

**ALLOY WIRE, CORROSION AND HEAT RESISTANT**

20Cr - 15Ni - 40Co - 7.0Mo - 16Fe  
Solution Heat Treated and Cold Drawn      UNS R30003

**1. SCOPE:**

- 1.1 **Form:** This specification covers a corrosion and heat resistant cobalt alloy in the form of round wire 0.140 in. (3.50 mm) and under in nominal diameter supplied in straight lengths.
- 1.2 **Application:** Primarily for springs and torsion bars requiring a combination of high strength up to 800°F (425°C) after aging, excellent corrosion resistance, and good fatigue properties. Alloy is nonmagnetic.

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 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

**REAFFIRMED**

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

ASTM E8 - Tensile Testing of Metallic Materials

ASTM E18 - Rockwell Hardness and Rockwell Superficial Hardness of Metallic 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                | --        | 0.15   |
| Manganese             | 1.5       | - 2.5  |
| Silicon               | --        | 1.20   |
| Phosphorus            | --        | 0.015  |
| Sulfur                | --        | 0.015  |
| Chromium              | 19.0      | - 21.0 |
| Nickel                | 14.0      | - 16.0 |
| Cobalt                | 39.0      | - 41.0 |
| Molybdenum            | 6.0       | - 8.0  |
| Beryllium             | --        | 0.10   |
| Other Elements, total | --        | 1.00   |
| Iron                  | remainder |        |

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

3.2 Condition: Solution heat treated and cold drawn.

3.2.1 Solution Heat Treatment: Wire shall be solution heat treated by heating to  $2150^{\circ}\text{F} + 25$  ( $1175^{\circ}\text{C} + 15$ ), holding at heat for a time commensurate with section thickness, and cooling as required.

3.3 Properties: Wire shall conform to the following requirements:

### 3.3.1 As Solution Heat Treated and Cold Drawn:

3.3.1.1 Tensile Properties: Shall be as specified in Table I, determined in accordance with ASTM E8.

TABLE I

| Specified Diameter<br>Inch | Tensile Strength<br>psi, min |
|----------------------------|------------------------------|
| 0.001 to 0.005, incl       | 260,000                      |
| Over 0.005 to 0.040, incl  | 240,000                      |
| Over 0.040 to 0.060, incl  | 235,000                      |
| Over 0.060 to 0.100, incl  | 225,000                      |
| Over 0.100 to 0.140, incl  | 220,000                      |

TABLE I (SI)

| Specified Diameter<br>Millimetres | Tensile Strength<br>MPa, min |
|-----------------------------------|------------------------------|
| 0.02 to 0.12, incl                | 1795                         |
| Over 0.12 to 1.00, incl           | 1655                         |
| Over 1.00 to 1.50, incl           | 1620                         |
| Over 1.50 to 2.50, incl           | 1550                         |
| Over 2.50 to 3.50, incl           | 1515                         |

3.3.2 After Aging: Wire shall meet the requirements of 3.3.2.1 and 3.3.2.2 after being aged by heating to a temperature within the range 900° - 1000°F (480° - 540°C), holding at the selected temperature within +25°F (+15°C) for 5 - 5-1/2 hr, and cooling in air to room temperature.

3.3.2.1 Tensile Properties: Shall be in accordance with Table II, determined in accordance with ASTM E8.

TABLE II

| Specified Diameter<br>Inch | Tensile Strength<br>psi, min | Yield Strength<br>at 0.2% Offset,<br>psi, min |
|----------------------------|------------------------------|-----------------------------------------------|
| 0.001 to 0.005, incl       | 330,000                      | --                                            |
| Over 0.005 to 0.040, incl  | 290,000                      | 210,000                                       |
| Over 0.040 to 0.060, incl  | 285,000                      | 200,000                                       |
| Over 0.060 to 0.080, incl  | 275,000                      | 200,000                                       |
| Over 0.080 to 0.100, incl  | 275,000                      | 195,000                                       |
| Over 0.100 to 0.120, incl  | 270,000                      | 185,000                                       |
| Over 0.120 to 0.140, incl  | 270,000                      | 180,000                                       |

TABLE II (SI)

| Specified Diameter<br>Millimetres | Tensile Strength<br>MPa, min | Yield Strength<br>at 0.2% Offset,<br>MPa, min |
|-----------------------------------|------------------------------|-----------------------------------------------|
| 0.02 to 0.12, incl                | 2275                         | --                                            |
| Over 0.12 to 1.00, incl           | 2000                         | 1450                                          |
| Over 1.00 to 1.50, incl           | 1965                         | 1380                                          |
| Over 1.50 to 2.00, incl           | 1895                         | 1380                                          |
| Over 2.00 to 2.50, incl           | 1895                         | 1345                                          |
| Over 2.50 to 3.00, incl           | 1860                         | 1275                                          |
| Over 3.00 to 3.50, incl           | 1860                         | 1240                                          |

3.3.2.2 Hardness: Should be not lower than 46 HRC, or equivalent, determined in accordance with ASTM E18, but wire shall not be rejected on the basis of hardness if the tensile property requirements of 3.3.2.1 are met.

### 3.4 Quality:

3.4.1 Alloy shall be produced by multiple melting using vacuum induction  
Ø followed by vacuum consumable electrode or electroslag melting practices.

3.4.2 Wire, 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 wire.

3.5 Tolerances: Shall be as follows:

3.5.1 Diameter: In accordance with Table III.

TABLE III

| Specified Diameter<br>Inch | Tolerance, Inch<br>plus and minus |
|----------------------------|-----------------------------------|
| 0.001 to 0.0028, excl      | 0.0001                            |
| 0.0028 to 0.005, excl      | 0.00015                           |
| 0.005 to 0.009, excl       | 0.0002                            |
| 0.009 to 0.016, excl       | 0.00025                           |
| 0.016 to 0.021, excl       | 0.00035                           |
| 0.021 to 0.038, excl       | 0.00045                           |
| 0.038 to 0.051, excl       | 0.00055                           |
| 0.051 to 0.099, excl       | 0.00065                           |
| 0.099 to 0.140, incl       | 0.0007                            |

TABLE III (SI)

| Specified Diameter<br>Millimetres | Tolerance, Millimetre<br>plus and minus |
|-----------------------------------|-----------------------------------------|
| 0.02 to 0.070, excl               | 0.002                                   |
| 0.070 to 0.12, excl               | 0.0038                                  |
| 0.12 to 0.22, excl                | 0.005                                   |
| 0.22 to 0.40, excl                | 0.0062                                  |
| 0.40 to 0.52, excl                | 0.0088                                  |
| 0.52 to 0.95, excl                | 0.0112                                  |
| 0.95 to 1.28, excl                | 0.0138                                  |
| 1.28 to 2.48, excl                | 0.0162                                  |
| 2.48 to 3.50, incl                | 0.018                                   |

3.5.2 Out-of-Round: Wire shall not be out-of-round by more than one-half of the total tolerance shown in Table III.

3.5.3 Straightness: Wire shall be of such straightness that the maximum curvature (depth of arc) shall not exceed 0.016 in. (0.04 mm) in any 6 in. (150 mm) of length.

#### 4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of wire 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 wire conforms to the requirements of this specification.

4.2 Classification of Tests: Tests to determine conformance to all technical requirements of this specification are classified as acceptance tests and shall be performed on each heat or lot as applicable.

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

#### 4.4 Reports:

4.4.1 The vendor of wire shall furnish with each shipment a report showing the  
Ø results of tests for chemical composition of each heat and for tensile properties and hardness of each lot. This report shall include the purchase order number, heat number, AMS 5833A, size, and quantity.