


**AWS A5.13:2000**  
**An American National Standard**



# **Specification for Surfacing Electrodes for Shielded Metal Arc Welding**



**American Welding Society**

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**Key Words**—Hardfacing, weld surfacing, hard surfacing covered electrodes, wear resistance, build-up electrodes, cobalt electrodes, copper electrodes, manganese electrodes, nickel electrodes, tungsten carbide electrodes

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**Approved by**  
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# **Specification for Surfacing Electrodes for Shielded Metal Arc Welding**

**Supersedes ANSI/AWS A5.13-80**

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 surfacing electrodes for shielded metal arc welding. Classification is based upon the chemical composition of the deposited weld metal except for tungsten carbide electrodes where classification is based on the mesh range, quantity, and composition of the tungsten carbide granules. A guide is appended to the specification as a source of information as to the characteristics and applications of the classified electrodes.



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# Specification for Surfacing Electrodes for Shielded Metal Arc Welding

## 1. Scope

**1.1** This specification prescribes requirements for the classification of surfacing electrodes for shielded metal arc welding. Solid bare electrodes and rods previously classified in ANSI/AWS A5.13-80 are now either discontinued or reclassified in AWS A5.21:2001, *Specification for Bare Electrodes and Rods for Surfacing* (see Section A8 in Annex A).

**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 Sections A5 and A9 in Annex A. 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 standard<sup>1</sup> is referenced in the mandatory section of this standard:

- (1) AWS A5.01, *Filler Metal Procurement Guidelines*.
- (2) ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*.

**2.2** The following ASTM standards<sup>2</sup> are referenced in the mandatory section of this standard:

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- 1. AWS Standards may be obtained from the American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.
  - 2. ASTM Standards may be obtained from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

(1) ASTM A 36/A 36M, *Specification for Structural Steel*.

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

(3) ASTM B 214, *Test Method for Sieve Analysis for Granular Metal Powders*.

(4) ASTM E 29, *Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications*.

(5) ASTM DS-56/SAE HS-1086, *Metals and Alloys in the Unified Numbering System*.

## 3. Classification

**3.1** Except for tungsten carbide electrodes, the surfacing electrodes covered by this specification are classified according to the chemical composition of the undiluted weld metal, as specified in Tables 1, 2, and 3.

**3.2** Tungsten carbide surfacing electrodes are classified on the basis of size and chemical composition of the tungsten carbide granules (see Tables 4 and 5).

**3.3** Electrodes classified under one classification shall not be classified under any other classification in this specification.

## 4. Acceptance

Acceptance<sup>3</sup> of the electrodes shall be in accordance with the provisions of AWS A5.01, *Filler Metal Procurement Guidelines*.

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- 3. See Section A3, Acceptance (in Annex A), for further information concerning acceptance, testing of material shipped, and AWS A5.01, *Filler Metal Procurement Guidelines*.

**Table 4**  
**Mesh Size and Quantity of**  
**Tungsten Carbide (WC) Granules in**  
**the Core of Tungsten Carbide Electrodes**

AWS Classification <sup>a, b</sup>	U.S. Standard Mesh Size of Tungsten Carbide Granules <sup>c</sup>	Quantity of Tungsten Carbide (WC1 + WC2) Granules, Weight Percent
EWCX-12/30	thru 12—on 30	60
EWCX-20/30	thru 20—on 30	60
EWCX-30/40	thru 30—on 40	60
EWCX-40	thru 40	60
EWCX-40/120	thru 40—on 120	60

## Notes:

- a. "X" designates the type of tungsten carbide granules; X = 1 for WC1 granules, X = 2 for WC2 granules, X = 3 for a blend of WC1 and WC2 granules.
- b. These AWS classifications have been transferred to AWS A5.21:2001 without a change in classification for solid bare electrodes and rods and with the prefix "ERC" for electrode/rod made from metal or flux cored stock.
- c. The mesh size of the tungsten carbide granules may vary from that specified above, provided that no more than 5% of the granules are retained on the "thru" sieve, and that no more than 20% passes the "on" sieve.

## SI Equivalents

U.S. Standard Mesh Size	Opening, mm
12	1.70
20	0.85
30	0.60
40	0.43
120	0.13

**Table 5**  
**Chemical Composition of**  
**Tungsten Carbide (WC) Granules**

Element	Composition, weight percent <sup>a</sup>		
	WC1	WC2	WC3
C	3.6–4.2	6.0–6.2	
Si	0.3	0.3	
Ni	0.3	0.3	
Mo	0.6	0.6	as agreed
Co	0.3	0.3	between purchaser
W	94.0 min	91.5 min	and supplier
Fe	1.0	0.5	
Th	0.01	0.01	

## Note:

- a. Single values are maximum, unless noted otherwise.

## 5. Certification

By affixing the AWS specification and classification designations to the package, or the classification to the product, the manufacturer certifies that the product meets the requirements of this specification.<sup>4</sup>

## 6. Units of Measure and Rounding-Off Procedure

**6.1** U.S. Customary Units are the standard units of measure in this specification. The International System of Units (SI) are given as equivalent values to the U.S. Customary Units. The standard sizes and dimensions in the two systems are not identical, and for this reason conversion from a standard size or dimension in one system will not always coincide with a standard size or dimension in the other. Suitable conversions, encompassing standard sizes of both, can be made, however, if appropriate tolerances are applied in each case.

**6.2** For the purpose of determining conformance with this specification, an observed or calculated value shall be rounded to the "nearest unit" in the last right-hand place of figures used in expressing the limiting value in accordance with the rounding-off method given in ASTM E 29, *Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications*.

### Part B

## Tests, Procedures, and Requirements

## 7. Summary of Tests

**7.1** Except for tungsten carbide electrodes, chemical composition of undiluted weld metal is the only test required for classification of a product under this specification (see Tables 1, 2, and 3).

**7.2** Tests required for tungsten carbide electrodes include:

**7.2.1** Determination of the amount and mesh size distribution of the tungsten carbide granules (see Table 4). Sieve analysis shall be in accordance with ASTM B 214, *Test Method for Sieve Analysis for Granular Metal Powders*.

4. See Section A4, Certification (in Annex A), for further information concerning certification and the testing called for to meet this requirement.

handling any acids appropriate safety precautions should be followed.

(3) Dry tungsten carbide by holding in an oven at  $250^{\circ} \pm 25^{\circ}\text{F}$  [ $120^{\circ} \pm 15^{\circ}\text{C}$ ].

(4) Weigh the cleaned and dried tungsten carbide granules. Calculate the percentage of tungsten carbide from the initial weight of the tube using the following formula:

% tungsten carbide granules =

$$\frac{\text{Weight of clean and dried tungsten carbide granules}}{\text{Weight of electrode after removal of covering}} \times 100$$

### *Part C*

## *Manufacture, Identification, and Packaging*

## 11. Method of Manufacture

The electrodes 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 electrodes, any carbon steel sheath material (typically C1008) that will not alter the matrix significantly may be used.

## 12. Standard Sizes and Lengths

**12.1** Standard sizes (diameter of core wire) and lengths of electrodes shall be as shown in Tables 6, 7, and 8.

**12.2** The diameter of solid drawn core wire shall not vary more than  $\pm 0.003$  in. ( $\pm 0.08$  mm) from the diameter specified. The length shall not vary more than  $\pm 1/4$  in. ( $\pm 6.4$  mm) from that specified.

**12.3** The diameter of composite or cast core wire (except tungsten carbide) shall not vary more than  $\pm 0.02$  in. ( $\pm 0.5$  mm). The length shall not vary more than  $\pm 3/8$  in. ( $\pm 9.6$  mm) from that specified.

**12.4** The diameter of tungsten carbide core wire shall not vary more than  $\pm 0.04$  in. ( $\pm 1.0$  mm) from the nominal diameter. The length shall not vary more than  $\pm 3/8$  in. ( $\pm 9.6$  mm) from that specified.

**Table 6**  
**Standard Sizes and Lengths of Covered Electrodes Using Solid Drawn Core Wire<sup>a</sup>**

Electrode Sizes Diameter of Solid Drawn Core Wire <sup>b</sup>		Standard Lengths	
in.	mm	in.	mm
5/64 (0.078)	2.0	$9 \pm 1/4$	$230 \pm 6.4$
3/32 (0.094)	2.4	$9 \pm 1/4$ $12 \pm 1/4$	$230 \pm 6.4$ $300 \pm 6.4$
1/8 (0.125) 5/32 (0.156)	3.2 4.0	$14 \pm 1/4$ $14 \pm 1/4$	$350 \pm 6.4$ $350 \pm 6.4$
3/16 (0.187)	4.8	$14 \pm 1/4$ $18 \pm 1/4$	$350 \pm 6.4$ $450 \pm 6.4$
1/4 (0.250)	6.4	$14 \pm 1/4$ $18 \pm 1/4$	$350 \pm 6.4$ $450 \pm 6.4$
5/16 (0.312)	8.0	$14 \pm 1/4$ $18 \pm 1/4$	$350 \pm 6.4$ $450 \pm 6.4$

Notes:

- a. Other electrode diameters and lengths may be supplied as agreed between the manufacturer and purchaser.  
b. Tolerance on the diameter shall be  $\pm 0.003$  in. ( $\pm 0.08$  mm).

## 13. Core Wire and Covering

Core wire and covering shall be free of defects that would interfere with uniform deposition of the electrode.

## 14. Exposed Core

**14.1** The grip end of each electrode shall be bare (free of covering) for a distance of not less than  $1/2$  in. (13 mm), nor more than  $1-1/2$  in. (38 mm), to provide for electrical contact with the electrode holder.

**14.2** The arc end of each electrode shall be sufficiently bare and the covering sufficiently tapered to permit easy striking of the arc. The length of the bare portion (measured from the end of the core wire to the location where the full cross-section of the covering is obtained) shall not exceed  $1/8$  in. (3.2 mm) or the diameter of the core wire, whichever is less. Electrodes with chipped coverings near the arc end, baring the core wire slightly more than the prescribed distance, may be accepted provided