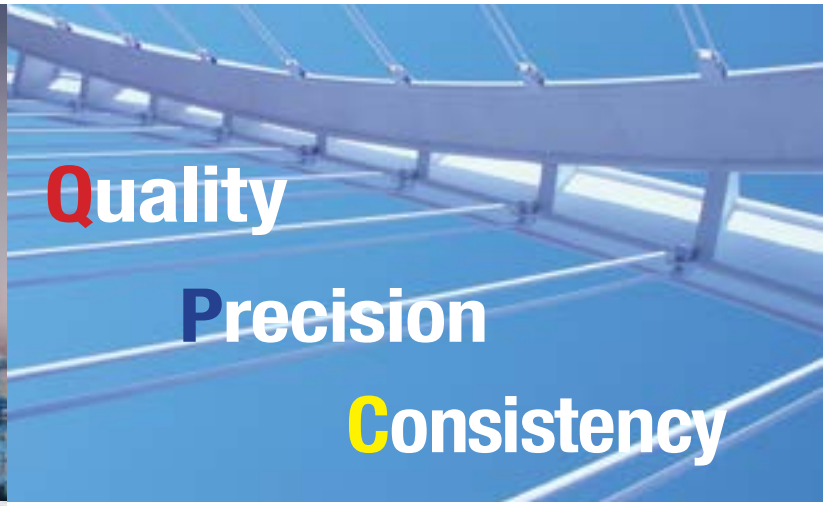
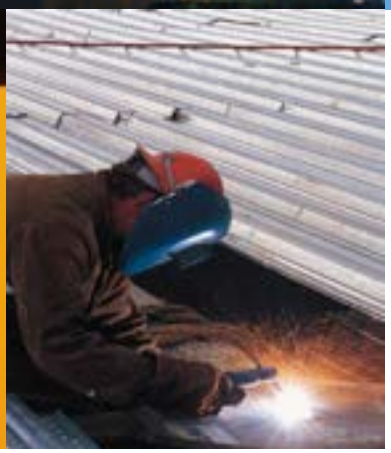
AMERICAN FILLER METALS





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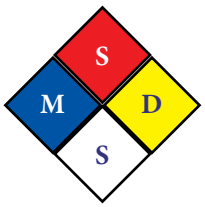

Material
Safety
Data
Sheet

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AFM Pure Tungsten

AWS/SFA A5.12 EWP (*ISO 6848* -WP)

Description:

AFM Pure Tungsten electrodes are commercially pure & unalloyed tungsten electrodes. (99.5% Tungsten minimum).
Their current-carrying capacity is lower than that of other electrodes.
They provide good stability when used with alternating current, either balanced wave or continuously high frequency stabilized.
They may be used with direct current and also with either argon or helium, or a combination of both, as a shielding gas.
They maintain a clean, balled end, which is preferred for aluminum and magnesium welding.
These electrodes have reasonably good resistance to contamination of the weld metal by the electrode, although the oxide containing electrodes are superior in this respect.
EWP electrodes are generally used on less critical applications, except for welding aluminum and magnesium.
The lower cost EWP electrodes can be used for less critical applications where some tungsten contamination of welds is acceptable.
Tip color is Green.

Chemical Composition Requirements (%):

W Min.	99.5
Total Other	0.5

Typical Current Ranges:

Diameter	Alternating Current Unbalance Ware (amps)	Alternating Current Balanced Ware (amps)
0.040” (1.0 mm)	20 ~ 60	10 ~ 30
1/16” (1.6 mm)	50 ~ 100	30 ~ 80
3/32” (2.4 mm)	100 ~ 160	60 ~ 130
1/8” (3.2 mm)	150 ~ 200	100 ~ 180
5/32” (4.0 mm)	200 ~ 275	160 ~ 240

All values are based on the usage of argon gas.

AFM 2% Thoriated

AWS/SFA A5.12 EWTh-2 *(ISO 6848 -WTh 20)*

Description:

AFM 2% Thoriated Tungsten electrodes have been designed for direct current applications.
The higher thoria content (1.7–2.2 percent) in the EWTh-2 electrode causes the operating characteristic improvements to be more pronounced than in the lower thoria content EWTh-1.
They have the thoria content dispersed evenly throughout their entire length.
They maintain a sharpened point well, which is desirable for welding steel.
They can be used on alternating current work, but a satisfactory balled end, which is desirable for the welding of nonferrous metals, is difficult to maintain.
Should it be desired to use these electrodes for alternating current welding, then balling can be accomplished by briefly, and carefully, welding with direct current electrode positive prior to welding with alternating current.
During alternating current welding, the balled end does not melt and so emission is not as good as from a liquid ball on a pure tungsten (EWP) electrode.
Tip color is **Red**.

Chemical Composition Requirements (%):

W	97.3
ThO_2	1.7 ~ 2.2
Total Other	0.5

Typical Current Ranges:

Diameter	DCEN (DCSP) (amps)	DCEP (DCRP) (amps)
0.040” (1.0 mm)	15 ~ 80	Not Applicable
1/16” (1.6 mm)	70 ~ 150	10 ~ 20
3/32” (2.4 mm)	150 ~ 250	15 ~ 30
1/8” (3.2 mm)	250 ~ 400	25 ~ 40
5/32” (4.0 mm)	400 ~ 500	40 ~ 55

All values are based on the usage of argon gas.

AFM 2% Ceriated

AWS/SFA A5.12 EWCe-2 *(ISO 6848 -WCe 20)*

Description:

AFM 2% Ceriated Tungsten electrodes are tungsten electrodes containing about two percent cerium oxide (CeO2), referred to as ceria.
The EWCe-2 electrodes were first introduced into the United States market in 1987.
Several other grades of this type electrode are commercially practical, including electrodes containing one percent CeO, but only one grade, EWCe-2, has been incorporated in this specification as having commercial significance.
The advantages of tungsten electrodes containing ceria, compared to pure tungsten, include increased ease of starting, improved arc stability, and reduced rate of vaporization or burn-off.
Unlike thoria, ceria is not a radioactive material.
These advantages increase with increased ceria content.
These electrodes operate successfully with alternating current or direct current, either polarity.
Tip color is Grey.

Chemical Composition Requirements (%):

W	97.3
CeO_2	1.8 ~ 2.2
Total Other	0.5

Typical Current Ranges:

Diameter	Alternating Current Unbalance Ware (amps)	Alternating Current Balanced Ware (amps)
0.040” (1.0 mm)	15 ~ 80	20 ~ 60
1/16” (1.6 mm)	70 ~ 150	60 ~ 120
3/32” (2.4 mm)	140 ~ 235	100 ~ 180
1/8” (3.2 mm)	225 ~ 325	160 ~ 250
5/32” (4.0 mm)	300 ~ 400	200 ~ 320

All values are based on the usage of argon gas.

Diameter	DCEN (DCSP) (amps)	DCEP (DCRP) (amps)
0.040” (1.0 mm)	15 ~ 80	Not Applicable
1/16” (1.6 mm)	70 ~ 150	10 ~ 20
3/32” (2.4 mm)	150 ~ 250	15 ~ 30
1/8” (3.2 mm)	250 ~ 400	25 ~ 40
5/32” (4.0 mm)	400 ~ 500	40 ~ 55

All values are based on the usage of argon gas.

AFM 1.5% Lanthanated

AWS/SFA A5.12 EWLA-1.5 *(ISO 6848 -WLa 15)*

Description:

AFM 1.5% Lanthanated Tungsten electrodes which contain 1.3-1.7 wt.-% of dispersed lanthanum oxide (La2O3) for enhanced arc starting and stability, reduced tip erosion rate, and extended operating range. These electrodes can be used as nonradioactive substitutes for 2% thoriated tungsten as the operating characteristics are very similar.
Lanthanated tungsten can be used for both dcen and ac applications.
Tip color is Gold.

Chemical Composition Requirements (%):

W	97.8
CeO_2	1.3 ~ 1.7
Total Other	0.5

Typical Current Ranges:

Diameter	Alternating Current Unbalance Ware (amps)	Alternating Current Balanced Ware (amps)
0.040” (1.0 mm)	15 ~ 80	20 ~ 60
1/16” (1.6 mm)	70 ~ 150	60 ~ 120
3/32” (2.4 mm)	140 ~ 235	100 ~ 180
1/8” (3.2 mm)	225 ~ 325	160 ~ 250
5/32” (4.0 mm)	300 ~ 400	200 ~ 320

All values are based on the usage of argon gas.

Diameter	DCEN (DCSP) (amps)	DCEP (DCRP) (amps)
0.040” (1.0 mm)	15 ~ 80	Not Applicable
1/16” (1.6 mm)	70 ~ 150	10 ~ 20
3/32” (2.4 mm)	150 ~ 250	15 ~ 30
1/8” (3.2 mm)	250 ~ 400	25 ~ 40
5/32” (4.0 mm)	400 ~ 500	40 ~ 55

All values are based on the usage of argon gas.

Chemical Composition Requirements for Tungsten Electrodes

Classification Symbol *(ISO 6848 Classification)*	Chemical Composition Requirement				Colour Code, RGB Colour Value & Colour Sample[a]
	Principal Oxidie	Mass Percent	Impurities, Mass Percent	Tungsten, Mass Percent	
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)*	$La2O_3$	0.8 to 1.2	0.5 max.	Balance	Black #000000
EWLa-1.5 *(WLa 15)*	$La2O_3$	1.3 to 1.7	0.5 max.	Balance	Gold #FFD700
EWLa-2 *(WLa 20)*	$La2O_3$	1.8 to 2.2	0.5 max.	Balance	Blue #0000FF
EWTh-1 *(WTh 10)*	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 0.8	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.

Standard Diameters & 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.

Suitability of Current Supply Type

Type of Metal or Alloy to be welded	Direct Current		Alternating Current
	Electrode Negative (-)	Electrode Positive (+)	
Aluminium and its alloys, thickness ≤ 2.5 mm [0.10 in]	Acceptable	Acceptable	Best
Aluminium and its alloys, thickness > 2.5 mm [0.10 in]	Acceptable	N.R.[a]	Best
Magnesium and its alloys	N.R.	Acceptable	Best
Non-alloy (Carbon) Steels and Low Alloy Steels	Best	N.R.	N.R.
Stainless Steels	Best	N.R.	N.R.
Copper	Best	N.R.	N.R.
Bronze	Best	N.R.	Acceptable
Aluminium Bronze	Acceptable	N.R.	Best
Silicon Bronze	Best	N.R.	N.R.
Nickel and its alloys	Best	N.R.	Acceptable
Titanium and its alloys	Best	N.R.	Acceptable

[a] N.R. = Not Recommended.

Approximate Current Ranges depending upon the Electrode Diameter[a]

Electrode Diameter		Direc Current A				Alternating Current A	
		Electrode Negative (-)		Electrode Positive (+)			
mm	in	Pure Tungsten	Tungsten with Oxide Additives	Pure Tungsten	Tungsten with Oxide Additives	Pure Tungsten	Tungsten with Oxide Additives
0.25	0.010	up to 15	up to 15	Not Applicable	Not Applicable	up to 15	up to 15
0.30		up to 15	up to 15	Not Applicable	Not Applicable	up to 15	up to 15
0.50	0.020	2 to 20	2 to 20	Not Applicable	Not Applicable	2 to 15	2 to 15
1.0	0.040	10 to 75	10 to 75	Not Applicable	Not Applicable	15 to 55	15 to 70
1.5	0.060	60 to 150	60 to 150	10 to 20	10 to 20	45 to 90	60 to 125
1.6		60 to 150	60 to 150	10 to 20	10 to 20	45 to 90	60 to 125
2.0		75 to 180	100 to 200	15 to 25	15 to 25	65 to 125	85 to 160
2.4	0.093 (3/32)	120 to 220	150 to 250	15 to 30	15 to 30	80 to 140	120 to 210
2.5		130 to 230	170 to 250	17 to 30	17 to 30	80 to 140	120 to 210
3.0		150 to 300	210 to 310	20 to 35	20 to 35	140 to 180	140 to 230
3.2	0.125 (1/8)	160 to 310	225 to 330	20 to 35	35 to 50	150 to 190	150 to 250
4.0	0.156 (5/32)	275 to 450	350 to 480	35 to 50	50 to 70	180 to 260	240 to 350
4.8	0.187 (3/16)	380 to 600	480 to 650	50 to 70	50 to 70	240 to 350	330 to 450
5.0		400 to 625	500 to 675	50 to 70	50 to 70	240 to 350	330 to 460
6.3		550 to 875	650 to 950	65 to 100	35 to 100	300 to 450	430 to 575
6.4	0.250 (1/4)	575 to 900	750 to 1000	70 to 125	70 to 125	325 to 450	450 to 600
8.0							650 to 830
10.0							

NOTE : If no value is given, no recommendation is available.

[a] The current values are based on the use of argon gas, and these values may vary depending on the type of shielding gas, type of equipment, and application.

Statement of Commission VIII on Health Aspects In The Use of Thoriated Tungsten Electrodes

"Thorium oxides are found in Thoriated Tungsten Electrodes {up to 4.2% (ISO 6848-WT 40 Electrode)}[6].
Thorium is radioactive and may present hazards by external and internal exposure.
If alternatives are technically feasible, they should be used.
"Several studies carried out on Thoriated Electrodes have shown that due to the type of radiation generated, external radiation risks—during storage, welding, or disposal of residues—are negligible under normal conditions of use.
"On the contrary, during the grinding of electrode tips there is generation of radioactive dust, with the risk of internal exposure.
Consequently, it is necessary to use local exhaust ventilation to control the dust at the source, complemented if necessary by respiratory protective equipment.
The risk of internal exposure during welding is considered negligible since the electrode is consumed at a very slow rate.
"Precautions must be taken in order to control any risks of exposure during the disposal of dust from grinding devices.
"The above statement is based on a considered view of the available reports. Commission VIII will continue to keep these aspects under review."