AEROSPACE MATERIAL SPECIFICATION

AMS5842™	REV. H

Issued 1977-03
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Superseding AMS5842G

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 and Work Strengthened
(Composition similar to UNS R30159)

RATIONALE

This revision is the result of a Five-Year Review and update of the document. The revision includes an update to include size (1.1), prohibits unauthorized exceptions (3.5.3, 3.8, 4.4.1, 5.2.1, 8.7), prohibits bar being cut from plate (3.3.1, 4.4.2), adds strain rate control (3.5.2.1.3), and allows prior revisions (8.6).

1. SCOPE

1.1 Form

This specification covers a high strength, corrosion- and heat-resistant cobalt-nickel-chromium alloy in the form of bars 1-3/4 inch (44 mm) nominal diameter thickness or for hexagons least distance between parallel sides (see 8.3).

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 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 +1 724-776-4970 (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

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

For more information on this standard, visit
https://www.sae.org/standards/content/AMS5842H/

AMS2371 Quality Assurance Sampling and Testing, Corrosion and Heat-Resistant Steels and Alloys, Wrought Products and Forging Stock

AMS2750 Pyrometry

AMS2806 Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Corrosion and Heat-Resistant Steels and Alloys

AS7766 Terms Used in Aerospace Metals Specifications

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 E8/E8M Tension Testing of Metallic Materials

ASTM E18 Rockwell 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 E140 Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness

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

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1, determined in accordance with ASTM E354, 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 cold drawn.

3.3.1 Bar shall not be cut from plate (also see 4.4.2).

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 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 E18.

3.5.1.2 Average Grain Size

Shall be ASTM No. 4 or finer, determined in accordance with ASTM E112.

3.5.2 Response to Heat Treatment - After Aging

Samples from bars, 1-3/4 inches (44 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 E8/E8M 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 E21 on specimens as in 4.3.1 heated to 1100 °F ± 10 °F (593 °C ± 6 °C), held at heat for 20 to 30 minutes before testing, and tested at 1100 °F ± 10 °F (593 °C ± 6 °C).

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%

3.5.2.1.3 Unless otherwise specified, the strain rate for both room temperature and elevated temperature tensile testing shall be set at 0.005 in/in/min (0.005 mm/mm/min) and maintained within a tolerance of ±0.002 in/in/min (0.002 mm/mm/min) through 0.2% offset yield strain. The strain rate after yield may be increased to any value up to 0.5 in/in/min (or 0.5 mm/mm/min) or equivalent crosshead speed as a function of gage length. The requirement for compliance becomes effective for material produced 1 year after the publication date of this document.

3.5.2.2 Hardness

Shall be not lower than 44 HRC, or equivalent (see 8.2), determined in accordance with ASTM E18.

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 E292 and of smooth specimens as in 4.3.1 in accordance with ASTM E139:

3.5.2.3.1 A standard cylindrical combination smooth-and-notched specimen conforming to ASTM E292, maintained at 1200 °F ± 3 °F (649 °C ± 2 °C) 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 E292, 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.

3.5.3 Mechanical property requirements for product outside of the range covered by 1.1 shall be agreed upon between purchaser and producer.

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.

3.8 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.1.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of the product shall supply all samples for producer'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 producer unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing

Shall be in accordance with AMS2371 and the following:

4.3.1 Specimens for tensile and smooth-bar stress-rupture testing shall be of standard proportions in accordance with ASTM E8/E8M 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.

4.4 Reports

The producer of the product shall furnish with each shipment a report showing the producer's name and country where the metal was melted (e.g., final melt in the case of metal processed by multiple melting operations), and the results of tests for composition of each heat and for hardness, average grain size and tensile 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, AMS5842H, size, quantity and a statement of record of specific temperature and time used in the laboratory aging cycle (see 3.5.2).