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AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 6464D
Superseding AMS 6464C

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WELDING ELECTRODES, COVERED, STEEL 1.05Mo - 0.20V (0.06 - 0.12C)

UNS W10013

1. SCOPE:

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

1.2 Application: Primarily for use as filler metal for metal-arc welding of carbon and low-alloy steels when the deposited weld metal is required to have heat treating characteristics comparable to those of the parent metal.

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 2350 - Standards and Test Methods
AMS 6350 - Steel Sheet, Strip, and Plate, 0.95Cr - 0.20Mo (0.28 - 0.33C) (SAE 4130)
AMS 6355 - Steel Sheet, Strip, and Plate, 0.50Cr - 0.55Ni - 0.20Mo (0.28 - 0.33C) (SAE 8630)

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

ASTM A370 - Mechanical Testing of Steel Products
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-W-10430 - Welding Rods and Electrodes, Preparation for Delivery of

2.4 AWS Publications: Available from American Welding Society, Inc., P.O. Box 351050, Miami, FL 33135.

AWS A5.5 - Low-Alloy Steel Covered Arc-Welding Electrodes

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Weld metal deposited from electrodes shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E350 or by spectrographic or other analytical methods approved by purchaser:

	min	max
Carbon	0.06	0.12
Manganese	0.35	0.70
Silicon	0.30	0.60
Phosphorus	--	0.025
Sulfur	--	0.025
Molybdenum	0.90	1.20
Vanadium	0.10	0.30
Chromium	--	0.20
Nickel	--	0.25
Copper	--	0.35

3.1.1 Weld Pads for Chemical Analysis: The referee procedure for making pads of weld metal and removing samples for chemical analysis shall be AWS A5.5.

3.1.2 When permitted by purchaser, the composition requirements specified above may be waived if the requirements of 3.2 and 3.3 are met.

3.2 Type: Electrodes shall be suitable for welding in all positions using AC or using DC straight polarity (electrode negative) or reverse polarity.

3.3 Properties: Electrodes shall conform to the following requirements:

3.3.1 Tensile Properties: Shall be as follows, determined in accordance with ASTM A370 on specimens as in 4.3.1:

Tensile Strength Through Weld Zone, min	90% of Parent Metal
Elongation in 2 in. (50 mm), min	10%

3.3.2 Weldability: Electrodes shall demonstrate good weldability and shall flow smoothly and evenly under the conditions specified in 3.2.

3.3.3 Burn-Off: The covering shall be consumed uniformly all around and shall not burn back from the core wire under proper welding conditions. Heating of the electrode during welding shall not cause injurious blistering of the covering within the range of current values recommended by the manufacturer.

3.3.4 Grip Portion and Arc Ends: A portion of the electrode 0.75 - 1.25 in. (19 - 32 mm) long on end-grip rods and 1.5 - 2.0 in. (38 - 50 mm) long on center-grip rods shall be bare to permit good electrical contact with the electrode holder. The arc end of the electrodes shall be sufficiently bare to permit easy striking of the arc but the length of this bare section, measured from the end of the electrode to the point where the full cross-section of the covering begins, shall not exceed the diameter of the bare wire and in no case shall it exceed 1/8 in. (3 mm).

3.3.5 Cleaning: Slag produced during welding shall be readily removable with hand tools.

3.4 Quality:

3.4.1 Core Wire: Shall be uniform in quality and condition, cylindrical, clean, sound, and free from foreign materials and from imperfections detrimental to weld quality.

3.4.2 Covering: Shall be uniform in quality, tightly adherent, and free from abnormal scabs, blisters, pockmarks, bruises, and other surface defects and shall withstand normal handling without damage. It shall not be harmfully hygroscopic and shall not adversely affect weld quality.

3.5 Standard Size and Lengths: The sizes and lengths in Table I are standard:

TABLE I

Nominal Diameter of Core Wire Inch	Length Inches
1/16	9
5/64, 3/32	9 or 12
1/8, 5/32, 3/16	14

TABLE I (SI)

Nominal Diameter of Core Wire Millimetres	Length Millimetres
1.6	225
2.0, 2.4	225 or 300
3.2, 4.0, 4.8	350

3.5.1 Unless otherwise ordered, end-grip electrodes shall be supplied.

3.6 Tolerances: Shall be as follows:

3.6.1 Electrodes shall not vary in length more than ±1/4 in. (±6 mm) from the length ordered.

3.6.2 Electrode core wire shall not vary in diameter more than ±0.003 in. (±0.08 mm) from the size ordered.

3.6.2.1 Overall diameter of the covered electrode shall not vary more than 4% from that of the approved sample.

3.6.3 Covering shall be concentric with the core wire to the extent that the maximum core-plus-one-covering dimension shall not exceed the minimum core-plus-one-covering dimension by more than 3% of the minimum core-plus-one-covering dimension.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of electrodes shall supply all Ø samples 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 electrodes conform 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), grip portion and arc ends (3.3.4), size (3.5), and tolerances (3.6) are classified as acceptance tests and shall be performed on each control number of electrodes.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for tensile properties (3.3.1), weldability (3.3.2), burn-off (3.3.3), and cleaning (3.3.5) 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 electrodes 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 as agreed upon by purchaser and vendor; a control number shall be a designation indicating batch processing and core wire heat number.

4.3.1 Tensile specimens conforming to ASTM A370, with the weld in the approximate center of the gage length and perpendicular to the longitudinal axis of the specimen, shall be cut from coupons having a single-bevel-groove, butt-joint weld, made from one side, between two pieces of AMS 6350 or AMS 6355 steel plate nominally 0.250 in. (6.25 mm) thick, one piece of which is chamfered 7/32 in. (5.5 mm) deep to a 60 deg included angle. Root opening shall be adjusted for electrode diameter to ensure 100% weld penetration. Weld metal shall be machined flush with the parent metal on both faces. Test specimens shall be hardened and tempered to a parent metal hardness of 26 - 32 HRC. Hardness shall be determined in accordance with ASTM A370.

4.4 Approval:

4.4.1 Sample electrodes shall be approved by purchaser before electrodes for production use are supplied, unless such approval be waived by purchaser.

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

4.5 Reports:

4.5.1 The vendor of electrodes shall furnish with each shipment a report stating that the electrodes conform to the technical requirements of this specification. This report shall include the purchase order number, AMS 6464D, control number, size, and quantity. When requested by purchaser, the vendor shall also include in the report the composition of the deposited weld metal for each heat in the shipment.

4.5.2 When assemblies requiring use of these electrodes are supplied, the assembly manufacturer shall inspect each lot of electrodes to determine conformance to the technical requirements of this specification and shall furnish with each shipment a report stating that the electrodes conform. This report shall include the purchase order number, AMS 6464D, assembly number, and quantity.

4.6 Resampling and Retesting: If any specimen used in the above tests fails to meet the specified requirements, disposition of the electrodes may be based on the results of testing three additional specimens for each original nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the electrodes represented and no additional testing shall be permitted. Results of all tests shall be reported.