Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

AEROSPACE MATERIAL SPECIFICATION

AMS 6464B
Superseding AMS 6464A

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

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 similar to those of the metals joined.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., Two Pennsylvania Plaza, New York, New York 10001.

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)
AMS 6355 - Steel Sheet, Strip, and Plate, 0.55Ni - 0.50Cr - 0.20Mo (0.28 - 0.33C)

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 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 Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.

2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

2.4 AWS Publications: Available from American Welding Society, Inc., 2501 Northwest 7th Street, Miami, Florida 33125.

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, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other approved analytical methods:

	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 in accordance with 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:

3.3.1 Tensile Properties: Deposited weld metal shall be capable of meeting the following requirements; tensile and hardness testing shall be conducted in accordance with ASTM A370:

3.3.1.1 Tensile test 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, hardened and tempered to a parent metal hardness not lower than 26 HRC, shall have the following properties:

Tensile Strength Through Weld Zone, % of Parent Metal, min	90
Elongation in 2 in. (50.8 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 on all sides 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 ranges 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. (19.0 - 31.8 mm) long on end-grip rods and 1.5 - 2.0 in. (38 - 51 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, as 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. (3.2 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 Sizes and Lengths: The sizes and lengths in Table I are standard:

TABLE I

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

TABLE I (SI)

Nominal Diameter of Core Wire Millimeters	Length Millimeters
2.4	305
3.2, 4.0, 4.8	356

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

3.6 Tolerances: Unless otherwise specified, tolerances shall be as follows:

3.6.1 Length: Shall vary not more than ± 1/8 in. (± 3.2 mm) from the length ordered.

3.6.2 Diameter:

3.6.2.1 Core Wire: Shall vary not more than ± 0.003 in. (± 0.08 mm) from the size ordered.

3.6.2.2 Covered Electrodes: Shall vary not 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 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 perform such confirmatory testing as he deems necessary to assure 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 composition (3.1) grip portion and arc ends (3.3.4), size (3.3.5), and tolerance (3.6) requirements are classified as acceptance or routine control tests.

4.2.2 Qualification Tests: Tests to determine conformance to tensile property (3.3.1), weldability (3.3.2), burn-off (3.3.3), and cleaning (3.3.5) requirements are classified as qualification or periodic control tests.

4.3 Sampling: Shall be as agreed upon by purchaser and vendor and as follows:

4.3.1 Tensile Properties: Specimens for tensile testing shall be standard sheet-type specimens cut from coupons having a single-bevel-groove, butt-joint weld made from one side between two pieces of AMS 6350 or AMS 6355 plate 0.250 in. (6.35 mm) thick, one of which is chamfered 7/32 in. (5.6 mm) deep to a 60 deg (1.05 rad) included angle. Root opening shall be adjusted for electrode diameter to assure 100% weld penetration. The weld metal shall be machined flush with the parent metal on both faces.

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.

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 which could affect quality or properties of the electrodes, vendor shall submit for reapproval a statement of the revised procedures and, when requested, sample electrodes. No production electrodes incorporating the revised procedures shall be shipped prior to receipt of reapproval.

4.5 Reports:

4.5.1 The vendor of the electrodes shall furnish with each shipment three copies of a report stating that the electrodes conform to the requirements of this specification. This report shall include the purchase order number, material specification number and its revision letter, control number, size, and quantity. Control number shall be a designation indicating batch processing and core wire heat number. When requested by the 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 this specification and shall furnish with each shipment three copies of a report stating that the electrodes conform. This report shall include the purchase order number, material specification number and its revision letter, part 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.

5. PREPARATION FOR DELIVERY:

5.1 Identification:

5.1.1 Individual Electrodes:

5.1.1.1 At least one legible imprint of the AWS classification (E-10013) shall be applied to the electrode covering as near as practical to the grip end of the core wire and within 2-1/2 in. (63.5 mm) of the grip end. In the case of center-grip electrodes, the imprint shall be applied to the electrode covering as above and upon both sides of the center grip (bare core wire) area. The prefix letter E in the electrode classification may be omitted from the imprint on the electrode covering.

5.1.1.2 The numbers of the imprinted electrode classification shall be of bold block type and of sufficient size and color contrast to be legible before and after normal welding applications.

5.1.2 Electrode Packages: Each package or container shall be legibly marked with the following: Purchase order number, AMS 6464B, control number, size, quantity, recommended current value, and manufacturer's designation.

5.2 Packaging:

5.2.1 Packaging shall be accomplished in such a manner as to ensure that the electrodes, during shipment and storage, will be protected against mechanical injury and exposure to moisture. Such packaging shall not cause loss of moisture from the covering to the extent that use of the electrodes may be impaired.