ADOPTION NOTICE

SAE-AMS 6501, "Steel, Maraging, Welding Wire 18Ni - 8.0Co - 4.9Mo - 0.40Ti - 0.10Al Vacuum Induction Melted, Environment Controlled Packaging" was adopted on 5 August 1996 for use by the Department of Defense (DoD). Proposed changes by DoD activities must be submitted to the DoD Adopting Activity: Air Force, ASC/ENSI, 2530 Loop Road West, Wright-Patterson AFB OH 45433-7101. DoD activities may obtain copies of this standard from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 1911 l-5094. The private sector and other Government agencies may purchase copies from the Society of Automotive Engineers Inc., 400 Commonwealth Drive, Warrendale, PA 15096-0001.

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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 6501B

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Superseding AMS 6501A

Submitted for recognition as an American National Standard

STEEL, MARAGING, WELDING WIRE
18Ni - 8.0Co - 4.9Mo - 0.40Ti - 0.10Al
Vacuum Induction Melted, Environment Controlled Packaging

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 following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

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 2635 Radiographic Inspection
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

2.1 (Continued):

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.

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

3. TECHNICAL REQUIREMENTS:

3.1 Wire Composition:

(R) 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	--	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)	--	0.0025 (25 ppm)
Nitrogen (3.1.1)	--	0.0050 (50 ppm)
Hydrogen (3.1.1)	--	0.0010 (10 ppm)

3.1.1 Determination of oxygen, nitrogen, and hydrogen content is not required for cut lengths.

3.1.2 (R) 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.

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

3.2 Melting Practice:

(R) 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:

(R) 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 (R) 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.

3.4.2 (R) 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.

3.4.3 (R) 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.

3.4.4 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:

3.51 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.

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.

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 %

3.5.3.1 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	Tolerance Inch Minus
Cut Lengths	0.030, 0.035, 0.045, 0.062	0.002	0.002
Cut Lengths	0.094, 0.125	0.003	0.003
Spools	0.007, 0.010, 0.015, 0.020	0.0005	0.0005
Spools	0.030, 0.035, 0.045	0.001	0.002
Spools	0.062, 0.094	0.002	0.002

TABLE 38 - Sizes and Diameter Tolerance, SI Units

Form	Nominal Diameter Millimeters	Tolerance Millimeter Plus	Tolerance Millimeter Minus
Cut Lengths	0.76, 0.89, 1.14, 1.57	0.05	0.05
Cut Lengths	2.39, 3.18	0.08	0.08
Spools	0.18, 0.25, 0.38, 0.51	0.013	0.013
Spools	0.76, 0.89, 1.14	0.025	0.05
Spools	1.57, 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 (-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), tensile properties (3.5.1) when specified, tolerances (3.7), and alloy verification (5.2) are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.2 Periodic Tests: Weldability (3.5.2), cast (3.5.3.1), and helix (3.5.3.2) are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing:

Shall be in accordance with AMS 2371 and as specified herein.

4.3.1 Specimens for tensile testing, when specified, shall be obtained from a single-vee-groove, butt-joint weld made between two pieces of AMS 6520 plate, nominally 0.250 inch (6.35 mm) thick. The weld metal shall be finished flush with the parent metal on both faces. The weld area in the location of the tensile specimen or specimens shall be free from defects detrimental to tensile properties of the weld, determined by radiographic inspection in accordance with AMS 2635. A standard sheet-type rectangular tensile specimen shall be prepared in accordance with ASTM E 8 or ASTM E 8M, with the weld in the approximate center of the gage length and perpendicular to the longitudinal axis of the specimen.