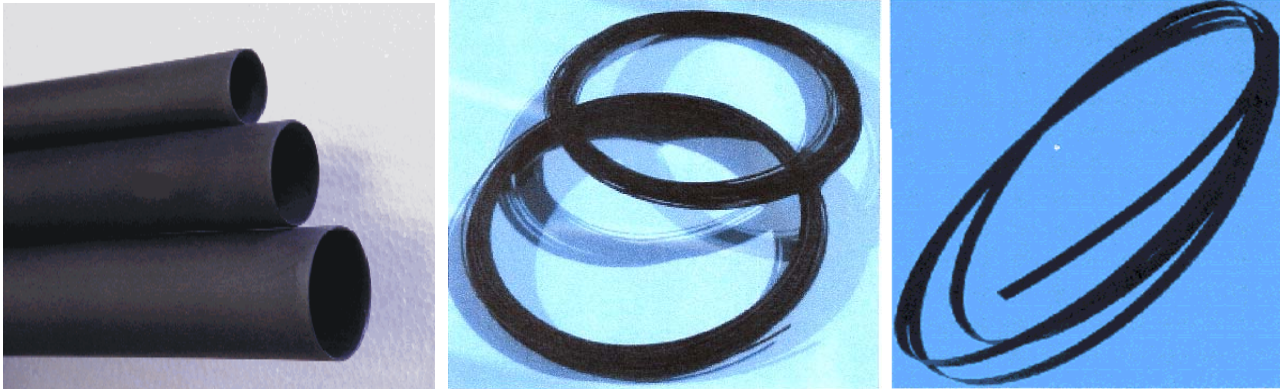




# Mixed Metal Anodes Data Sheet



Mixed metal oxides (MMO) anodes have become the industry standard where reliable performance and long life are paramount. With the additional advantages of light weight, variety of sizes, configurations and good electrical connectivity, MMO offers an ideal choice for the Corrosion Engineer for many varied applications.

Mixed Metal Oxide Coating has been designed for use in all cathodic protection applications. The MMO coating consists of mainly  $\text{IrO}_2/\text{Ta}_2\text{O}_5$  and is suitable for use in soils, carbonaceous backfill, fresh and brackish water, seawater and concrete. Operating parameters are varied for each parameter and are tabled below. Mixed Metal Oxide Anodes have an extremely low consumption rate.

The titanium substrate remains constant throughout the design life of the anode is manufactured using titanium which meets ASTM B338 Grade 1 or 2 Standards.

The operating characteristics for MMO coating loadings are shown below:

Electrolyte	Maximum Design Current Density	Anode life
Carbonaceous backfill	50 $\text{A/m}^2$	20 years
Calcined petroleum coke	100 $\text{A/m}^2$	20 years
Fresh water	100 $\text{A/m}^2$	20 years
Brackish water	100 $\text{A/m}^2$ - 300 $\text{A/m}^2$ *	20 years
Sea Water	600 $\text{A/m}^2$	20 years

\* Current density should be determined in accordance with brackish water resistivity.

Coating loadings can be increased or decreased depending on particular life/current density requirements.

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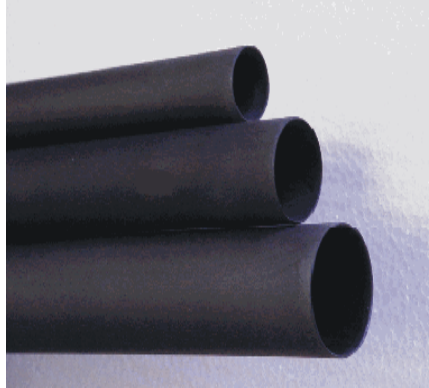
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Tubular anodes are manufactured using titanium which meets ASTM B338 grade 1 or 2 standards.

MMO tubular anodes have an extremely low consumption rate. The titanium substrate remains constant throughout the design life of the anode.

The anodes are resin filled and helium tested for an effective seal of the connection. The cable end of the anode is protected with a teflon sleeve. Tubular anodes are centre connected and tested for resistance (less than .001 ohms). A variety of cable types and sizes are available. Several anodes may be fitted to a single cable to form a string of anodes for use in deepwell groundbeds.

Environment	Anode Size (mm)	Current Output (amps)	Life (Years)
Petroleum Coke	19 x 1200	7	20
	Soil	25 x 500	4
Freshwater	25 x 1000	8	20
	25 x 1200	9.6	20
	25 x 1500	12	20
	32 x 1200	12	20
Seawater	19 x 1200	45	20
	25 x 500	25	20
	25 x 1000	50	20
	25 x 1200	60	20
	25 x 1500	75	20
	32 x 1200	75	20

Anode life can be extended up to 30 years or more by increasing the thickness of the MMO coating.

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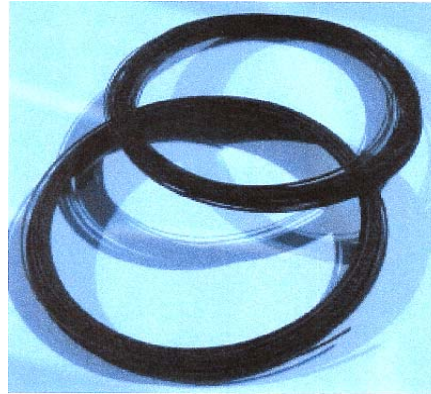
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## MMO WIRE ANODES



MMO wire anodes are available in two standard sizes, with two standard current ratings. Other sizes and rating are available upon request.

MMO Wire Anode consists of solid titanium wire which meets AS1M 6348 Grade 1 or 2 standard that has been coated with Mixed Metal Oxide Coating.

MMO tubular anodes have an extremely low consumption rate. The titanium substrate remains constant throughout the design life of the anode.

Approximate electrical resistance @ 25°C of wire is:

1.5mm diameter	- 751537 microhm/ft
3.0mm diameter	- 181884 microhms/ft

Environment (anode maximum operating current density)	Current output/m 1.5 mm dia wire	Current output/m 3.0 mm dia wire
In carbonaceous backfill (current density of 50 A/m <sup>2</sup> )	0.25 A/m	0.5 A/m
In petroleum coke backfill (current density of 100 A/m <sup>2</sup> )	0.5 A/m	1.0 A/m
In fresh water (current density of 100 A/m <sup>2</sup> )	0.5 A/m	1.0 A/m
In seawater (current density of 600 A/m <sup>2</sup> )	3.0 A/m	6.0 A/m

Design Life: 20 years + when operating at an anode current density as above.

Anode life can be extended up to 30 years or more by increasing the thickness of the MMO coating.

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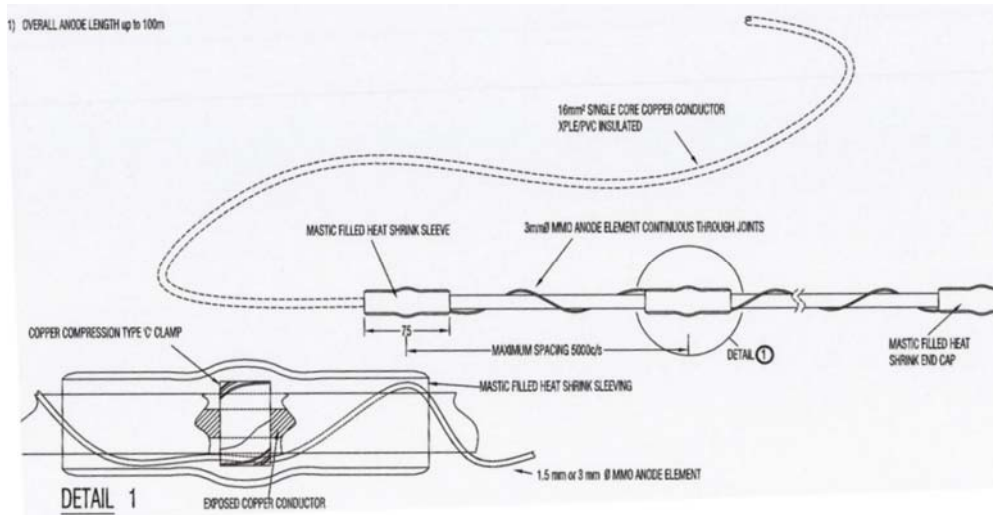
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## CONTINUOUS MMO WIRE ANODE



**pml** MMO wire anodes can be manufactured to provide a low resistance continuous anode by attaching the wire anode at frequent intervals to an insulated carrier cable. In this way the main anode /groundbed current is carried by the copper conductor thereby keeping the volt drop in the wire anode to a minimum and evenly distributing the current along the length of the anode.

The **pml** MMO wire anode can be installed alongside poorly coated or shielded pipelines where effective protection may be difficult to achieve. **pml** MMO wire anodes can often be installed instead of expensive recoating. Both on single and multi-parallel pipelines, safe levels of protection can be restored along the length of the pipeline parallel to the anode. The system avoids difficult and expensive field recoating and greatly reduces environmental disturbance.

The **pml** MMO wire anode is manufactured in coils or on drums and is available in lengths up to 100m. Several anodes may be easily connected together using standard splice kits to make a longer anode.

Two sizes of wire are available with appropriate current outputs as detailed below. The current outputs are much higher than those available from similar conductive polymer anodes. The anode is installed in 100mm square cross-section of coke breeze. For increased current output, calcined petroleum coke backfill should be used.

Environment (anode maximum operating current density)	Current output/m 1.5 mm dia wire	Current output/m 3.0 mm dia wire
In carbonaceous backfill (current density of 50 A/m <sup>2</sup> )	0.25 A/m	0.5 A/m
In petroleum coke backfill (current density of 100 A/m <sup>2</sup> )	0.5 A/m	1.0 A/m

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## RIBBON ANODES FOR USE IN FINE SAND AND CONCRETE



Ribbon anodes are manufactured using titanium substrate which meets ASTM B265 Grade 1 Standards and Mixed Metal Oxide Coating,

MMO tubular anodes have an extremely low consumption rate. The titanium substrate remains constant throughout the design life of the anode.

Nominal Dimensions of Solid Ribbon:

Width: 6.35mm      Thickness: 0.635mm

Standard Coil Length: 76.22m

Standard Coil Weight: 1.12kgs

Surface Area of Ribbon: 0.014m<sup>2</sup>/m

Current Output of Ribbon in Fine Sand: 42 mA/m operating at an anode current density of 3 A/m<sup>2</sup>  
Design Life: 50 years + when operating at an anode current density of 3 A/m<sup>2</sup>.

Current Output of Ribbon in Concrete: 1.5 mA/m when at an anode current density of 0.11 A/m<sup>2</sup>.  
Design Life: 100 years + when operating at an anode current density of 0.11 A/m<sup>2</sup>.

Titanium Conductor Bar Dimensions:

Width: 12.7mm Thickness: 0.9mm

Coil Length: 76.22m

Weight: 3.8 kg

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