SAE The Engineering Resource For Advancing Mobility®

400 Commonwealth Dr., Warrendale, PA 15096

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

SAE AMS 6469

Issued 4-1-86

STEEL WELDING WIRE
1.75Mn - 0.80Cr - 2.8Ni - 0.85Mo (0.09 - 0.12C)
Vacuum Melted, Environment-Controlled Packaging

1. SCOPE:

1.1 Form: This specification covers a low-alloy steel in the form of welding wire.

1.2 Application: Primarily for use as filler metal for gas-tungsten-arc and gas-metal-arc welding of low alloy steels of similar composition where the weld area is required to have strength and notch-toughness comparable to that of the parent metal without the need for post-weld heat treatment.

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 2259 - Chemical Check Analysis Limits, Wrought Low-Alloy and Carbon Steels
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 2814 - Packaging of Welding Wire, Premium Quality
AMS 2815 - Identification, Welding Wire, Line Code System
AMS 2816 - Identification, Welding Wire, Color Code System

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

ASTM D2650 - Chemical Composition of Gases by Mass Spectrometry
ASTM E350 - Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

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

2.3.1 Military Specifications:

MIL-S-24371 - Steel Plate, Alloy, Structural, High Yield Strength (HY-130)

2.4 AWS Publications: Available from American Welding Society, P.O. Box 351040, Miami, FL 33135.

ANSI/AWS B4.0 - Standard Methods for Mechanical Testing of Welds

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E350 or, except as specified in 3.1.1, by spectrographic or other analytical methods approved by purchaser:

	min	max
Carbon	0.09	0.12
Manganese	1.50	2.00
Silicon	0.30	0.50
Phosphorus	--	0.008
Sulfur	--	0.008
Chromium	0.65	0.90
Nickel	2.60	3.10
Molybdenum	0.70	1.00
Titanium	--	0.04
Aluminum	--	0.04
Copper	--	0.15
Vanadium	--	0.04
Oxygen	--	0.0025 (25 ppm)
Nitrogen	--	0.0050 (50 ppm)
Hydrogen (3.1.1)	--	0.0003 (3 ppm)

3.1.1 The hydrogen content of the wire shall be determined at final diameter in accordance with ASTM D2650.

3.1.2 Check Analysis: Composition variations shall meet the applicable requirements of AMS 2259. No variation over max 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 machine welding equipment. Wire shall be formed from bar descaled by a process which does not affect the composition of the wire. Surface irregularities inherent with a forming process which does not tear the wire surface are acceptable provided the wire conforms to the tolerances of 3.6. Surface texture of spooled wire shall be as agreed upon by purchaser and vendor.

3.2.1 Wire shall be furnished on disposable spools for machine welding or in cut lengths for manual welding, as ordered.

3.2.2 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.

3.2.3 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 under vacuum or in an 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).

3.4 Mechanical Properties: When wire is deposited on parent metal conforming to MIL-S-24371, an all-weld-metal specimen prepared and tested in accordance with AWS B4.0 shall conform to the following requirements:

Yield Strength at 0.2% Offset	135,000 - 150,000 psi (930 - 1035 MPa)	
Elongation in 2 in. (50 mm), min	14%	--
Charpy V-Notch Impact Energy, Minimum Average (See 3.4.2 and 3.4.3)		
At 30°F (-1°C)	50 ft-lb (68 J)	--
At 75°F (24°C)	50 ft-lb (68 J)	--

3.4.1 Ultimate tensile strength and percentage of reduction of area shall be recorded for information only.

3.4.2 For each testing temperature, the average values, computed from the three middle tests of five tests run, shall be equal to or greater than the minimum average value specified. Only one specimen may show an impact value below the minimum average specified and that value shall be no more than 10 ft-lb (13.5 J) below the specified minimum average.

3.4.3 The average impact value obtained at 75°F (24°C) shall be not more than 10 ft-lb (13.5 J) higher than the average value obtained at 30°F (-1°C).

3.5 Quality:

3.5.1 Steel shall be multiple melted under vacuum using consumable electrode practice in the remelt cycle or shall be vacuum induction melted.

3.5.2 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.

3.6 Sizes and Tolerances: Wire shall be supplied in the sizes and to the tolerances shown in 3.5.1 and 3.5.2.

3.6.1 Diameter:

TABLE I

Form	Nominal Diameter Inch	Tolerance, Inch plus	Tolerance, Inch minus
Cut Lengths	0.030, 0.045, 0.062, 0.094, 0.125	0.003	0.003
Spools	0.030, 0.035, 0.045	0.001	0.002
Spools	0.062, 0.094	0.002	0.002

TABLE I (SI)

Form	Nominal Diameter Millimetres	Tolerance, Millimetre plus	Tolerance, Millimetre minus
Cut Lengths	0.75, 1.15, 1.55, 2.35, 3.10	0.08	0.08
Spools	0.75, 0.90, 1.15	0.02	0.05
Spools	1.55, 2.35	0.05	0.05

3.6.2 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, -0.5 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 4.5. 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 to requirements for composition (3.1) 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), helix (3.3.2.2), and mechanical properties (3.4) are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.2.3 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests and shall be performed prior to or on the first-article shipment of wire to a purchaser, when a change in material, processing, or both requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.3.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, the contracting officer, or the request for procurement.

4.3 Sampling: Shall be in accordance with AMS 2370 and as specified herein.

4.3.1 Sample welds shall be made in accordance with a procedure agreed upon by purchaser and vendor to determine conformance to requirements of 3.4.

4.4 Approval:

4.4.1 Sample wire shall be approved by purchaser before wire for production use is supplied, unless such approval be waived by purchaser. Results of tests on production wire shall be essentially equivalent to those on the approved sample wire.

4.4.2 Vendor shall use materials, manufacturing procedures and processes, and methods of inspection on production wire which are essentially the same as those used on the approved sample wire. If necessary to make any change in materials or in manufacturing procedures and processes, vendor shall submit for reapproval a statement of the proposed changes in material, processing, or both and, when requested, sample wire. Production wire made by the revised procedure shall not be shipped prior to receipt of reapproval.