SAE Aerospace
An SAE International Group

AEROSPACE MATERIAL SPECIFICATION

SAE AMS5841 REV. F

Issued 1977-03
Revised 2011-09

Superseding AMS5841E

Cobalt-Nickel Alloy, Corrosion and Heat-Resistant, Bars
19Cr - 36Co - 25Ni - 7.0Mo - 0.50Cb (Nb) - 2.9Ti - 0.20Al - 9.0Fe
Vacuum Induction Plus Vacuum Consumable Electrode Melted
Solution Heat Treated for Work Strengthening

(Composition similar to UNS R30159)

RATIONALE

AMS5841F results from a Five Year Review and update of this specification.

1. SCOPE

1.1 Form

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

1.2 Application

These bars have been used typically for applications requiring a combination of high strength up to 1100 °F (593 °C), good tension-tension fatigue strength, toughness, and ductility (See 8.4), but usage is not limited to such applications. This alloy exhibits exceptionally good resistance to corrosion, crevice-corrosion, stress-corrosion cracking, and elevated temperature relaxation.

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

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**

AMS2750 Pyrometry

AMS2806 Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Corrosion and Heat-Resistant Steels and 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 8/E 8M Tension Testing of Metallic Materials

ASTM E 18 Rockwell Hardness of Metallic Materials

ASTM E 21 Elevated Temperature Tension Tests 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 292 Conducting Time-for-Rupture Notch Tension Tests of 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	--	0.04
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 (Niobium)	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 applicable requirements of AMS2269.

3.2 Melting Practice

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

3.3 Condition

Solution heat treated and centerless ground.

3.4 Solution Heat Treatment

Bars shall be solution heat treated by heating to a temperature within the range 1900 to 1925 °F (1038 to 1052 °C), holding at the selected temperature within ±25 °F (±14 °C) for 4 to 8 hours, and quenching in water. Pyrometry shall be in accordance with AMS2750.

3.5 Properties

Bars shall conform to the following requirements:

3.5.1 As Solution Heat Treated

3.5.1.1 Tensile Properties

Shall be as shown in Table 2, determined in accordance with ASTM E 8/E 8M.

TABLE 2 - TENSILE PROPERTIES AS SOLUTION HEAT TREATED

Property	Value
Tensile Strength, max	160 ksi (1103 MPa)
Yield Strength at 0.2% Offset, max	70 ksi (483 MPa)
Elongation in 4D, min	50%
Reduction of Area, min	65%

3.5.1.2 Hardness

Shall be not higher than 20 HRC, or equivalent (See 8.2), determined in accordance with ASTM E 18.

3.5.1.3 Average Grain Size

Shall be ASTM No. 4 or finer, determined in accordance with ASTM E 112.

3.5.2 After Cold Working and Aging

Specimens as in 4.3.1 from bars 1-3/4 inches (44.4 mm) and under in nominal diameter, solution heat treated as in 3.4, shall have the following properties after being reduced by cold drawing 48% ± 1 of original cross-section area (See 8.3) and aged by heating to a temperature within the range 1200 to 1250 °F (649 to 677 °C), holding at the selected temperature within ±25 °F (±14 °C) for not less than 4 hours, and cooling at a rate equivalent to an air cool (See 8.4).

3.5.2.1 Tensile Properties

3.5.2.1.1 At Room Temperature

Shall be as shown in Table 3, determined in accordance with ASTM E 8/E 8M.

TABLE 3 - MINIMUM ROOM TEMPERATURE TENSILE PROPERTIES

Property	Value
Tensile Strength	260 ksi (1793 MPa)
Yield Strength at 0.2% Offset	250 ksi (1724 MPa)
Elongation in 4D	6%
Reduction of Area	22%

3.5.2.1.2 At 1100 °F (593 °C)

Shall be as shown in Table 4, determined in accordance with ASTM E 21 on specimens heated to 1100 °F ± 10 (593 °C ± 6), held at heat for 20 to 30 minutes before testing, and tested at 1100 °F ± 10 (593 °C ± 6).

TABLE 4 - MINIMUM ELEVATED TEMPERATURE TENSILE PROPERTIES

Property	Value
Tensile Strength	205 ksi (1413 MPa)
Yield Strength at 0.2% Offset	190 ksi (1310 MPa)
Elongation in 4D	5%
Reduction of Area	15%

3.5.2.2 Hardness

Shall be not lower than 44 HRC, or equivalent (See 8.2), determined in accordance with ASTM E 18.

3.5.2.3 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 E 292 and of smooth specimens as in 4.3.1 in accordance with ASTM E 139:

3.5.2.3.1 A standard, cylindrical combination smooth-and-notched specimen conforming to ASTM E 292, maintained at 1200 °F ± 3 (649 °C ± 2) while a load sufficient to produce an initial axial stress of 140 ksi (965 MPa) or higher 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 hours, 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.

3.5.2.3.2 As an alternate procedure, separate smooth and notched specimens, machined from adjacent sections of the same piece with gage sections conforming to the respective dimensions shown in ASTM E 292, may be tested individually under the conditions of 3.5.2.3.1. The smooth specimen shall not rupture in less than 23 hours 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 hours and need not be tested to rupture.

3.5.2.3.3 Tests of 3.5.2.3.1 and 3.5.2.3.2 may be conducted using incremental loading. In such case, the load required to produce an initial axial stress of 140 ksi (965 MPa) or higher 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 5.0 ksi (34.5 MPa). Time to rupture and elongation requirements shall be as specified in 3.5.2.3.1.

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 bars.

3.7 Tolerances

Shall conform to all applicable requirements of AMS2261.