-STD-163 - Steel Mill Products, Preparation for Shipment and Storage

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E354, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other approved analytical methods:

	min	max
Carbon	--	0.04
Manganese	--	0.20
Silicon	--	0.20
Phosphorus	--	0.020
Sulfur	--	0.010
Chromium	18.00	20.00
Cobalt	34.00	38.00
Molybdenum	6.00	8.00
Columbium	0.25	0.75
Titanium	2.50	3.25
Aluminum	0.10	0.30
Iron	8.00	10.00
Boron	--	0.03
Nickel	remainder	

3.1.1 Check Analysis: Composition variations shall meet the requirements of AMS 2269.

3.2 Condition: Solution heat treated, cold drawn, aged, and centerless ground.

3.3 Heat Treatment: Bars shall be solution heat treated by heating to 1925°F ± 25 (1050°C ± 15), holding at heat for not less than 4 hr, and cooling at a rate equivalent to an air cool. After cold drawing, bars shall be aged by heating to a temperature within the range 1200° - 1250°F (650° - 675°C), holding at the selected temperature within ±25°F (±15°C) for 4 - 4-1/2 hr, and cooling at a rate equivalent to an air cool.

3.4 Properties: Bars shall conform to the following requirements:

3.4.1 Tensile Properties:

3.4.1.1 At Room Temperature: Shall be as follows, determined in accordance with ASTM E8:

Tensile Strength, min	260,000 psi (1793 MPa)
Yield Strength at 0.2% Offset, min	250,000 psi (1724 MPa)
Elongation in 2 in. (50.8 mm) or 4D, min	6%
Reduction of Area (round specimens), min	22%

3.4.1.2 At 1100°F (593°C): Shall be as follows, determined in accordance with ASTM E21 on specimens heated to 1100°F ± 10 (593°C ± 6), held at heat for 30 min. before testing, and tested at 1100°F ± 10 (593°C ± 6):

Tensile Strength, min	205,000 psi (1413 MPa)
Yield Strength at 0.2% Offset, min	190,000 psi (1310 MPa)
Elongation in 2 in. (50.8 mm) or 4D, min	5%
Reduction of Area, min	15%

3.4.2 Hardness: Shall be not lower than 44 HRC or equivalent, determined in accordance with ASTM E18.

3.4.3 Grain Size: Predominantly 4 or finer with occasional grains as large as 2 permissible, determined by comparison of a polished and etched specimen with the chart in ASTM E112.

3.4.4 Stress-Rupture Properties at 1200°F (649°C): Shall be as follows; testing of notched specimens and of combination smooth-and-notched specimens shall be in accordance with ASTM E292 and of smooth specimens in accordance with ASTM E139:

3.4.4.1 A combination smooth-and-notched test specimen machined to the dimensions shown in Fig. 1 and Table I, maintained at 1200°F ± 3 (649°C ± 2) while a load sufficient to produce an initial axial stress of 140,000 psi (965 MPa) is applied continuously, shall not rupture in less than 23 hours. The test shall be continued to rupture without change of load. After the 23 hr, if rupture occurs in the notch, the smooth section shall, by suitable means, be continued to rupture or a separate smooth specimen shall be tested to rupture under the above conditions. Elongation of the smooth section after rupture, measured at room temperature, shall be not less than 5% in 4D.

3.4.4.2 As an alternate procedure, separate smooth and notched test specimens, machined from adjacent sections of the same piece with gage sections conforming to the respective dimensions of Table I, may be tested individually under the conditions of 3.4.4.1. The smooth specimen shall not rupture in less than 23 hr and elongation after rupture, measured at room temperature, shall be not less than 5% in 4D. The notched specimen shall not rupture in less than 23 hr but need not be tested to rupture.

3.4.4.3 The tests of 3.4.4.1 and 3.4.4.2 may be conducted using a load higher than required to produce an initial axial stress of 140,000 psi (965 MPa) but load shall not be changed while tests are in progress. Time to rupture and elongation requirements shall be as specified in 3.4.4.1.

3.4.4.4 When permitted by purchaser, the tests of 3.4.4.1 and 3.4.4.2 may be conducted using incremental loading. In such case, the load required to produce an initial axial stress of 140,000 psi (965 MPa) shall be used to rupture or for 23 hr, whichever occurs first. After the 23 hr and at intervals of 8 - 16 hr, preferably 8 - 10 hr, thereafter, the stress shall be increased in increments of 5,000 psi (34.5 MPa). Time to rupture and elongation requirements shall be as specified in 3.4.4.1.

3.5 Quality:

3.5.1 Alloy shall be produced by multiple melting using vacuum induction followed by vacuum consumable electrode melting practice.

3.5.2 Bars, as received by the purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from internal and external imperfections detrimental to usage of the bars.

3.6 Sizes: Except when exact lengths or multiples of exact lengths are ordered, straight bars will be acceptable in mill lengths of 6 - 20 ft (1.8 - 6.1 m) but not more than 10% of any shipment shall be supplied in lengths shorter than 10 ft (3 m).

3.7 Tolerances: Unless otherwise specified, tolerances shall conform to all applicable requirements of AMS 2261.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of bars shall supply all samples and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.4. Purchaser reserves the right to perform such confirmatory testing as he deems necessary to ensure that the bars conform to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to the following requirements are classified as acceptance tests:

4.2.1.1 Composition (3.1).

4.2.1.2 Tensile properties at room temperature (3.4.1.1), hardness (3.4.2), grain size (3.4.3), and stress-rupture properties (3.4.4).

4.2.1.3 Tolerances (3.7).

4.2.2 Periodic Tests: Tests to determine conformance to requirements for tensile properties at 1100°F (593°C) (3.4.1.2) are classified as periodic tests.

4.3 Sampling: Shall be in accordance with the following; a heat shall be the consumable electrode remelted ingots produced from alloy originally melted as a single furnace charge; a lot shall be all bars of one size from one heat produced at one time:

4.3.1 Acceptance Tests: AMS 2371.

4.3.2 Periodic Tests: As agreed upon by purchaser and vendor.

4.3.3 Specimens for tensile and smooth-bar stress-rupture testing shall be of standard proportions in accordance with ASTM E8 with either 0.250 in. (6.35 mm) diameter at the reduced parallel gage section or smaller specimens proportional to the standard when required. Other stress-rupture specimens shall be as specified in 3.4.4. All specimens shall be machined from the center of bars 0.800 in. (20.32 mm) and under in nominal diameter or distance between parallel sides and from midradius of larger size bars.

4.4 Reports:

4.4.1 The vendor of bars shall furnish with each shipment three copies of a report showing the results of tests for chemical composition of each heat and for the room-temperature tensile properties, hardness, grain size, and stress-rupture properties of each lot, and stating that the bars conform to the other technical requirements of this specification. This report shall include the purchase order number, heat number, material specification number, size, and quantity from each heat.

4.4.2 The vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, material specification number, contractor or other direct supplier of bars, part number, and quantity. When bars for making parts are produced or purchased by the parts vendor, that vendor shall inspect each lot of bars to determine conformance to the requirements of this specification, and shall include in the report a statement that the bars conform, or shall include copies of laboratory reports showing the results of tests to determine conformance.

4.5 Resampling and Retesting: Shall be in accordance with AMS 2371.

5. PREPARATION FOR DELIVERY:

5.1 Identification: Bars shall be identified in accordance with AMS 2806.

5.2 Packaging:

5.2.1 Bars shall be prepared for shipment in accordance with commercial practice to ensure carrier acceptance and safe transportation to the point of delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

5.2.2 For direct U.S. Military procurement, packaging shall be in accordance with MIL-STD-163, Level A or Level C, as specified in the request for procurement. Commercial packaging as in 5.2.1 will be acceptable if it meets the requirements of Level C.

6. ACKNOWLEDGMENT: A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.

7. REJECTIONS: Bars not conforming to this specification or to authorized modifications will be subject to rejection.

8. NOTES:

8.1 For direct U.S. Military procurement, purchase documents should specify the following:

Title, number, and date of this specification
Size of bars desired
Quantity of bars desired
Applicable level of packaging (See 5.2.2).