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400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 6461G

Issued 8-15-58
Revised 1-1-88

Superseding 6461F

STEEL WELDING WIRE
0.95Cr - 0.20V (0.28 - 0.33C) (SAE 6130)
Vacuum Melted, Environment Controlled Packaging

UNS K13148

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 critical weldments of low-alloy steels where the joint is capable of being heat treated to 180,000 psi (1240 MPa) minimum 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 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 2635 - Radiographic Inspection
AMS 2814 - Packaging of Welding Wire, Premium Qualtiy
AMS 2815 - Identification, Welding Wire, Line Code System
AMS 2816 - Identification, Welding Wire, Color Code System
AMS 6350 - Steel Sheet, Strip, and Plate, 0.95Cr - 0.20Mo (0.28 - 0.33C) (SAE 4130)

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 E350 - Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

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 by spectrochemical or other analytical methods approved by purchaser:

	min	max
Carbon	0.28	0.33
Manganese	0.60	0.90
Silicon	0.15	0.35
Phosphorus	--	0.008
Sulfur	--	0.008
Phosphorus + Sulfur	--	0.012
Chromium	0.80	1.10
Vanadium	0.15	0.25
Nickel	--	0.25
Molybdenum	--	0.06
Oxygen	--	0.0025 (25 ppm)
Nitrogen	--	0.005 (50 ppm)
Hydrogen	--	0.0025 (25 ppm)
Copper	--	0.35

3.1.1 Check Analysis: Composition variations shall meet the applicable requirements of AMS 2259, except that the limit for phosphorus plus sulfur includes the check analysis tolerance. No variation is permitted for oxygen, nitrogen, and hydrogen.

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

3.2.1 Wire shall be furnished on disposable spools for machine welding or 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, 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 by vacuum degassing. 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 to 8 ft (1200 to 2400 mm), to form one loop, when cut from the spool and laid on a flat surface, shall form a circle 15 - 30 in. (375 - 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: Specimens, prepared in accordance with 4.3.1 and tested in accordance with ASTM E8, shall have average tensile strength not lower than 90% of the average of the control specimens of 4.3.1; elongation of the welded specimens shall be not less than 5% in 2 in. (50 mm).

3.4 Quality:

3.4.1 Steel shall be vacuum induction melted.

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.

3.5 Sizes and Tolerances: 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	Tolerance, Inch minus
Cut Lengths	0.030, 0.045, 0.062, 0.078	0.002	0.002
Cut Lenghts	0.094, 0.125, 0.156, 0.188	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, 0.078, 0.094	0.002	0.002

TABLE I (SI)

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

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 to requirements for composition (3.1) and sizes 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 tensile properties (3.3.3) are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

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

4.3.1 Specimens for Tensile Property Testing: A single-vee-grove, butt-joint weld shall be made between two pieces of AMS 6350 plate, 0.250 in. (6.25 mm) in nominal thickness, which have been chamfered full depth to a 60-deg included angle; the weld shall be perpendicular to the longitudinal grain direction of the test pieces. Test pieces, prior to machining the test specimens, shall be heat treated to a tensile strength not lower than 180,000 psi (1240 MPa). After heat treatment, the weld metal shall be finished flush with the parent metal on both faces and standard sheet-type, rectangular tensile specimens shall be prepared in accordance with ASTM E8, with the weld in the approximate center of the gage length. The weld in the specimens, prior to tensile testing, shall be free from defects detrimental to tensile properties of the weld, determined in accordance with AMS 2635. Three control standard sheet-type, rectangular tensile specimens shall be machined from 0.250 in. (6.25 mm) AMS 6350 plate of the same heat as that used for the welded specimens, heat treated with the welded specimens, and tested for comparative tensile properties in accordance with ASTM E8.