SAE Aerospace
An SAE International Group

AEROSPACE MATERIAL SPECIFICATION

SAE AMS6501 | REV. D

Issued 1984-10
Revised 2007-05
Reaffirmed 2012-04

Superseding AMS6501C

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

RATIONALE

AMS6501D has been reaffirmed to comply with the SAE five-year review policy.

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 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.

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
AMS 6520	Steel, Maraging, Sheet, Strip, and Plate, 18Ni - 7.8Co - 4.9Mo - 0.40Ti - 0.10Al, Consumable Electrode Melted, Solution Heat Treated

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

SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/AMS6501D

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.

ASTM E 8 Tension Testing of Metallic Materials
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 applicable 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 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 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 that 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, 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 Inch	Tolerance Inch 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 Millimeters	Tolerance Millimeter 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 (+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.