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An American National Standard

Specification for Bare Electrodes and Rods for Surfacing

American Welding Society

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ANSI

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Specification for Bare Electrodes and Rods for Surfacing

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Prepared by
AWS A5 Committee on Filler Metals and Allied Materials

Under the Direction of
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

This specification prescribes the requirements for classification of bare electrodes and rods for surfacing. Solid surfacing electrodes and rods, are classified on the basis of the composition of the material as manufactured. Metal cored and flux cored composite (tubular) surfacing electrodes and rods, are classified on the basis of the chemical composition of the deposited weld metal. Tubular tungsten carbide bare rods are classified on the basis of the mesh range, quantity, and composition of the tungsten carbide granules. A guide is appended to the specification as a source of information concerning the characteristics and applications of the classified electrodes.

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Specification for Bare Electrodes and Rods for Surfacing

1. Scope

1.1 This specification prescribes the requirements for the classification of bare electrodes and rods for surfacing. The specification does not provide for classification of electrode-flux combinations for submerged arc welding.

1.2 Safety and health issues and concerns are beyond the scope of this standard and, therefore, are not fully addressed herein. Some safety and health information can be found in the nonmandatory annex sections A5 and A10. Safety and health information is available from other sources, including, but not limited to, ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*, and applicable federal and state regulations.

Part A
General Requirements

2. Normative References

2.1 The following AWS standards[1] are referenced in the mandatory sections of this document:

AWS A5.01, *Filler Metal Procurement Guidelines*

ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*

2.2 The following ASTM standards[2] are referenced in the mandatory sections of this document:

ASTM E 29, *Practice of Using Significant Digits in Test Data to Determine Conformance with Specifications*

ASTM A 36/A 36M, *Specification for Structural Steel*

ASTM B 214, *Test Method for Sieve Analysis for Granular Metal Powder*

ASTM A 285/A 285M, *Specification for Pressure Vessel Plates, Carbon Steel, Low and Intermediate Tensile Strength*

ASTM DS-56/SAE HS-1086, *Unified Numbering System for Metals and Alloys*

3. Classification

3.1 The surfacing electrodes and rods covered by this specification are classified according to the following:

3.1.1 Solid surfacing electrodes and rods, are classified on the basis of the composition of the material as manufactured (or the stock from which it was made) (see Tables 1, 2, and 4).

3.1.2 Metal cored and flux cored composite (tubular) surfacing electrodes and rods, except for tungsten carbide rods, are classified on the basis of the composition of an undiluted weld deposit, as shown in Tables 1, 3, and 4.

3.1.3 Tubular tungsten carbide surfacing rods are classified on the basis of the mesh range, quantity, and composition of the tungsten carbide granules, as shown in Tables 5 and 6.

3.2 Material classified under one classification shall not be classified under any other classification in this specification.

1. AWS standards may be obtained from the Global Engineering Documents, An Information Handling Services Group Company, 15 Inverness Way East, Englewood, Colorado 80112-5776. Telephone (800) 854-7179, (303) 397-7956; FAX (303) 397-2740; Internet: www.global.ihs.com.
2. ASTM standards may be obtained from American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

Part B
Tests, Procedures, and Requirements

7. Summary of Tests

7.1 Solid Electrodes or Rods. Chemical analysis of the filler metal itself (or the stock from which it is made) is the only test required for classification of a product under this specification.

7.2 Metal Cored and Flux Cored Composite (Tubular) Electrodes and Rods

7.2.1 Chemical analysis of a pad of undiluted weld metal, as shown in Figure 1, or a fused sample as agreed upon by the supplier and purchaser, is the only test required for classification. In case of dispute, the weld pad described in 9.4 shall be the referee method.

7.3 Tungsten Carbide Rods

7.3.1 The amount and mesh size distribution of the tungsten carbide granules shall be determined (see Table 5). Sieve analysis shall be in accordance with ASTM B 214, *Test Method for Sieve Analysis for Granular Metal Powder.*

7.3.2 Chemical analysis of the tungsten carbide granules shall be determined (see Table 6).

8. Retest

If the results of any test fail to meet the requirement, that test shall be repeated twice. The results of both retests shall meet the requirement. Material, specimens, or samples for retest may be taken from the original test assembly or sample, or from one or two new test assemblies or samples. For chemical analysis, retest need be only for those specific elements that failed to meet the test requirement. If the results of one or both retest fail to meet the requirement, the material under test shall be considered as not meeting the requirements of this specification for that classification.

In the event that, during preparation or after completion of any test, it is clearly determined that prescribed or proper procedures were not followed in preparing the weld test assembly or test specimen(s) or in conducting the test, the test shall be considered invalid, without regard to whether the test was actually completed or whether test results met, or failed to meet, the requirement. That test shall be repeated, following proper prescribed procedures. In this case, the requirement for doubling the number of test specimens does not apply.

9. Chemical Composition Requirements

9.1 The need for a weld pad test assembly or an undiluted weld metal ingot shall be determined based on whether the electrode or rod is solid or composite as specified in these subsequent paragraphs.

9.2 For solid drawn bare surfacing electrodes or rods, the requirements are based on the chemical analysis of the as-manufactured material, or the stock from which it was made. For cast bare surfacing electrodes or rods, the requirements are based on the chemical analysis of the as-manufactured material only. Solid filler metal, when analyzed for elements that are present in a coating (copper flashing for example), shall be analyzed without removing the coating. When the electrode is analyzed for elements other than those in the coating, the coating must be removed if its presence affects the results of the analysis for other elements. Rod stock may be analyzed prior to coating for those elements not added in the coating.

9.3 For composite metal cored electrodes or rods other than tungsten carbide rods (see 9.7), samples for chemical analysis may be obtained by any method producing undiluted weld metal that is agreed upon by the purchaser and supplier or from a weld pad (Figure 1) deposited with the welding process for which it was designed to operate. In case of a dispute, the weld pad described in 9.4 shall be the referee method.

9.3.1 For flux cored composite electrodes and rods, including self-shielded electrodes, the sample for chemical analysis shall be obtained from an undiluted weld pad (see Figure 1) deposited with the welding process for which it was designed.

9.4 The dimensions of the completed pad shall be as shown in Figure 1 for each size of electrode. Testing shall be as specified in 9.5.

9.4.1 The weld pad test assembly shall be welded in the flat position using welding conditions specified by the manufacturer.

9.4.2 The base metal shall conform to one of the following specifications or its equivalent:

9.4.2.1 ASTM A 285/A 285M, *Specification for Pressure Vessel Plates, Carbon Steel, Low and Intermediate Tensile Strength, Grade A*.

9.4.2.2 ASTM A 36/A 36M, *Specification for Structural Steel*.

9.5 The sample for analysis shall come from the as-manufactured solid electrode or rod or from feedstock from which it is drawn or from the undiluted weld metal ingot or from an undiluted region of the weld pad that is located entirely within the top layer of weld deposit. The

sample may be removed by any convenient method. Postweld heat treatment may be used to facilitate this removal procedure. Chemical analysis may be made by any suitable method agreed upon by the manufacturer and purchaser. The referee method shall be the appropriate ASTM method for the element being determined.

9.6 The results of the analysis shall meet the requirements in either Table 1, 2, 3, or 4, for the classification of bare surfacing electrode or rod under test.

9.7 Tungsten Carbide Rods

9.7.1 Weight-percentage of the tungsten carbide granules, as specified in Table 5, shall be determined by the following steps:

(1) Record the weight of the tungsten carbide welding electrode or rod sample to the nearest tenth of a gram.

(2) Remove the tungsten carbide from the tube and clean it by washing with water and treating with 1-1 hydrochloric acid, as required, to remove any flux, powdered iron, graphite, etc. Heating of the acid may be required. Hot or cold 1-1 hydrochloric acid will not appreciably attack cast tungsten carbide in less than an hour. When handling any acids appropriate safety precautions should be followed.

(3) Wash and rinse thoroughly with tap water.

(4) Dry the tungsten carbide particles by holding in an oven at 250° ± 25°F (120° ± 15°C) for a minimum period of one hour.

(5) Weigh the cleaned and dried tungsten carbide granules, and calculate the percentage of tungsten carbide from the initial weight of the tube. See formula below:

$$\%\ \text{of tungsten carbide granules} = \frac{\text{weight of clean and dried tungsten carbide granules}}{\text{weight of bare electrode or rod sample}} \times 100$$

9.7.2 Chemical composition of tungsten carbide granules shall conform to the requirements of Table 6. Chemical analysis may be made by any suitable method agreed upon by the supplier and purchaser. Tungsten carbide granules for chemical analysis shall be free of any surface contaminant.

Part C
Manufacture, Identification, and Packaging

10. Method of Manufacture

The electrodes and rods classified according to this specification may be manufactured by any method that will produce material which meets the requirements of this specification. For tungsten carbide rods, any carbon steel sheath material that will not significantly alter the matrix of the deposit may be used.

11. Standard Sizes and Lengths

Standard sizes of electrodes and rods shall be as shown in Tables 7, 8, and 9. Standard size refers to the nominal diameter of the electrode or rod. Nonstandard diameters and lengths of welding electrodes and rods shall be as agreed upon between the purchaser and manufacturer.

12. Finish and Uniformity

12.1 All electrodes and rods shall have a smooth finish that is free from slivers, depressions, scratches, scale, seams, laps (exclusive of the longitudinal joint in metal cored and flux cored composite [tubular] electrodes or rods), and foreign matter that would adversely affect the welding characteristics, the operation of the welding equipment, or the properties of the weld metal.

12.2 Each continuous length of electrode or rod shall be from a single *heat* or *lot* of material. Welds, when present, shall have been made so as not to interfere with the uniform, uninterrupted feeding of the electrode or rod on automatic and semiautomatic equipment.

Table 7
Standard Sizes of Bare Electrodes and Rods Using Solid Drawn or Composite (Tubular) Wire[a,b]

Diameter			Tolerance	
in.		mm	in.	mm
	0.045	1.2	±0.002	±0.05
	0.052	1.3	±0.002	±0.05
1/16	(0.062)	1.6	±0.002	±0.05
5/64	(0.078)	2.0	±0.003	±0.08
3/32	(0.094)	2.4	±0.003	±0.08
7/64	(0.109)	2.8	±0.003	±0.08
	0.120	3.0	±0.003	±0.08
1/8	(0.125)	3.2	±0.005	±0.13
5/32	(0.156)	4.0	±0.005	±0.13
3/16	(0.188)	4.8	±0.005	±0.13
1/4	(0.250)	6.4	±0.005	±0.13
5/16	(0.312)	7.9	±0.005	±0.13

Notes:
a. Other diameter electrodes may be supplied as agreed upon between the manufacturer and purchaser.
b. Electrode and rod length may be supplied as agreed upon between the manufacturer and purchaser.