AWS A5.12M/A5.12:2009
(ISO 6848:2004 MOD)
An American National Standard

Specification for Tungsten and Oxide Dispersed Tungsten Electrodes for Arc Welding and Cutting

American Welding Society

Approved American National Standard
ANSI

second printing, August 2009

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Approved by the
American National Standards Institute
April 17, 2009

Specification for Tungsten and Oxide Dispersed Tungsten Electrodes for Arc Welding and Cutting

7th Edition

Supersedes ANSI/AWS A5.12/A5.12M-98

Prepared by the
American Welding Society (AWS) A5 Committee on Filler Metals and Allied Materials

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This specification prescribes the requirements for the classification of bare tungsten and *oxide dispersed tungsten* electrodes for gas tungsten arc welding and cutting and plasma arc welding and cutting. Classification is based upon the chemical composition of the electrode. Standard sizes, finish, lengths, quantities, product identification, color coding, and chemical composition limits are specified.

This specification makes use of both U.S. Customary Units and the International System of Units (SI). Since these are not equivalent, each system must be used independently of the other.

This specification adopts the requirements of ISO 6848:2004 and incorporates the provisions of earlier versions of AWS A5.12, allowing for classifications under both specifications.

American Welding Society
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Specification for tungsten and oxide dispersed tungsten electrodes for arc welding and cutting

1 Scope

This standard specifies requirements for classification of nonconsumable tungsten electrodes for inert gas shielded arc welding, and for plasma welding, cutting, and thermal spraying.

This specification makes use of both International System of Units (SI) and the U.S. Customary Units. The measurements are not exact equivalents; therefore, each system must be used independently of the other without combining in any way when referring to material properties. The specification designated A5.12M uses SI Units; and the specification designated A5.12 uses U.S. Customary Units. The later units are shown within brackets [ ] or in appropriate columns in tables and figures. Standard dimensions based on either system may be used for sizing of tungsten electrodes or packaging or both under A5.12M or A5.12 specification.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

2.1 *The following AWS standard*[1] *is referenced in the mandatory sections of this document:*

AWS A5.01M/A5.01 (ISO 14344 MOD), Procurement Guidelines for Consumables—Welding and Allied Processes—Flux and Gas Shielded Electrical Welding Processes

2.2 *The following ANSI standard*[2] *is referenced in the mandatory sections of this document:*

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

2.3 *The following ASTM standards*[3] *are referenced in the mandatory sections of this document:*

ASTM E 29, Standard Practice for using Significant Digits in Test Data to Determine Conformance with Specifications

ASTM F 288, Standard Specification for Tungsten Wire for Electron Devices and Lamps

2.4 *The following ISO standard*[4] *is referenced in the mandatory sections of this document:*

ISO 31-0:1992, *Quantities and units — Part 0: General principles; and Annex B, Rule A*

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[1] AWS standards are published by the American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.
[2] This ANSI standard is published by the American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.
[3] ASTM standards are published by the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.
[4] ISO standards are published by the International Organization for Standardization, 1, rue de Varembé, Case postale 56, CH-1211 Geneva 20, Switzerland.

3 Classification

3.1 Classification of a tungsten electrode is based upon its chemical composition.

3.2 The tungsten and oxide dispersed tungsten electrodes covered by this specification are classified using a system that is independent of the U.S. Customary Units and the International System of Units (SI). Classification is according to the chemical composition of the electrode as specified in Table 1. See Clause B7 for classification descriptions.

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

3.4 No electrode meeting the requirements of any other classification, shall be classified under EWG.

3.5 The electrodes classified under this specification are intended for gas tungsten arc welding (GTAW), gas tungsten arc cutting (GTAC), plasma arc welding (PAW), or plasma arc cutting (PAC), but that is not to prohibit their use with any other process for which they are found suitable.

See Clause B2 for an explanation of the classification system.

4 Acceptance

Acceptance of the electrodes shall be in accordance with the provisions of AWS A5.01M:A5.01 (ISO 14344 MOD). See Annex Clause B3 for further information concerning acceptance and testing of material shipped.

5 Chemical analysis

Chemical analysis shall be performed on specimens of the electrode being classified. Any analytical technique may be used but, in cases of dispute, reference shall be made to established published methods. *The referee method shall be ASTM F 288. The results of the analysis shall meet the requirements of Table 1 for the classification of electrode under test.*

6 Retests

If any test fails to meet the requirement, that test shall be repeated twice. The results of both retests shall meet the requirements. Specimens for retesting may be taken from the original test sample or from a new test sample. For chemical analysis, retests need only be for those specific elements that failed to meet their test requirement. If the results of one or both retests 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 test specimen, or in conducting the tests, the test shall be considered invalid, without regard to whether the test was actually completed, or whether the 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.

7 Marking

In accordance with Table 1, tungsten electrodes shall be marked on the basis of their chemical composition, with one color ring near one end of the electrode. The width of the color ring shall be at least 3 mm [1/8 in]. *Such color coding shall have no adverse effect on the operation or use of the electrode.* Alternatively, tungsten electrodes may have their classification symbols marked on the surface of the electrode near at least one end of the electrode.

Table 1 — Chemical composition requirements for tungsten electrodes

Classification symbol (*ISO 6848* Classification)	Chemical composition requirements: Oxide addition — Principal oxide	Oxide addition — Mass percent	Impurities, mass percent	Tungsten, mass percent	Colour code, RGB colour value and colour sample[a]
EWP (WP)	None	N.A.[b]	0.5 max.	99.5 min.	Green #008000
EWCe-2 *(WCe 20)*	CeO_2	1.8 to 2.2	0.5 max.	Balance	Grey (formerly orange) #808080
EWLa-1 *(WLa 10)*	La_2O_3	0.8 to 1.2	0.5 max.	Balance	Black #000000
EWLa-1.5 *(WLa 15)*	La_2O_3	1.3 to 1.7	0.5 max.	Balance	Gold #FFD700
EWLa-2 *(WLa 20)*	La_2O_3	1.8 to 2.2	0.5 max.	Balance	Blue #0000FF
EWTh-1 *(WTh10)*	ThO_2	0.8 to 1.2	0.5 max.	Balance	Yellow #FFFF00
EWTh-2 *(WTh 20)*	ThO_2	1.7 to 2.2	0.5 max.	Balance	Red #FF0000
(WTh 30)	ThO_2	2.8 to 3.2	0.5 max.	Balance	Violet #EE82EE
EWZr-1 *(WZr 3)*	ZrO_2	0.15 to 0.50	0.5 max.	Balance	Brown #A52A2A
EWZr-8 (WZr 8)	ZrO_2	0.7 to 0.9	0.5 max.	Balance	White #FFFFFF
EWG	*The manufacturer must identify all additions.*	*The manufacturer must state the nominal quantity of each addition.*	*0.5 max.*	*Balance*	*The manufacturer may select any color not already in use.*

NOTE Intentional additions of "doping oxides" other than indicated for a particular electrode classification is prohibited.

[a] RGB color values and color samples can be found at the following website: *http://msdn2.microsoft.com/en-us/library/ms531197.aspx*

[b] N.A. = Not applicable.

8 Standard sizes and tolerances

8.1 Electrode diameters, lengths and tolerances

Standard electrode diameters, *lengths*, and tolerances are given in Table 2. Other diameters, *lengths*, and tolerances may be as agreed upon between the purchaser and supplier.

Table 2 — Standard diameters and lengths

Size				Length			
Diameter mm	Tolerance ±mm	Diameter in	Tolerance ±in	Length mm	Tolerance mm	Length in	Tolerance ±in
0.25[b]	0.02	0.010	0.001	50[b]	±1.5		
0.30[b]	0.02			75[b]	-1.0, +2.5	3	1/16
0.50[b]	0.05	0.020	0.002	150[b]	-1.0, +4.0	6	1/16
1.00[b]	0.05	0.040	0.002	175[b]	-1.0, +6.0	7	1/8
1.50[b]	0.05	0.060[a]	0.002	300[b]	-1.0, +8.0	12	1/8
1.60[b]	0.05			450[b]	-1.0, +8.0	18	1/8
2.00[b]	0.05			600[b]	-1.0, +13.0	24	1/8
2.40[b]	0.08	0.093 (3/32)	0.003				
2.50[b]	0.08						
3.00[b]	0.10						
3.20[b]	0.10	0.125 (1/8)	0.003				
4.00[b]	0.10	0.156 (5/32)	0.003				
4.80[b]	0.10	0.187 (3/16)	0.003				
5.00[b]	0.10						
6.30[b]	0.10						
6.40[b]	0.10	0.250 (1/4)	0.003				
8.00[b]	0.10						
10.00[b]	0.10						

[a] Although the metric size 1.6 mm [0.063 in] is closer to 1/16 in [0.0625 in], it has been common industry practice to refer to the U.S. customary size 0.060 in as 1/16 in.
[b] Standard sizes and lengths in ISO 6848, though tolerances may be tighter in some cases.

8.2 Finish

Electrodes shall be supplied with a ground finish. The ground finish designates that the electrode has been cleaned of impurities after it has been centerless ground to a uniform size. It shall be supplied with a bright, polished surface. The maximum surface roughness shall be 0.8 µmRa [32 µin AARH].

8.3 Electrode straightness

The electrodes shall be straight such that any element of its surface, over a specified length, must lie between two parallel lines of a specified spacing where the two lines and the nominal axis of the electrode share a common plane, as shown in Figure 1. The specified spacing is 0.5 mm [0.020 in] over a length of 100 mm [4 in].

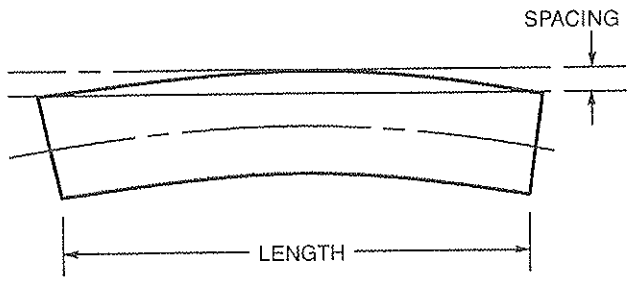

Figure 1 — Measurement procedure for straightness

8.4 Electrode roundness

Electrodes shall fit through ring gages sized for their maximum allowable diameter according to Table 2.

9 Rounding-off procedure

For purposes of determining compliance with the requirements of this Standard, the actual test values obtained shall be subjected to the rounding-off rules of ISO 31-0:1992, Annex B, Rule A *or ASTM E 29.* If the measured values are obtained by equipment calibrated in units other than those of this Standard, the measured values shall be converted to the units of this Standard before rounding off. If an average value is to be compared to the requirements of this Standard, rounding-off shall be done only after calculating the average. In the case where the testing standard cited in the normative references of this Standard contains instructions for rounding off that conflict with the instructions of this Standard, the rounding-off requirements of the testing standard shall apply. The rounded-off results shall fulfill the requirements of the appropriate table for the classification under test.

10 Electrode quality

The electrode surface shall be free of impurities, undesirable films, foreign inclusions, slivers, cracks, scale and other defects. Electrodes shall be internally free of foreign inclusions or anything else that would adversely affect the operation of the electrode. Oxide additions shall be sufficiently uniformly distributed throughout the electrode so that the operation of the electrode is not adversely affected.

11 Packaging

11.1 Marking of packages

The following information, as a minimum, shall be legibly marked so as to be visible from the outside of each package:

a) the number of this Standard, i.e., *AWS A5.12M/A5.12:2009* (ISO 6848:2004 MOD);

b) electrode classification symbol in accordance with Table 1;

c) electrode diameter;

d) electrode length;

e) net quantity of electrodes;

f) supplier's name and trade designation;

g) lot, control, or heat number.

11.2 Packing

Tungsten electrodes shall be packed so that their surfaces are protected from all damage or staining when they are properly transported and stored.

11.3 Marking of overpacking

Marking of any, or all, overpacking of unit packages with items listed in 11.1 shall be optional with the manufacturer.

11.4 Warning label

The appropriate precautionary information[5] as given in ANSI Z49.1, latest edition (as a minimum) or its equivalent, shall be prominently dispayed in legible print on all packages of electrodes, including individual unit packages enclosed within a larger package.

[5] Typical examples of "warning labels" are shown in figures in ANSI Z49.1 for some common or specific consumables used with certain processes.