

# AEROSPACE MATERIAL SPECIFICATION



AMS 6501C

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Superseding AMS 6501B

Steel, Maraging, Welding Wire  
18Ni - 8.0Co - 4.9Mo - 0.40Ti - 0.10Al  
Vacuum Induction Melted, Environment Controlled Packaging  
(Composition similar to UNS K92890)

## 1. SCOPE:

### 1.1 Form:

This specification covers a maraging steel in the form of welding wire.

### 1.2 Application:

This wire has been used typically as filler metal for inert gas-metal-arc welding of critical weldments of maraging steels requiring a joint capable of being heat treated to 255 ksi (1758 MPa) tensile strength, but usage is not limited to such applications.

## 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 or [www.sae.org](http://www.sae.org).

|          |                                                                                                                                           |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------|
| AMS 2248 | Chemical Check Analysis Limits, Corrosion and Heat Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels, and Iron Alloys |
| AMS 2371 | Quality Assurance Sampling and Testing, Corrosion and Heat Resistant Steels and Alloys, Wrought Products and Forging Stock                |
| AMS 2813 | Packaging and Marking of Packages of Welding Wire, Standard Method                                                                        |
| AMS 2814 | Packaging and Marking of Packages of Welding Wire, Premium Quality                                                                        |
| AMS 2816 | Identification, Welding Wire, Tab Marking Method                                                                                          |
| AMS 2819 | Identification, Welding Wire, Direct Color Code System                                                                                    |

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## 2.1 (Continued):

|          |                                                                                                                                      |
|----------|--------------------------------------------------------------------------------------------------------------------------------------|
| AMS 6520 | Steel, Maraging, Sheet, Strip, and Plate, 18Ni - 7.8Co - 4.9Mo - 0.40Ti - 0.10Al, Consumable Electrode Melted, Solution Heat Treated |
| ARP1876  | Weldability Test for Weld Filler Metal Wire                                                                                          |
| ARP4926  | Alloy Verification and Chemical Composition Inspection of Welding Wire                                                               |

## 2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or [www.astm.org](http://www.astm.org).

|             |                                                                                                         |
|-------------|---------------------------------------------------------------------------------------------------------|
| ASTM E 8    | Tension Testing of Metallic Materials                                                                   |
| ASTM E 8M   | Tension Testing of Metallic Materials (Metric)                                                          |
| ASTM E 353  | Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys |
| ASTM E 1742 | Radiographic Examination                                                                                |

## 3. TECHNICAL REQUIREMENTS:

## 3.1 Wire Composition:

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 353, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - Composition

| Elements           | min   | max              |
|--------------------|-------|------------------|
| Carbon (3.1.1.1)   | --    | 0.03             |
| Manganese          | --    | 0.10             |
| Silicon            | --    | 0.10             |
| Phosphorus         | --    | 0.010            |
| Sulfur             | --    | 0.010            |
| Nickel             | 17.00 | 19.00            |
| Cobalt             | 7.50  | 8.50             |
| Molybdenum         | 4.60  | 5.20             |
| Titanium           | 0.30  | 0.50             |
| Aluminum           | 0.05  | 0.15             |
| Boron              | --    | 0.003 ( 30 ppm)  |
| Zirconium          | --    | 0.010            |
| Oxygen (3.1.1.1)   | --    | 0.010 (100 ppm)  |
| Nitrogen (3.1.1.1) | --    | 0.0050 ( 50 ppm) |
| Hydrogen (3.1.1.1) | --    | 0.0010 ( 10 ppm) |

3.1.1 Chemical analysis of initial ingot, bar, or rod stock before drawing is acceptable provided the processes used for drawing or rolling, annealing, and cleaning are controlled to ensure continued conformance to composition requirements.

3.1.1.1 Carbon, oxygen, nitrogen, and hydrogen shall also be determined periodically on finished wire (Refer to 4.2.2).

3.1.2 Check Analysis: Composition variations shall meet the requirements of AMS 2248. No variation is permitted for oxygen, nitrogen, and hydrogen.

### 3.2 Melting Practice:

Steel shall be vacuum induction melted; it may be remelted using consumable electrode vacuum practice in the remelt cycle, but remelting is not required.

### 3.3 Condition:

Cold worked, bright finish, in a temper and with a surface finish which will provide proper feeding of the wire in machine welding equipment.

### 3.4 Fabrication:

3.4.1 Wire shall be formed from rod or bar descaled by a process that does not affect the composition of the wire.

3.4.2 In-process annealing between cold rolling or drawing operations shall be performed in a protective atmosphere to avoid surface oxidation and adsorption of other extraneous elements.

3.4.3 Butt welding is permissible provided both ends to be joined are alloy verified using a method or methods capable of distinguishing the alloy from all other alloys processed within the facility or the repair is made at the wire processing station. The butt weld shall not interfere with uniform, uninterrupted feeding of the wire in machine welding equipment.

3.4.4 Drawing compounds, oxides, dirt, oil, and other foreign materials shall be removed by cleaning processes which will neither result in pitting nor cause gas absorption by the wire or deposition of substances harmful to welding operations.

3.4.5 Residual elements and dissolved gases deposited on, or absorbed by, the wire as a result of cleaning or drawing operations shall be removed by vacuum degassing.

### 3.5 Properties:

Wire shall conform to the following requirements:

- 3.5.1 Tensile Properties: When specified, specimens prepared in accordance with 4.3.1 shall meet the requirements shown in Table 2, determined in accordance with ASTM E 8 or ASTM E 8M, after being solution heat treated by heating in air to 1500 °F ± 25 (816 °C ± 14), holding at heat for not less than 30 minutes, and cooling in air, and maraged by heating to 900 °F ± 15 (482 °C ± 8), holding at heat for 3 to 5 hours, and cooling in air.

TABLE 2 - Minimum Tensile Properties

| Property                         | Value              |
|----------------------------------|--------------------|
| Tensile Strength                 | 255 ksi (1758 MPa) |
| Yield Strength at 0.2% Offset    | 245 ksi (1689 MPa) |
| Elongation in 2 Inches (50.8 mm) | 4%                 |

- 3.5.2 Weldability: Melted wire shall flow smoothly and evenly during welding and shall produce acceptable welds. ARP1876 may be used to resolve disputes.

- 3.5.3 Spooled Wire: Shall conform to 3.5.3.1 and 3.5.3.2.

- 3.5.3.1 Cast: Wire, wound on standard 12-inch (305-mm) diameter spools, shall have imparted to it a curvature such that a specimen sufficient in length to form one loop with a 1 inch (25 mm) overlap, when cut from the spool and laid on a flat surface, shall form a circle 15 to 50 inches (381 to 1270 mm) in diameter.

- 3.5.3.2 Helix: The specimen on which cast was determined, when laid on a flat surface and measured between adjacent turns, shall show a vertical separation not greater than 1 inch (25 mm).

- 3.6 Quality:

Wire, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from imperfections detrimental to welding operations, operation of welding equipment, or properties of the deposited weld metal.

- 3.7 Sizes and Tolerances:

Wire shall be supplied in the sizes and to the tolerances shown in 3.7.1 and 3.7.2.

- 3.7.1 Diameter: Shall be as shown in Table 3.

TABLE 3A - Sizes and Diameter Tolerances, Inch/Pound Units

| Form        | Nominal Diameter<br>Inch   | Tolerance<br>Inch<br>Plus and Minus |
|-------------|----------------------------|-------------------------------------|
| Cut Lengths | 0.030, 0.035, 0.045        | 0.001                               |
| Cut Lengths | 0.062, 0.094, 0.125        | 0.002                               |
| Spools      | 0.007, 0.010, 0.015, 0.020 | 0.0005                              |
| Spools      | 0.030, 0.035, 0.045        | 0.001                               |
| Spools      | 0.062, 0.094               | 0.002                               |

TABLE 3B - Sizes and Diameter Tolerances, SI Units

| Form        | Nominal Diameter<br>Millimeters | Tolerance<br>Millimeter<br>Plus and Minus |
|-------------|---------------------------------|-------------------------------------------|
| Cut Lengths | 0.76, 0.89, 1.14                | 0.025                                     |
| Cut Lengths | 1.57, 2.39, 3.18                | 0.05                                      |
| Spools      | 0.18, 0.25, 0.38, 0.51          | 0.013                                     |
| Spools      | 0.76, 0.89, 1.14                | 0.025                                     |
| Spools      | 1.57, 2.39                      | 0.05                                      |

3.7.2 Length: Cut lengths shall be furnished in 18, 27, or 36 inch (457, 686, or 914 mm) lengths, as ordered, and shall not vary more than +0, -0.5 inch (-13 mm) from the length ordered.

#### 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 the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the wire conforms to specified requirements.

##### 4.2 Classification of Tests:

4.2.1 Acceptance Tests: Composition (3.1.1), tensile properties when specified (3.5.1), tolerances (3.7), and alloy verification (5.2) are acceptance tests and shall be performed on each heat or lot as applicable.