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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 5842D

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Superseding AMS 5842C

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

UNS R30159

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, 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 (See 8.3).

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 canceled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2261	Tolerances, Nickel, Nickel Alloy, and Cobalt Alloy Bars, Rods, and Wire
MAM 2261	Tolerances, Metric, 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

QUESTIONS REGARDING THIS DOCUMENT: (724) 772-7161 FAX: (724) 776-0243
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SAE WEB ADDRESS: http://www.sae.org

2.1 (Continued):

AMS 2750	Pyrometry
AMS 2806	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, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 8	Tension Testing of Metallic Materials
ASTM E 8M	Tension Testing of Metallic Materials (Metric)
ASTM E 18	Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E 21	Elevated Temperature Tension Tests of Metallic Materials
ASTM E 112	Determining the 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	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 AMS 2269.

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 cold drawn.

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 AMS 2750.

3.5 Properties:

Bars shall conform to the following requirements:

3.5.1 As Solution Heat Treated and Cold Drawn:

3.5.1.1 Hardness: Shall be not lower than 38 HRC, or equivalent (See 8.2), determined in accordance with ASTM E 18.

3.5.1.2 Average Grain Size: Shall be ASTM No. 4 or finer, determined in accordance with ASTM E 112.

3.5.2 After Aging: Bars, 1-3/4 inches (44.4 mm) and under in nominal diameter, solution heat treated as in 3.4 and suitably cold drawn, shall have the following properties after being 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 4 to 4-1/2 hours, and cooling at a rate equivalent to an air cool (See 8.3):

3.5.2.1 Tensile Properties:

3.5.2.1.1 At Room Temperature: Shall be as shown in Table 2, determined in accordance with ASTM E 8 or ASTM E 8M on specimens as in 4.3.1.

TABLE 2 - 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 3, determined in accordance with ASTM E 21 on specimens as in 4.3.1 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 3 - 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 but 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 to 16 hours, 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:

Bars, 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 AMS 2261 or MAM 2261.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The vendor of bars 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 bars conform to specified requirements.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: 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) and average grain size (3.5.1.2) of each lot as solution heat treated and cold drawn.

4.2.1.3 Tensile properties at room temperature of each lot after aging (3.5.2.1.1).

4.2.1.4 Tolerances (3.7).

4.2.2 Periodic Tests: Tensile properties at 1100 °F (593 °C) (3.5.2.1.2), hardness (3.5.2.2), and stress-rupture properties (3.5.2.3) after aging 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 in accordance with AMS 2371 and the following.

4.3.1 Specimens for tensile and smooth-bar stress-rupture testing shall be of standard proportions in accordance with ASTM E 8 or ASTM E 8M with either 0.250 inch (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 3.5.2.3. All specimens shall be machined from the center of bars 0.800 inch (20.32 mm) and under in nominal diameter or least distance between parallel sides and from mid-radius of larger size bars.