
**Arc welding and cutting —
Nonconsumable tungsten electrodes
— Classification**

*Soudage et coupage à l'arc — Électrodes non consommables en
tungstène — Classification*

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC 44, *Welding and allied processes*, Subcommittee SC 3, *Welding consumables*.

This third edition cancels and replaces the second edition (ISO 6848:2004), which has been technically revised.

Introduction

Tungsten electrodes are used in a variety of welding and allied processes, including tungsten inert gas welding, plasma arc welding and cutting, plasma spraying, and atomic hydrogen welding. In contrast to most other welding electrodes, tungsten electrodes are not intended to become part of the weld deposit. Nevertheless, the chemical composition of a tungsten electrode has an important effect on its range of usage in welding and allied processes. Therefore, tungsten electrodes are classified according to their chemical composition.

Requests for official interpretations of any aspect of this International Standard should be directed to the Secretariat of ISO/TC 44/SC 3 via your national standards body. A complete listing of national standards bodies can be found at www.iso.org.

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Arc welding and cutting — Nonconsumable tungsten electrodes — Classification

1 Scope

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

Information on conditions of use of these electrodes is given in [Annex A](#) (informative).

2 Normative references

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

ISO 80000-1:2009, *Quantities and units — Part 1: General*

3 Classification

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

4 Symbols and requirements

4.1 Symbol for the product/process

The symbol for gas shielded tungsten-arc processes is the letter W.

4.2 Symbol for the chemical composition

The symbol for the chemical composition of the tungsten electrode is the chemical symbol(s) for the principal oxide additive(s) followed by digits indicating the nominal mass percent of the oxide additive multiplied by 10. If there is no additive, the symbol is the letter P. [Table 1](#) lists the composition requirements for the various classifications.

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.

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 specimen or from a new test specimen. 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 test specimen(s), 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

Tungsten electrodes 50mm in length and above, as manufactured, shall be marked on the basis of their chemical composition, with one or more colour rings near one end of the electrode in accordance with [Table 1](#).

The width of the colour rings shall be at least 3 mm. Alternatively, tungsten electrodes may have their classification symbols marked on the surface of the electrode near at least one end of the electrode.

For tungsten electrodes shorter than 50 mm in length, as manufactured, packaging shall be marked in accordance with [Clause 11](#).

Table 1 — Chemical composition requirements for tungsten electrodes

Classification symbol	Chemical composition requirements				Colour code, RGB colour value and colour sample ^a
	Principal oxide	Oxide addition Mass percent	Impurities, mass percent	Tungsten, mass percent	
WP		None	0,1 max.	Balance	Green #008000 
WCe20	CeO ₂	1,8 to 2,2	0,1 max.	Balance	Grey #808080 
WLa10	La ₂ O ₃	0,8 to 1,2	0,1 max.	Balance	Black #000000 
WLa15	La ₂ O ₃	1,3 to 1,7	0,1 max.	Balance	Gold #FFD700 
WLa20	La ₂ O ₃	1,8 to 2,2	0,1 max.	Balance	Blue #0000FF 
WTh10	ThO ₂	0,8 to 1,2	0,1 max.	Balance	Yellow #FFFF00 

^a RGB colour values and colour samples can be found at: [https://msdn.microsoft.com/library/aa358802\(v=vs.85\).aspx](https://msdn.microsoft.com/library/aa358802(v=vs.85).aspx)

^b Compositions not listed in this table are symbolized by the letters WG, followed by the chemical symbol(s) and digits for the major oxide additive(s) in accordance with the principle used for the other compositions.

Table 1 (continued)

Classification symbol	Chemical composition requirements				Colour code, RGB colour value and colour sample ^a
	Principal oxide	Mass percent	Impurities, mass percent	Tungsten, mass percent	
WTh20	ThO ₂	1,7 to 2,2	0,1 max.	Balance	Red #FF0000 
WTh30	ThO ₂	2,8 to 3,2	0,1 max.	Balance	Violet #EE82EE 
WZr3	ZrO ₂	0,15 to 0,50	0,1 max.	Balance	Brown #A52A2A 
WZr8	ZrO ₂	0,7 to 0,9	0,1 max.	Balance	White #FFFFFF 
WG ^b	The manufacturer shall identify all additions and their nominal quantity		0,1 max.	Balance	Any colour or combination of colours not already used in this International Standard

^a RGB colour values and colour samples can be found at: [https://msdn.microsoft.com/library/aa358802\(v=vs.85\).aspx](https://msdn.microsoft.com/library/aa358802(v=vs.85).aspx)

^b Compositions not listed in this table are symbolized by the letters WG, followed by the chemical symbol(s) and digits for the major oxide additive(s) in accordance with the principle used for the other compositions.

8 Standard sizes and tolerances

8.1 Electrode diameters

Standard electrode diameters and tolerances are given in [Table 2](#). Other diameters and tolerances may be as agreed between supplier and purchaser.

Electrodes should fit through ring gages sized for their maximum allowable diameter in accordance with [Table 2](#).

Table 2 — Standard electrode diameters and tolerances

Nominal Diameter mm	Tolerance mm
0,25	±0,02
0,30	±0,02
0,50	±0,05
1,0	±0,05
1,5	±0,05
1,6	±0,05
2,0	±0,05
2,4	±0,1
2,5	±0,1
3,0	±0,1
3,2	±0,1
4,0	±0,1
4,8	±0,1
5,0	±0,1
6,3	±0,1
6,4	±0,1
8,0	±0,1
10,0	±0,1

8.2 Electrode lengths

Standard electrode lengths and tolerances are given in [Table 3](#). Other lengths and tolerances may be as agreed between supplier and purchaser.

Table 3 — Standard electrode lengths and tolerances

Nominal length mm	Tolerance mm
50	±1,5
75	+2,5 -1,0
150	+4 -1
175	+6 -1
300	+8 -1
450	+8 -1
600	+13 -1

9 Electrode shape and condition

9.1 Electrode straightness

Electrode straightness shall not vary by more than 0,5 mm over a length of 100 mm.

For shorter electrodes, the electrode straightness shall not vary by more than 0,13 mm over a length of 50 mm.

9.2 Electrode 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 centreless ground to a uniform size. It shall be supplied with a bright, polished surface. The average surface roughness, measured longitudinally, shall not exceed 0,8 $\mu\text{m Ra}$.

9.3 Electrode quality

The electrode surface shall be free of excessive 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.

10 Rounding procedure

For purposes of determining compliance with the requirements of this International Standard, the actual test values obtained shall be subject to ISO 80000-1:2009, B.3, Rule A. If the measured values are obtained by equipment calibrated in units other than those of this International Standard, the measured values shall be converted to the units of this International Standard before rounding. If an arithmetic average value is to be compared to the requirements of this International Standard, rounding shall be done only after calculating the arithmetic average. The rounded results shall fulfil the requirements of the appropriate table for the classification under test.

11 Marking and packaging

11.1 Marking

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 International Standard, i.e. ISO 6848;
- 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 Packaging

Packaging shall ensure that the tungsten electrodes are protected from all damage or staining when they are properly transported and stored.

12 Classification examples

Example 1: A nonconsumable tungsten electrode with a chemical composition of La_2O_3 1,3 – 1,7 %, impurities max 0,1 % and W balance for the alloy symbol WLa15, in accordance with [Table 1](#), is designated:

ISO 6848 — WLa15

where

ISO 6848 is the number of this International Standard, and

WLa15 indicates the chemical composition La_2O_3 1,3 – 1,7 %.

Example 2: A nonconsumable tungsten electrode with a chemical composition of La_2O_3 1,3 – 1,7 %, ZrO_2 0,05 %, CeO_2 0,05 % and W balance for the alloy symbol WG, in accordance with [Table 1](#), is designated:

ISO 6848 — WG La15Ce0,5Zr0,5

where

ISO 6848 is the number of this International Standard,

WG indicates that the chemical composition ranges are not specified in ISO 6848 (see [Table 1](#)), and

La15Ce0,5Zr0,5 indicates the chemical composition, i.e. La_2O_3 1,3 – 1,7 %, CeO_2 0,05 %, ZrO_2 0,05 % and W balance.