SAE Aerospace
An SAE International Group

AEROSPACE MATERIAL SPECIFICATION

SAE AMS6463 | REV. E

Issued 1974-06
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Superseding AMS6463D

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

AMS6463E results from a Five Year Review and editorial 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.

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

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/AMS6463E

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

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 D 2650 Chemical Composition of Gases by Mass Spectrometry

ASTM E 8 / E 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 / 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	
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 Inch	Tolerance Inch plus	Tolerance Inch minus
Cut Lengths	0.030, 0.045	0.001	0.001
Cut Lengths	0.053, 0.062, 0.078, 0.094, 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 Millimeters	Tolerance Millimeter plus	Tolerance Millimeter minus
Cut Lengths	0.76, 1.14	0.025	0.025
Cut Lengths	1.32, 1.57, 1.98, 2.39, 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.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Composition (3.1), sizes and 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 (3.5.1), cast (3.5.2.1), helix (3.5.2.2), and tensile properties (3.5.3) 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 AMS2370 and as specified herein.

4.3.1 Specimens for tensile testing shall be prepared from a single vee-groove, butt-joint weld made between two pieces of AMS6514 at least 0.250 inch (6.35 mm) thick, that have been chamfered full depth to a 60 degree included angle; a backing strip of the same material may be used. The weld shall be perpendicular to the longitudinal grain direction of the test pieces. 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 ASTM E 1032. A standard tensile specimen shall be prepared, in accordance with ASTM E 8 / E 8M, with the weld in the approximate center of the gage length and perpendicular to the longitudinal axis of the specimen.

4.4 Reports

The vendor of wire shall furnish with each shipment a report showing the results of tests for composition of each heat and stating that the wire conforms to the other technical requirements. This report shall include the purchase order number, heat and lot numbers, AMS6463E, nominal size, and quantity.