

# AEROSPACE MATERIAL SPECIFICATION

**SAE** AMS6463D

Issued 1974-06  
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Superseding AMS6463C

Wire, Steel Welding  
18.5Ni - 8.5Co - 5.2Mo - 0.72Ti - 0.10Al (Marage 300)  
Vacuum Melted, Environment Controlled Packaging

(Composition similar to UNS K93130)

## RATIONALE

AMS6463D results from a Five Year Review and update of this specification.

### 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 gas-tungsten-arc and inert gas-metal-arc welding of maraging steels requiring a joint capable of being heat treated to 280 ksi (1931 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 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 724-776-4970 (outside USA), [www.sae.org](http://www.sae.org).

|         |                                                                                                                                            |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------|
| AMS2248 | Chemical Check Analysis Limits, Corrosion and Heat-Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels, and Iron Alloys  |
| AMS2370 | Quality Assurance Sampling and Testing, Carbon and Low-Alloy Steel Wrought Products and Forging Stock                                      |
| AMS2813 | Packaging and Marking of Packages of Welding Wire, Standard Method                                                                         |
| AMS2814 | Packaging and Marking of Packages of Welding Wire, Premium Quality                                                                         |
| AMS2816 | Identification, Welding Wire, Tab Marking Method                                                                                           |
| AMS2819 | Identification, Welding Wire, Direct Color Code System                                                                                     |
| AMS6514 | Steel, Maraging, Bars, Forgings, Tubing, and Rings, 18.5Ni - 9.0Co - 4.9Mo - 0.65Ti - 0.10Al, Consumable Electrode Vacuum Melted, Annealed |

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on this Technical Report, please visit  
<http://www.sae.org/technical/standards/AMS6463D>**

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 International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, [www.astm.org](http://www.astm.org).

ASTM D 2650 Chemical Composition of Gases by Mass Spectrometry

ASTM E 8 / 8M Tension Testing of Metallic Materials

ASTM E 353 Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys

ASTM E 1032 Radiographic Examination of Weldments

## 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 353, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - COMPOSITION

| Element                  | min   | max             |
|--------------------------|-------|-----------------|
| Carbon (3.1.2)           | --    | 0.010           |
| Manganese                | --    | 0.10            |
| Silicon                  | --    | 0.10            |
| Phosphorus               | --    | 0.010           |
| Sulfur                   | --    | 0.010           |
| Nickel                   | 18.00 | 19.00           |
| Cobalt                   | 8.00  | 9.00            |
| Molybdenum               | 4.50  | 6.00            |
| Titanium                 | 0.65  | 0.80            |
| Aluminum                 | 0.05  | 0.15            |
| Oxygen (3.1.2)           | --    | 0.0025 (25 ppm) |
| Nitrogen (3.1.2)         | --    | 0.005 (50 ppm)  |
| Hydrogen (3.1.2) (3.1.4) | --    | 0.0025 (25 ppm) |

#### 3.1.1 Check Analysis

Composition variations shall meet the applicable requirements of AMS2248, except that no variation is permitted for oxygen, nitrogen, and hydrogen.

#### 3.1.2 Shall be determined on finished wire.

3.1.3 Chemical analysis of initial ingot, bar, or rod stock before drawing, other than those analyses required to be done on the finished wire, is acceptable provided the processes used for drawing or rolling, annealing, and cleaning are controlled to ensure continued conformance to requirements.

3.1.4 The hydrogen content of the wire shall be determined at final diameter in accordance with ASTM D 2650.

### 3.2 Melting Practice

Steel shall be produced by vacuum induction melting; it may be remelted using consumable electrode vacuum process, but remelting is not required.

### 3.3 Condition

Cold worked, bright finish, in a temper that 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, if required between cold rolling or drawing operations, shall be performed in vacuum or protective atmosphere to avoid surface oxidation and absorption of other extraneous elements.
- 3.4.3 Drawing compounds, oxides, dirt, oil, and other foreign materials shall be removed by cleaning processes that will neither result in pitting nor cause gas absorption by the wire or deposition of substances harmful to welding operations.
- 3.4.4 Butt welding is permissible provided both ends to be joined are either alloy verified using a method or methods capable of distinguishing the alloy from all others processed in 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.
- 3.4.5 Residual elements and dissolved gasses picked up during wire processing that can adversely affect the welding characteristics, the operation of the equipment, or the properties of the weld metal, shall be removed.

### 3.5 Properties

Wire shall conform to the following requirements:

#### 3.5.1 Weldability

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

#### 3.5.2 Spooled Wire

Shall conform to 3.5.2.1 and 3.5.2.2.

##### 3.5.2.1 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.

##### 3.5.2.2 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).

#### 3.5.3 Tensile Properties

A tensile specimen, prepared in accordance with 4.3.1, shall have the properties shown in Table 2, determined in accordance with ASTM E 8 / 8M, after being solution heat treated by heating in air to  $1500^{\circ}\text{F} \pm 25$  ( $816^{\circ}\text{C} \pm 14$ ), holding at heat for not less than 30 minutes, and cooling in air, and maraged by heating to  $900^{\circ}\text{F} \pm 15$  ( $482^{\circ}\text{C} \pm 8$ ), holding at heat for 3 to 5 hours, and cooling in air.

TABLE 2 - MINIMUM TENSILE PROPERTIES

| Property                         |                    |
|----------------------------------|--------------------|
| Tensile Strength                 | 280 ksi (1931 MPa) |
| Yield Strength at 0.2% Offset    | 270 ksi (1862 MPa) |
| Elongation in 2 Inches (50.8 mm) | 3%                 |

### 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    |               |
|-------------|----------------------------------------------------|--------------|---------------|
|             |                                                    | Inch<br>plus | Inch<br>minus |
| Cut Lengths | 0.030, 0.045                                       | 0.001        | 0.001         |
| Cut Lengths | 0.053, 0.062, 0.078, 0.094,<br>0.125, 0.156, 0.188 | 0.002        | 0.002         |
| Spools      | 0.007, 0.010, 0.015, 0.020                         | 0.0005       | 0.0005        |
| Spools      | 0.030, 0.035, 0.045                                | 0.001        | 0.001         |
| Spools      | 0.062, 0.078, 0.094                                | 0.002        | 0.002         |

TABLE 3B - SIZES AND DIAMETER TOLERANCES, SI UNITS

| Form        | Nominal Diameter<br>Millimeters             | Tolerance          |                     |
|-------------|---------------------------------------------|--------------------|---------------------|
|             |                                             | Millimeter<br>plus | Millimeter<br>minus |
| Cut Lengths | 0.76, 1.14                                  | 0.025              | 0.025               |
| Cut Lengths | 1.32, 1.57, 1.98, 2.39,<br>3.18, 3.96, 4.78 | 0.05               | 0.05                |
| Spools      | 0.18, 0.25, 0.38, 0.51                      | 0.013              | 0.013               |
| Spools      | 0.76, 0.89, 1.14                            | 0.025              | 0.025               |
| Spools      | 1.57, 1.98, 2.39                            | 0.05               | 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 (+0, -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.