



AEROSPACE MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

AMS 6463

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Revised

STEEL WIRE, WELDING

18.5Ni - 8.5Co - 5.25Mo - 0.72Ti - 0.10Al

Vacuum Melted, Environment Controlled

1. SCOPE:

1.1 Form: This specification covers an 18% nickel maraging steel in the form of welding wire.

1.2 Application: Primarily for use as filler metal for inert gas-metal-arc welding of critical weldments of maraging steels where the joint is capable of being heat treated to 280,000 psi (1931 MPa) tensile strength.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., Two Pennsylvania Plaza, New York, New York 10001.

2.1.1 Aerospace Material Specifications:

AMS 2248 - Chemical Check Analysis Limits, Wrought Heat and Corrosion
Resistant Steels and Alloys

AMS 2350 - Standards and Test Methods

AMS 2370 - Quality Assurance Sampling of Carbon and Low-Alloy Steels,
Wrought Products Except Forgings and Forging Stock

AMS 2635 - Radiographic Inspection

AMS 2814 - Packaging, Welding Wire, Premium Quality

AMS 2815 - Identification, Welding Wire, Line Code System

AMS 6521 - Sheet, Strip, and Plate, 18.5Ni - 9.0Co - 4.9Mo - 0.65Ti - 0.10Al,
Consumable Electrode Melted, Solution Heat Treated

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

ASTM A370 - Mechanical Testing of Steel Products

ASTM E353 - Chemical Analysis of Stainless, Heat-Resisting, Maraging, and
Other Similar Chromium-Nickel-Iron Alloys

2.3 Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.

2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E353, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other approved analytical methods:

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	min	max
Carbon	--	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	--	0.0025 (25 ppm)
Nitrogen	--	0.005 (50 ppm)
Hydrogen	--	0.0025 (25 ppm)

3.1.1 Check Analysis: Composition variations shall meet the requirements of AMS 2248.

3.2 Condition: Cold drawn, bright finish, as-drawn temper. Wire shall be furnished on disposable spools for machine welding and in cut lengths for manual welding operations, as ordered. Surface roughness of spooled wire shall be as agreed upon by purchaser and vendor.

3.2.1 Drawing compounds, oxides, and dirt 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.

3.2.2 Residual elements and dissolved gases deposited on, or absorbed by, the welding wire as a result of cleaning or drawing operations shall be removed by vacuum degassing. Annealing, if required, shall be performed in vacuum or inert gas atmosphere.

3.3 Properties:

3.3.1 Weldability: Melted wire shall flow smoothly and evenly during welding and shall be capable of producing acceptable welds, determined by a procedure agreed upon by purchaser and vendor.

3.3.2 Spooled Wire: Shall conform to the following, unless otherwise agreed upon by purchaser and vendor:

3.3.2.1 Cast: Wire shall have imparted to it a curvature such that a specimen sufficient in length to form one loop, when cut from the spool and laid on a flat surface, shall form a circle not less than 15 in. (381 mm) and not greater than 30 in. (762 mm) in diameter.

3.3.2.2 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 in. (25 mm).

3.3.3 Tensile Properties: A test specimen prepared in accordance with 4.3.1, solution heat treated by heating in air to $1500^{\circ}\text{F} \pm 25$ ($815.6^{\circ}\text{C} \pm 14$), holding at heat for not less than 30 min., and cooling in air, and maraged by heating to $900^{\circ}\text{F} \pm 15$ ($482.2^{\circ}\text{C} \pm 8.3$), holding at heat for 3 - 5-hr, and cooling in air, shall be capable of meeting the following requirements:

Tensile Strength, min	280,000 psi (1931 MPa)
Yield Strength at 0.2% Offset, min	270,000 psi (1862 MPa)
Elongation in 2 in. (50.8 mm), min	3%

3.4 Quality:

3.4.1 Steel shall be vacuum induction melted; it may be remelted using vacuum consumable electrode process but remelting is not required.

3.4.2 Wire shall be uniform in quality and condition, clean, sound, and free from foreign materials and from internal and external imperfections detrimental to welding operations, operation of welding equipment, or properties of the deposited weld metal.

3.5 Sizes and Tolerances: Unless otherwise specified wire shall be furnished in the sizes and to the tolerances shown in 3.5.1 and 3.5.2.

3.5.1 Diameter:

TABLE I

Form	Nominal Diameter Inch	Tolerance, Inch plus and minus
Cut Lengths	0.045, 0.062, 0.093, 0.125	0.003
Spools	0.030, 0.035, 0.045, 0.062, 0.093	0.001

TABLE I (SI)

Form	Nominal Diameter Millimetres	Tolerance, Millimetre plus and minus
Cut Lengths	1.14, 1.57, 2.36, 3.18	0.08
Spools	0.76, 0.89, 1.14, 1.57, 2.36	0.03

3.5.2 Length: Cut lengths shall be furnished in 18, 27, or 36 in. (457, 686, or 914 mm) lengths, as ordered, and shall not vary more than $\pm 0, -1/2$ in. (-12.7 mm) from the length ordered.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of wire shall supply all samples and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.4. Purchaser reserves the right to perform such confirmatory testing as he deems necessary to assure that the wire conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to composition (3.1) and tolerance (3.5) requirements are classified as acceptance or routine control tests.

4.2.2 Qualification Tests: Tests to determine conformance to weldability (3.3.1), cast (3.3.2.1), helix (3.3.2.2), and tensile property (3.3.3) requirements are classified as qualification or periodic control tests.

4.3 Sampling: Shall be in accordance with AMS 2370 and the following:

4.3.1 Specimens for Tensile Property Testing: A single-vee-groove, butt-joint weld shall be made between two pieces of AMS 6521 plate 0.250 in. (6.35 mm) thick, which are chamfered full depth to a 60 deg (1.05 rad) included angle. 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 the tensile properties of the weld as revealed by radiographic inspection in accordance with AMS 2635. A standard sheet-type rectangular tensile test specimen shall be prepared in accordance with ASTM A370, with the weld in the approximate center of the gage length and perpendicular to the longitudinal axis of the specimen.