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400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 5842B

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Superseding AMS 5842A

ALLOY BARS, CORROSION AND HEAT RESISTANT
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-chromium-nickel alloy in the form of bars.

1.2 Application: Primarily for applications requiring a combination of 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 shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2261 - Tolerances, Nickel, Nickel Alloy, and Cobalt Alloy Bars and Forging Stock
MAM 2261 - Tolerances, Metric, Nickel, Nickel Alloy, and Cobalt Alloy Bars and Forging Stock
AMS 2269 - Chemical Check Analysis Limits, Wrought Nickel Alloys and Cobalt Alloys
AMS 2350 - Standards and Test Methods
AMS 2371 - Quality Assurance Sampling of Corrosion and Heat Resistant Steels and Alloys, Wrought Products Except Forgings and Forging Stock
AMS 2806 - Identification, Bars, Wire, Mechanical Tubing, and Extrusions, 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 Tests of Metallic Materials
ASTM E112 - Determining Average Grain Size
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 Alloys

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

2.3.1 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 or by spectrochemical or other analytical methods approved by purchaser:

	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 and cold drawn.

3.3 Solution Heat Treatment: Bars shall be solution heat treated by heating to a temperature within the range 1900° - 1925°F (1040° - 1050°C), holding at the selected temperature within ±25°F (±15°C) for 4 - 8 hr, and quenching in water.

3.4 Properties: Bars shall conform to the following requirements:

3.4.1 As Solution Heat Treated and Cold Drawn:

3.4.1.1 Hardness: Shall be not lower than 38 HRC, or equivalent, determined in accordance with ASTM E18.

3.4.1.2 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.

3.4.2 After Aging: Bars, 1-3/4 in. (45 mm) and under in nominal diameter, solution heat treated as in 3.3 and suitably cold drawn, shall have the following properties after being 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 (See 8.2):

3.4.2.1 Tensile Properties:

3.4.2.1.1 At Room Temperature: Shall be as follows, determined in accordance with ASTM E8 on specimens as in 4.3.1:

Tensile Strength, min	260,000 psi (1795 MPa)
Yield Strength at 0.2% Offset, min	250,000 psi (1725 MPa)
Elongation in 4D, min	6%
Reduction of Area, min	22%

3.4.2.1.2 At 1100°F (595°C): Shall be as follows, determined in accordance with ASTM E21 on specimens as in 4.3.1 heated to 1100°F ± 10 (595°C ± 5), held at heat for 20 - 30 min. before testing, and tested at 1100°F ± 10 (595°C ± 5):

Tensile Strength, min	205,000 psi (1415 MPa)
Yield Strength at 0.2% Offset, min	190,000 psi (1310 MPa)
Elongation in 4D, min	5%
Reduction of Area, min	15%

3.4.2.2 Hardness: Should be not lower than 44 HRC, or equivalent, determined in accordance with ASTM E18, but bars shall not be rejected on the basis of hardness if the tensile property requirements of 3.4.2.1.1 are met.

3.4.2.3 Stress-Rupture Properties at 1200°F (650°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 as in 4.3.1 in accordance with ASTM E139:

3.4.2.3.1 Ø A standard cylindrical combination smooth-and-notched specimen conforming to ASTM E292, maintained at 1200°F ± 3 (650°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.

3.4.2.3.2 Ø 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 E292 may be tested individually under the conditions of 3.4.2.3.1. 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.

3.4.2.3.3 The tests of 3.4.2.3.1 and 3.4.2.3.2 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 test is in progress. Time to rupture and elongation requirements shall be as specified in 3.4.2.3.1.

3.4.2.3.4 When permitted by purchaser, the tests of 3.4.2.3.1 and 3.4.2.3.2 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 (35 MPa). Time to rupture and elongation requirements shall be as specified in 3.4.2.3.1.

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 purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from 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 (2 - 6 m) but not more than 10% of any shipment shall be supplied in lengths shorter than 10 ft (3 m).

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 performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.4. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the bars conform to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Test to determine conformance to the following requirements are classified as 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 (3.4.1.1) and grain size (3.4.1.2) of each lot as solution heat treated and cold drawn.

4.2.1.3 Tensile properties at room temperature of each lot after aging (3.4.2.1.1).

4.2.1.4 Tolerances (3.7).

4.2.2 Periodic Tests: Test to determine conformance to the following requirements are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.2.2.1 Tensile properties at 1100°F (595°C) (3.4.2.1.2), hardness (3.4.2.2), and stress-rupture properties (3.4.2.3) after aging.

4.3 Sampling: Shall be in accordance with AMS 2371 and the following; a heat shall be the consumable electrode remelted ingots produced from alloy originally melted as a single furnace charge:

4.3.1 Specimens for tensile and smooth-bar stress-rupture testing shall be of standard proportions in accordance with ASTM E8 with either 0.250 in. (6.25 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 3.4.2.3. All specimens shall be machined from the center of bars 0.800 in. (20.00 mm) and under in nominal diameter or distance between parallel sides and from mid-radius of larger size bars.