SAE The Engineering Resource For Advancing Mobility®
400 COMMONWEALTH DRIVE WARRENDALE PA 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 6501

Issued 10-1-84
Revised

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

1. SCOPE:

1.1 Form: This specification covers a 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 requiring a joint capable of being heat treated to 255,000 psi (1760 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 shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2248 - Chemical Check Analysis Limits, Wrought Corrosion and Heat Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels, and Iron Alloys
AMS 2350 - Standards and Test Methods
AMS 2371 - Quality Assurance Sampling of Corrosion and Heat Resistant Steels and Alloys, Wrought Products Except Forgings and Forging Stock
AMS 2635 - Radiographic Inspection
AMS 2814 - Packaging of Welding Wire, Premium Quality
AMS 2815 - Identification, Welding Wire, Line Code System
AMS 2816 - Identification, Welding Wire, Color Code System
AMS 6520 - Steel Sheet, Strip, and Plate, Maraging, 18Ni - 7.8Co - 4.9Mo - 0.40Ti - 0.10Al, Consumable Electrode Melted, Solution Heat Treated

SAENORM.COM : Click to view the full PDF of ams6501

SAE Technical Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

AMS documents are protected under United States and international copyright laws. Reproduction of these documents by any means is strictly prohibited without the written consent of the publisher.

Copyright 1984 Society of Automotive Engineers, Inc. Printed in U.S.A.

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

ASTM E8 - Tension Testing of Metallic Materials
ASTM E353 - Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys

2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 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 analytical methods approved by purchaser:

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

SAENORM.COM : Click to view the full PDF of ams6501

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

3.2 Condition: Cold finished, bright finish in a temper which will provide proper feeding of the wire in welding equipment.

3.2.1 Wire shall be furnished on disposable spools for machine welding and in cut lengths for manual welding, as ordered. Surface texture of spooled wire shall be as agreed upon by purchaser and vendor.

3.2.2 Drawing compounds, oxides, dirt, and oil 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.

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

3.3 Properties: Wire shall conform to the following requirements:

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

3.3.2 Spooled Wire: Shall conform to 3.3.2.1 and 3.3.2.2.

3.3.2.1 Cast: Wire wound on standard 12-in. (300-mm) diameter spools shall have imparted to it a curvature such that a specimen sufficient in length, 4 - 8 ft (1.2 - 2.4 m), to form one loop, when cut from the spool and laid on a flat surface, shall form a circle not less than 15 in. (375 mm) and not greater than 30 in. (750 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: When specified, specimens prepared in accordance with 4.3.1 shall meet the following requirements, determined in accordance with ASTM E8, after being solution heat treated by heating in air to 1500°F ± 25 (815°C ± 5), holding at heat for not less than 30 min., and cooling in air, and maraged by heating to 900°F ± 15 (480°C ± 8), holding at heat for 3 - 5 hr, and cooling in air:

Tensile Strength, min	255,000 psi (1760 MPa)
Yield Strength at 0.2% Offset, min	245,000 psi (1690 MPa)
Elongation in 2 in. (50 mm), min	4%

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, 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.

SAENORM.COM : Click to view the full PDF of ams6501

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.

TABLE I

Form	Nominal Diameter Inch	Tolerance, Inch plus	Tolerance, Inch minus
Cut Lengths	0.094, 0.125, 0.156, 0.188	0.003	0.003
Cut Lengths	0.030, 0.045, 0.062, 0.078	0.002	0.002
Spools	0.062, 0.078, 0.094	0.002	0.002
Spools	0.030, 0.035, 0.045	0.001	0.002
Spools	0.007, 0.010, 0.015, 0.020	0.0005	0.0005

TABLE I (SI)

Form	Nominal Diameter Millimetres	Tolerance, Millimetre plus	Tolerance, Millimetre minus
Cut Lengths	2.35, 3.10, 4.00, 4.75	0.08	0.08
Cut Lengths	0.75, 1.15, 1.55, 2.00	0.05	0.05
Spools	1.55, 2.00, 2.35	0.05	0.05
Spools	0.75, 0.90, 1.15	0.02	0.05
Spools	0.20, 0.25, 0.40, 0.50	0.015	0.015

3.5.2 Length: Cut lengths shall be furnished in 18, 27, or 36 in. (450, 675, or 900 mm) lengths, as ordered, and shall not vary more than +0, -1/2 in. (-12 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 performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.4. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the wire conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance requirements for composition (3.1), tensile properties (3.3.3) when specified, and tolerances (3.5) are classified as acceptance tests and shall be performed on each heat or lot as applicable.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for weldability (3.3.1), cast (3.3.2.1), and helix (3.3.2.2) are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

SAENORM.COM : Click to view the full PDF of ams6501