SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 6456A

Issued 1 OCT 1984
Revised 1 OCT 1991
Superseding AMS 6456

Submitted for recognition as an American National Standard

STEEL WELDING WIRE
0.80Cr - 1.8Ni - 0.25Mo (0.35 - 0.40C) (SAE 4340 Mod)
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:

This product has been used typically as filler metal for gas-metal-arc or gas-tungsten-arc welding of critical weldments of low-alloy steels requiring a joint capable of being heat treated to a strength level approximating that of the basis metal, but usage is not limited to such applications.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2259 Chemical Check Analysis Limits, Wrought Low-Alloy and Carbon Steels
AMS 2370 Quality Assurance Sampling and Testing, Carbon and Low-Alloy Steel Wrought Products and Forging Stock
AMS 2635 Radiographic Inspection
AMS 2813 Packaging of Welding Wire, Standard Method
AMS 2814 Packaging of Welding Wire, Premium Quality
AMS 2815 Identification, Welding Wire, Line Code System

REAFFIRMED
5/95

2.1 SAE Publications (continued):

AMS 2816 Identification, Welding Wire, Color Code System
AMS 6359 Steel Sheet, Strip, and Plate, 0.80Cr - 1.8Ni - 0.25Mo (0.38 - 0.43C) (SAE 4340)
ARP1876 Weldability Test for Weld Filler Metal Wire

2.2 ASTM Publications:

Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM E 8 Tension Testing of Metallic Materials
ASTM E 8M Tension Testing of Metallic Materials (Metric)
ASTM E 350 Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

3. TECHNICAL REQUIREMENTS:

3.1 Composition:

(R) Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 350, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - Composition

Element	min	max
Carbon	0.35	0.40
Manganese	0.60	0.90
Silicon	0.15	0.35
Phosphorus	--	0.008
Sulfur	--	0.008
Chromium	0.70	0.90
Nickel	1.65	2.00
Molybdenum	0.20	0.30
Copper	--	0.30
Oxygen (3.1.2)	--	0.0025 (25 ppm)
Nitrogen (3.1.2)	--	0.0050 (50 ppm)
Hydrogen (3.1.2)	--	0.0010 (10 ppm)

3.1.1 Check Analysis: Composition variations shall meet the applicable requirements of AMS 2259. No variation over maximum is permitted for oxygen, nitrogen, and hydrogen.

3.1.2 (R) Determination of oxygen, nitrogen, and hydrogen not required for cut lengths.

3.2 Melting Practice:

Steel shall be vacuum induction melted; it may be remelted using consumable electrode vacuum practice in the remelt cycle but remelting is not required.

3.3 Condition:

Cold drawn, bright finish, in a temper and with a surface finish which will provide proper feeding of the wire in machine welding equipment.

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

3.3.2 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.

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

3.4 Properties:

Wire shall conform to the following requirements:

3.4.1 (R) Weldability: Melted wire shall flow smoothly and evenly during welding and shall produce acceptable welds. ARP1876 may be used to resolve disputes.

3.4.2 Spooled Wire: Shall conform to 3.4.2.1 and 3.4.2.2.

3.4.2.1 (R) 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, 4 - 14 feet (1.2 - 4.3m), to form one loop, when cut from the spool and laid on a flat surface, shall form a circle 15 - 50 inches (381 -1270 mm) in diameter.

3.4.2.2 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).

3.4.3 Tensile Properties: When specified, specimens prepared in accordance with 4.3.1 and tested in accordance with ASTM E 8 or ASTM E 8M 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 6% in 2 inches (50.8 mm).

3.5 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.

3.6 Sizes and Tolerances:

Wire shall be supplied in the sizes and to the tolerances shown in Table 2 and 3.6.2.

3.6.1 Diameter:

TABLE 2A - Diameter Sizes and Tolerances, Inch/Pound Units

Form	Standard Sizes Nominal Diameter Inch	Tolerance Inch Plus	Tolerance Inch Minus
Cut Lengths	0.030, 0.045, 0.062, 0.078	0.002	0.002
Cut Lengths	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 2B - Diameter Sizes and Tolerances, SI Units

Form	Standard Sizes Nominal Diameter Millimeters	Tolerance Millimeter Plus	Tolerance Millimeter Minus
Cut Lengths	0.76, 1.14, 1.57, 1.98	0.05	0.05
Cut Lengths	2.39, 3.18, 3.96, 4.78	0.08	0.08
Spools	0.18, 0.25, 0.38, 0.51	0.013	0.013
Spools	0.76, 0.89, 1.14	0.025	0.05
Spools	1.57, 1.98, 2.39	0.05	0.05

3.6.2 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, -1/2 inch (-13 mm) from the length ordered.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

(R)

The vendor of wire shall supply all samples for vendor's tests and shall be responsible for performing all required tests. 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 for composition (3.1), tensile properties (3.4.3) when specified, and sizes and tolerances (3.6) are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.2 Periodic Tests: Tests for weldability (3.4.1), cast (3.4.2.1), and helix (3.4.2.2) 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:

(R)

Shall be in accordance with AMS 2370 and as specified herein; a heat shall be the ingots produced from a single vacuum induction melt or, when steel is consumable electrode remelted, a heat shall be the consumable electrode remelted ingots produced from steel originally melted as a single furnace charge.

4.3.1 Tensile Specimens: Shall be obtained from a single-vee-groove, butt-joint weld made between two pieces of AMS 6359 plate, 0.250 inch (6.35 mm) in nominal thickness, chamfered full depth to a 60-degree included angle; the weld shall be perpendicular to the longitudinal grain direction of the test pieces. Samples, prior to machining the tensile specimens, shall be heat treated to a tensile strength not lower than 180 ksi (1241 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 conforming to ASTM E 8 or ASTM E 8M prepared with the weld in the approximate center of the gage length. The weld area in the location of the test specimens shall be free from defects detrimental to the tensile properties of the weld, determined by radiographic inspection in accordance with AMS 2635. Three control standard sheet-type, rectangular tensile specimens shall be machined from AMS 6359 plate, 0.250 inch (6.35 mm) in nominal thickness, from the same heat as that used for the welded specimens, heat treated with the welded specimens, and tested for comparative tensile properties.

4.4 Reports:

The vendor of wire shall furnish with each shipment a report showing the results of tests for chemical composition of each heat and stating that the wire conforms to the other acceptance test requirements. This report shall include the purchase order number, lot number, AMS 6456A, nominal size, and quantity.