AEROSPACE MATERIAL SPECIFICATION

AMS6456™	REV. E

Issued 1984-10
Revised 2017-10
Reaffirmed 2022-06

Superseding AMS6456D

Steel, Welding Wire 0.80Cr - 1.8Ni - 0.25Mo (0.35 - 0.40C) (SAE 4340 Mod) Vacuum Melted, Environment-Controlled Packaging (Composition similar to UNS G43370)

RATIONALE

AMS6456E results from a Five-Year Review and update of this specification that revises hydrogen to be determined in the wire (3.1.1.1), revises fabrication (3.4), adds winding requirement (3.5.2.3), changes weld examination to ASTM E1032 (4.3.1), and revises testing requirements (4.2). Type 2 copper coated wire was removed from this document.

AMS6456E has been reaffirmed to comply with the SAE Five-Year Review policy.

1. SCOPE

1.1 Form

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

1.2 Application

This wire 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 issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS2259 Chemical Check Analysis Limits Wrought Low-Alloy and Carbon Steels

AMS2370 Quality Assurance Sampling and Testing, Carbon and Low-Alloy Steel Wrought Products and Forging Stock

AMS2813 Packaging and Marking of Packages of Welding Wire Standard Method

AMS2814 Packaging and Marking of Packages of Welding Wire Premium Quality

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/AMS6456E/

AMS2816 Identification Welding Wire, Tab Marking Method

AMS2819 Identification, Welding Wire Direct Color Code System

AMS6359 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

ARP1917 Clarification of Terms Used in Aerospace Metals Specifications

ARP4926 Alloy Verification and Chemical Composition Inspection of Welding Wire

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM A370 Mechanical Testing of Steel Products

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

ASTM E1032 Radiographic Examination of Weldments

3. TECHNICAL REQUIREMENTS

3.1 Wire Composition

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E350, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

Table 1 - Composition

Element	Min	Max
Carbon (3.1.1.1)	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 (3.1.1.1)	--	0.0100 (100 ppm)
Nitrogen (3.1.1.1)	--	0.0050 (50 ppm)
Hydrogen (3.1.1.1)	--	0.0010 (10 ppm)

3.1.1 Chemical analysis of initial ingot, bar, or rod stock before drawing, other than when analyses are required to be performed on the finished wire, is acceptable provided processes used for drawing or rolling, annealing, and cleaning are controlled to ensure continued conformance to composition requirements.

3.1.1.1 Hydrogen shall be determined on each lot of finished wire (see 4.2.1) in accordance with ASTM D2650. Carbon, oxygen, and nitrogen shall be periodically determined on finished wire (see 4.2.2).

3.1.2 Check Analysis

Composition variations shall meet the applicable requirements of AMS2259. No variation over maximum is permitted for oxygen, nitrogen and hydrogen.

3.2 Melting Practice

Steel shall be either vacuum induction melted or consumable electrode vacuum remelted.

3.3 Condition

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

3.4 Fabrication

3.4.1 Wire shall be formed from rod or bar descaled by a process which does not affect the composition of the wire. Surface irregularities inherent with a forming process that do not tear the wire surface are acceptable provided the wire conforms to the tolerances of 3.7.

3.4.2 In process annealing, if required between cold rolling or drawing operations, shall be performed in vacuum or in protective atmosphere to avoid surface oxidation and absorption of other extraneous elements.

3.4.3 Butt welding is permissible only at diameters larger than final provided both ends to be joined are either alloy verified using a method or methods capable of distinguishing the alloy from all other alloys processed within the facility or the repair is made at the wire processing station. The butt weld shall not interfere with uniform, uninterrupted feeding of the wire in machine welding equipment.

3.4.4 Drawing compounds, oxides, dirt, oil, and other foreign materials shall be removed by cleaning processes that will neither result in pitting nor cause gas absorption by the wire or deposition of substances harmful to welding operations.

3.4.5 Residual elements, drawing compounds, oxides, dirt, oil, dissolved gases and other foreign materials picked up during wire processing that can adversely affect the welding characteristics, the operation of the equipment, or the properties of the weld metal, shall be removed by cleaning processes that will neither result in pitting nor cause gas adsorption by the wire or deposition of substances harmful to the welding operations

3.5 Properties

Wire shall conform to the following requirements:

3.5.1 Weldability

Melted wire shall flow smoothly and evenly during welding and shall produce acceptable welds. ARP1876 may be used to resolve weldability disputes.

3.5.2 Spooled Wire

Shall conform to 3.5.2.1, 3.5.2.2 and 3.5.2.3.

3.5.2.1 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 to form one loop with a 1 inch (25 mm) overlap, when cut from the spool and laid on a flat surface, shall form a circle 15 to 50 inches (381 to 1270 mm) in diameter.

3.5.2.2 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).

3.5.2.3 Winding

Filler metal in coils and on spools shall be wound so that kinks, waves, sharp bends, overlapping, or wedging are not encountered, leaving the filler metal free to unwind without restriction. The outside end of the electrode (the end where welding is to begin) shall be identified so it can be located readily and shall be fastened to avoid unwinding. The winding on spools shall be level winding.

3.5.3 Tensile Properties

When specified, specimens, prepared in accordance with 4.3.1 and tested in accordance with ASTM A370, 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).

3.6 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.

3.6.1 Surface irregularities inherent with a forming process that does not tear the wire surface are acceptable provided the wire conforms to the tolerances of 3.7.

3.7 Sizes and Tolerances

Wire shall be supplied in the sizes and to the tolerances shown in 3.7.1 and 3.7.2.

3.7.1 Diameter

Shall be as shown in Table 2.

Table 2

Table 2A - Sizes and diameter tolerances, inch/pound units

Form	Nominal Diameter Inch	Tolerance Inch Plus and Minus
Cut Lengths	0.030, 0.035, 0.045	0.001
Cut Lengths	0.062, 0.078, 0.094, 0.125	0.002
Spools	0.007, 0.010, 0.015	0.0005
Spools	0.020, 0.030, 0.035, 0.045	0.001
Spools	0.062, 0.078, 0.094	0.002

Table 2B - Sizes and diameter tolerances, SI units

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

3.7.2 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, -0.5 inch (+0, -13 mm) from the length ordered.