



NMT Electrodes

TELPRO

TITANIUM ELECTRODE PRODUCTS
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NMT

NMTELECTRODES

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Profile

NMT[®] Electrodes are the manufacturers of NMT[®] and TELPRO[®] Mixed Metal Oxide (MMO) and Platinised Titanium Anodes which are used in an extensive variety of electrochemical applications worldwide.

For many years NMT[®] Electrodes companies have been leaders in the manufacture and distribution of products and services relating to the electrochemical industry and have been offering the industry a cleaner solution to many of its problems through the application of Electrochemistry.

The major focus of NMT[®] Electrodes has been the manufacture of Mixed Metal Oxide and Platinised Titanium Anodes for Cathodic Protection to preserve/maintain the integrity of numerous structures, including:

- Cathodic Protection in offshore applications (e.g. the protection of ships hulls, jetties and wharves etc.)
- Cathodic Protection in land-based applications (e.g. the protection of pipelines, power stations, storage tanks etc.)

Other applications such as the production of chlorine, hypochlorite and sodium chlorate; inorganic and organic chemical manufacture; waste water treatment; metal finishing and metal winning are but a few areas where NMT[®] Electrodes' products and technology has also been utilised extensively.

NMT[®] Electrodes' Mixed Metal Oxide and Platinised Titanium Anodes are the products of choice and are selected worldwide for use in concrete, underground storage tanks and pipelines among numerous other applications.

NMT[®] Electrodes' full range of tubular, wire, ribbon, rod, mesh and plate anodes are available from its Australian, South African, European (sales) and now Middle East (sales) facilities.

The majority of our customers are the producers of complete production systems, electrochemical cells and end-users. NMT[®] Electrodes prides itself on the good working relationship that it maintains with all its customers worldwide and the trust these customers have placed in us. Our work ethic, work rate and expertise are such that through our customers we have been able to maintain a prominent position in the market for Mixed Metal Oxide and Platinised Titanium Anodes.

We, at NMT[®] Electrodes are committed to providing our customers with reliable products of the highest quality that are also cost-effective and designed to last.

Products

NMT® Electrodes manufactures a vast range of products for any electrochemical application that our customers should require;

- Anodes and Cathodes for use in the membrane cells for the productions of chlorine and hypochlorite
- Anodes for the production of chlorate
- Anodes for use in Pools and Spa chlorination
- Anodes for use in Industrial Electrochlorination (Seawater Electrolysis)
- Anodes for Cathodic Protection, Electroplating/ Surface finishing, Electrogalvanising, Electrowinning and Waste Water Treatment
- Cathodic Protection accessories



- Tubular Anodes
- Ribbon Anodes
- Sawtooth Ribbon Anodes
- Mesh Strip Anodes

- Wire Anodes
- Sock Anodes
- Rod Anodes
- Disc Anodes

- Jetty Anodes
- Pyramid Anodes
- Impressed Current Anodes for the Protection of the Ship Hulls

TUBULAR ANODES

NMT[®] Electrodes Tubular Anodes are manufactured using titanium which meets ASTM B338 Grade 1 or 2 standards.

NMT[®] Electrodes' Mixed Metal Oxide coatings are electrically conductive which activates the titanium tube allowing it to function as an anode.

NMT[®] Electrodes Mixed Metal Oxide Anodes have an extremely low consumption rate; therefore, the titanium substrate remains nearly constant throughout the design life of the anode. This provides a consistently low resistance anode.

NMT[®] Electrodes Mixed Metal Oxide Anodes exhibit high chemical stability even when exposed to low pH (acidic) environments and are suitable for use in chlorine- or oxygen-evolving electrolytes or a combination of both.

ADVANTAGES

- Resin-filled and helium tested to prove effective seal of the connection
- Cable-end of anode protected with Teflon[®] sleeve
- Centre connection has extremely low resistance (less than 0.001 OHMS)
- Dimensionally stable

Environment	Anode diameter	Anode length	Current output	Lifespan
Coke, Soil & Freshwater	19mm	1220mm	7 amps	20 years
	25mm	500mm	4 amps	20 years
	25mm	1000mm	8 amps	20 years
	25mm	1220mm	10 amps	20 years
	25mm	1500mm	12 amps	20 years
Seawater	31.75mm	1220mm	12 amps	20 years
	19mm	1220mm	45 amps	20 years
	25mm	500mm	25 amps	20 years
	25mm	1000mm	50 amps	20 years
	31.75mm	1220mm	75 amps	20 years

NOTES:

- A variety of cable types and sizes available upon request
- Coating loading may be adjusted to customers specifications of current density or design life
- While standard anodes have a design life of 20 years, design life of up to 50 years can be achieved, upon request.



Environment	Max. Current Density	Lifespan
Carbonaceous Backfill	50 A/m ²	20 years
Calcined Petroleum Backfill	100 A/m ²	20 years
Fresh Water	100 A/m ²	20 years
Brackish Water	100 - 300 A/m ²	20 years
Seawater	600 A/m ²	20 years

RIBBON ANODES

FOR USE IN FINE SAND

NMT® Electrodes Ribbon Anodes are manufactured using titanium which meets ASTM B265 Grade 1 or 2 standards.

NMT® Electrodes' Mixed Metal Oxide coatings are electrically conductive which activates the titanium rod allowing it to function as an anode.

NMT® Electrodes Mixed Metal Oxide Ribbon Anodes have an extremely low consumption rate; therefore, the titanium substrate remains nearly constant throughout the design life of the anode. This provides a consistently low resistance anode.

NMT® Electrodes Mixed Metal Oxide Anodes exhibit high chemical stability even when exposed to low pH (acidic) environments and are suitable for use in chlorine- or oxygen-evolving electrolytes or a combination of both.

NMT® Electrodes Mixed Metal Oxide Ribbon Anodes are used for various applications including use in reinforced concrete structures and above ground storage tank base plates.

ADVANTAGES

- Dimensionally stable

NOMINAL DIMENSIONS OF SOLID RIBBON

	(1)	(2)
Width	6.35 mm	12.7 mm
Thickness	0.635 mm	0.5 mm -0.6 mm
Std. Coil Length	76.22 m	76.22 m
Std. Coil Weight	1.36 kg	2.72 kg
Surface Area of Ribbon	0.014 m ² /m	0.0264 m ² /m

TITANIUM CONDUCTOR BAR DIMENSIONS

Width	12.7 mm
Thickness	0.9 mm
Coil Length	76.22 m
Coil Weight	3.8 kg

OPERATING CONDITIONS

	Current output (per m)	Current density	Lifespan
Fine Sand (1)	42 mA	3 A/m ²	50 years
Fine Sand (2)	76.2 mA	3 A/m ²	50 years



RIBBON ANODES

FOR USE IN WATER

NMT[®] Electrodes Ribbon Anodes are manufactured using titanium which meets ASTM B265 Grade 1 or 2 standards.

NMT[®] Electrodes' Mixed Metal Oxide coatings are electrically conductive which activates the titanium rod allowing it to function as an anode.

NMT[®] Electrodes Mixed Metal Oxide Ribbon Anodes have an extremely low consumption rate; therefore, the titanium substrate remains nearly constant throughout the design life of the anode. This provides a consistently low resistance anode.

NMT[®] Electrodes Mixed Metal Oxide Anodes exhibit high chemical stability even when exposed to low pH (acidic) environments and are suitable for use in chlorine- or oxygen-evolving electrolytes or a combination of both.

NMT[®] Electrodes Mixed Metal Oxide Ribbon Anodes are used for various applications in fresh water, brackish water and seawater and are available in lengths of 1 m and 2 m.

ADVANTAGES

- Dimensionally stable

NOMINAL DIMENSIONS OF SOLID RIBBON

Width	6.35 mm	12.7 mm
Thickness	0.635 mm	0.5 mm -0.6 mm
Std. Coil Length	76.22 m	76.22 m
Std. Coil Weight	1.12 kg	3.9 kg
Surface Area of Ribbon	0.014 m ² /m	0.0254 m ² /m

TITANIUM CONDUCTOR BAR DIMENSIONS

Width	12.7 mm
Thickness	0.9 mm
Coil Length	76.22 m
Coil Weight	3.8 kg

OPERATING CONDITIONS

Ribbon anode length	1 m	2 m
Max. Current Output	5.6 A	11.1 A

NOTES:

- Coating loading is able to be increased or decreased depending on the life and current density requirements stipulated by the client
- The current density should be determined in accordance with fresh water resistivity.



SAWTOOTH RIBBON ANODES

FOR USE IN CONCRETE

NMT® Electrodes Sawtooth Ribbon Anodes are manufactured using titanium which meets ASTM B265 Grade 1 or 2 standards.

NMT® Electrodes' Mixed Metal Oxide coatings are electrically conductive which activates the titanium rod allowing it to function as an anode.

NMT® Electrodes Mixed Metal Oxide Sawtooth Ribbon Anodes have an extremely low consumption rate; therefore, the titanium substrate remains nearly constant throughout the design life of the anode. This provides a consistently low resistance anode.

NMT® Electrodes Mixed Metal Oxide Anodes exhibit high chemical stability even when exposed to low pH (acidic) environments and are suitable for use in chlorine- or oxygen-evolving electrolytes or a combination of both.

NMT® Electrodes Mixed Metal Oxide Sawtooth Ribbon Anodes are used for various applications including use in reinforced concrete structures and above ground storage tank base plates.

ADVANTAGES

- Dimensionally stable

NOMINAL DIMENSIONS OF SOLID RIBBON

	(1)	(2)
Width	6.35 mm	12.7 mm
Thickness	0.635 mm	0.5 mm - 0.6 mm
Std. Coil Length	76.22 m	76.22 m
Std. Coil Weight	1.36 kg	2.72 kg
Surface Area of Ribbon	0.0287 m ² /m	0.0573 m ² /m

TITANIUM CONDUCTOR BAR DIMENSIONS

Width	12.7 mm
Thickness	0.9 mm
Coil Length	76.22 m
Coil Weight	3.8 kg

OPERATING CONDITIONS

	Current output (per m)	Current density	Lifespan
Concrete (1)	3.15mA	110 mA/m ²	50 years
Concrete (2)	6.3 mA	110 mA/m ²	50 years

NOTES:

- Coating loading is able to be increased or decreased depending on the life and current density requirements stipulated by the client
- The current density should be determined in accordance with fresh water resistivity.



MESH STRIP ANODES

NMT® Electrodes Mesh Strip Anodes are manufactured using titanium which meets ASTM B265 Grade 1 or 2 standards.

NMT® Electrodes' Mixed Metal Oxide coatings are electrically conductive which activates the titanium mesh allowing it to function as an anode.

NMT® Electrodes Mixed Metal Oxide Mesh Strip Anodes have an extremely low consumption rate; therefore, the titanium substrate remains nearly constant throughout the design life of the anode. This provides a consistently low resistance anode.

NMT® Electrodes Mixed Metal Oxide Anodes exhibit high chemical stability even when exposed to low pH (acidic) environments and are suitable for use in chlorine- or oxygen-evolving electrolytes or a combination of both.

NMT® Electrodes Canistered Mesh Strip Anode has been designed to replace the 3" x 60" silicon iron anodes in horizontal and shallow vertical groundbeds. Further applications include use in above ground storage tank base plates and cathodic protection for the protection of concrete rebars.

ADVANTAGES

- Lightweight and unbreakable
- Electrical connection fully encapsulated in resin
- Connection resistance is less than 0.001 OHMS
- Fine petroleum coke used to ensure efficient current distribution from anode
- Lower cost than 7.65 cm x 153 cm silicon iron anodes
- Flexible
- Dimensionally stable

Environment	Anode width	Anode length	Current output	Lifespan
Coke	31.75mm	1220mm	5 amps	20 years

* The above table corresponds to canistered anodes

NOTES:

- NMT® Electrodes can package the Mesh Strip Anodes in galvanised steel canisters, galvanised steel flexible conduit or flexible fabric. All of these packaging materials are available in a variety of diameters and lengths



WIRE ANODES

NMT® Electrodes Wire Anodes are manufactured using titanium which meets ASTM B348 Grade 1 or 2 standards.

NMT® Electrodes' Mixed Metal Oxide coatings are electrically conductive which activates the titanium wire allowing it to function as an anode.

NMT® Electrodes Mixed Metal Oxide Anodes have an extremely low consumption rate, therefore, the titanium substrate remains nearly constant throughout the design life of the anode. This provides a consistently low resistance anode.

NMT® Electrodes Mixed Metal Oxide Anodes exhibit high chemical stability even when exposed to low pH (acidic) environments and are suitable for use in chlorine- or oxygen-evolving electrolytes or a combination of both.

Applications for NMT® Electrodes Mixed Metal Oxide Wire Anodes include use in tank bottoms, tank internals, pipeline internals, canistered anodes, sock anodes, electrical cable shielding, continuous horizontal groundbeds and discontinuous horizontal groundbeds.

NMT® Electrodes MMO Wire Anodes are available in two sizes, with two standard current ratings. Other sizes and ratings are available upon request.

ADVANTAGES

- Low internal resistance
- Dimensionally stable

Anode diameter	Rating
1.5 mm	0.136 ohm / m
3.0 mm	0.068 ohm / m

NOTES:

- Approximate electrical resistance @ 25°C. Mechanical properties are based on typical room temperature
- Operating temperature affects resistance and resistivity changes maximum ampacity of wire



SOCK ANODES

NMT® Electrodes produces Sock Anodes using NMT® Electrodes Wire Anodes which are manufactured using titanium meeting ASTM B348 Grade 1 or 2 standards and are available in 2 different diameters.

NMT® Electrodes Sock Anodes linear assemblies, comprise NMT® Electrodes Wire Anodes and cable contained in a cotton sock. The cotton sock is filled with Calcined Petroleum Coke backfill, with a particle size of less than 1mm.

Header cable supplied is typically 10 mm² or 16 mm² XLPE/PVC connected to the MMO/Ti wire anode every 10 m. The header cable or spacing between the connections is able to be adjusted to suit the particular soil resistivity of the operation. Spacing of the connections will be dependent on the anode used, cable size used and environment where assembly will be installed. This “piggybacking” aids the distribution of current and attenuation.

The cable tail can be provided either at one end or at both ends of the NMT® Electrodes Sock Anode to allow the connection to powerfeed from the TR.

NMT® Electrodes Mixed Metal Oxide Anodes exhibit high chemical stability even when exposed to low pH (acidic) environments and are suitable for use in chlorine- or oxygen-evolving electrolytes or a combination of both.

Applications for NMT® Electrodes Sock Anodes include use in above and below ground storage tanks, conventional ground-beds and alongside pipelines.

ADVANTAGES

- Even current distribution
- Ease of handling and installation
- Well proven performance

Dimension of Ti Wire	1.5 mm dia. or 3 mm dia.
Current Output of Sock Anode	1.5 mm dia. Ti wire = 0.5 A / m ² 3 mm dia. Ti wire = 1.0 A / m ²
Sock Diameter	50 mm
Sock Lengths	1 m - 50 m
Sock Weight	2.3 kg per m



ROD ANODES

NMT® Electrodes Rod Anodes are manufactured using titanium which meets ASTM B348 Grade 1 or 2 standards.

NMT® Electrodes' Mixed Metal Oxide coatings are electrically conductive which activates the titanium rod allowing it to function as an anode.

NMT® Electrodes Mixed Metal Oxide Rod Anodes have an extremely low consumption rate, therefore, the titanium substrate remains nearly constant throughout the design life of the anode. This provides a consistently low resistance anode.

NMT® Electrodes Mixed Metal Oxide Anodes exhibit high chemical stability even when exposed to low pH (acidic) environments and are suitable for use in chlorine- or oxygen-evolving electrolytes or a combination of both.

NMT® Electrodes Rod Anodes are found in a variety of applications (heat exchangers, process vessels, water condenser boxes) and are suitable for operation in soils, carbonaceous backfill, freshwater, brackish water and seawater.

NMT® Electrodes Rod Anodes are available in diameters of:

- 3.175 mm
- 6.35 mm
- 12.70 mm
- 19 mm
- * Other sizes available upon request

ADVANTAGES

- Lower cost per Ampere Year
- Dimensionally stable

Environment	Max. Current Density
Fresh water	100 A / m ²
Brackish water	300 A / m ²
Seawater	600 A / m ²

NOTES:

- Coating loading is able to be increased or decreased depending on the life and current density requirements stipulated by the client
- The current density should be determined in accordance with fresh water resistivity.



DISC ANODES

NMT® Electrodes Disc Anodes are manufactured using titanium which meets ASTM B265 Grade 1 or 2 standards.

NMT® Electrodes' Mixed Metal Oxide coatings are electrically conductive which activates the titanium tube allowing it to function as an anode.

NMT® Electrodes Mixed Metal Oxide Anodes have an extremely low consumption rate, therefore, the titanium substrate remains nearly constant throughout the design life of the anode. This provides a consistently low resistance anode.

NMT® Electrodes Mixed Metal Oxide Anodes exhibit high chemical stability even when exposed to low pH (acidic) environments and are suitable for use in chlorine- or oxygen-evolving electrolytes or a combination of both.

Applications for NMT® Electrodes Mixed Metal Oxide Disc Anodes include use in condensers of power plants, water tanks, marine structures and internal protection of pipes. The disc anodes operate in fresh water, brackish water and seawater environments.

NMT® Electrodes MMO Disc Anodes are available in standard diameters of 25 mm, 60 mm, 100 mm and 150 mm. Other sizes and current ratings are available upon request.



ADVANTAGES

- No voltage restriction
- Dimensionally stable

Electrolyte	Maximum Current Density
Fresh water	100 A / m ²
Brackish water	100 - 300 A / m ²
Seawater	600 A / m ²

NOTES:

- Coating loading is able to be increased or decreased depending on the life and current density requirements stipulated by the client
- The current density should be determined in accordance with fresh water resistivity.

JETTY ANODES

NMT® Electrodes Jetty Anodes are designed for use in jetties and harbours where high current output and long design life is required in these installations. The jetty anode design integrates all the requirements for close surface fitting of plate anodes or offset cantilever fitting of tubular or rod anodes to tubular piling.

The anodes consist of a solid titanium plate, rod or tubular substrate coated with a Mixed Metal Oxide coating of IrO₂/Ta₂O₅ and is suitable for use in seawater.

The inert (dimensionally stable) MMO-coated titanium anodes possess a large current density, a low consumption rate, good conductivity, long life in extreme environments and have low cost. The MMO-coated titanium anode has conductive metal oxides which act as the catalysts, tailored to cater for the requirements of different working environments. In seawater, the chemical reactions taking place at the anode surface is primarily chlorine evolving. At high over-potentials an environment of low pH can be created around the anode, however, MMO coating is resistant to acid attack.

Platinised titanium jetty anodes are also available. Platinised anodes are also used in the application of cathodic protection of jetties and wharves. A thin layer of platinum is applied to the titanium metal substrate through a plating process. Platinised anodes perform extremely well in seawater environments exhibiting a large current density and an extremely low consumption rate; therefore, the substrate remains nearly constant throughout the design life of the anode. This provides a consistently low resistance anode.

A standard plate anode comprises of an MMO-coated titanium plate with exposed area that is 45 mm wide x 560 mm or 1130 mm long yielding a current output of 15 amps and 30 amps, respectively. The anode is mounted in an insulated assembly and is sealed with epoxy resin, while the cable connection is bolted directly to the plate to provide a watertight seal. The cable type, size and length is as per the customer's specifications. The standard cantilever-type anode is manufactured from MMO-coated titanium tubes with diameters 19 mm, 25 mm or 32 mm, or from platinum-coated 12 mm titanium rod.



Anode Type	Maximum Design Current Density	Maximum Voltage at Anode	Standard Anode Life	
MMO	600 A/m ²	8 V	20 years	
Platinised Titanium	1000 A/m ²	8V	20 years	

Environment	Anode Diameter (mm)	Anode Length (mm)	Current Output (amps)	Life (years)
Seawater Tubular MMO	19	1200	45	20
	25	500	25	20
	25	1000	50	20
	25	1200	60	20
	25	1500	75	20
	32	1200	75	20
Seawater Rod	12	250	9	20
	12	500	18	20
Platinised Titanium	12	750	27	20
	12	1000	36	20
	12	1250	45	20

Anode current rating (amps)	Anode Length (mm)	Anode Width (mm)	Overall Length (mm)	Overall Width (mm)
15	520	45	860	75
30	1130	45	1550	75

PYRAMID ANODES

NMT® Electrodes Pyramid Anodes are manufactured using titanium which meets ASTM B265 Grade 1 or 2 standards.

NMT® Electrodes' Mixed Metal Oxide coatings are electrically conductive which activates the titanium tube allowing it to function as an anode.

NMT® Electrodes Mixed Metal Oxide Anodes have an extremely low consumption rate, therefore, the titanium substrate remains nearly constant throughout the design life of the anode. This provides a consistently low resistance anode.

NMT® Electrodes Mixed Metal Oxide Anodes exhibit high chemical stability even when exposed to low pH (acidic) environments and are suitable for use in chlorine- or oxygen-evolving electrolytes or a combination of both.

PLEASE NOTE THAT NMT® ELECTRODES ONLY PRODUCES THE ANODE (MMO-COATED TITANIUM) COMPONENT OF THE COMPLETED PYRAMID ANODE.

The Pyramid Anode consists of a four-vented titanium substrate coated in a mixed metal oxide, $\text{IrO}_2/\text{Ta}_2\text{O}_5$, conductive film (top picture) mounted on a high-density waterproof concrete pyramid (second picture) to provide negative buoyancy and sea-bottom stability. Water seals are designed to established engineering principles and do not rely upon the dubious effectiveness of fillers, mastics resins and the like.

The anode, when fully assembled with special double-armoured insulated cable, requires only the installation contractor to lower the anode onto the seabed and terminate the onshore end of the cable, resulting in minimal installation time, and further cost savings.

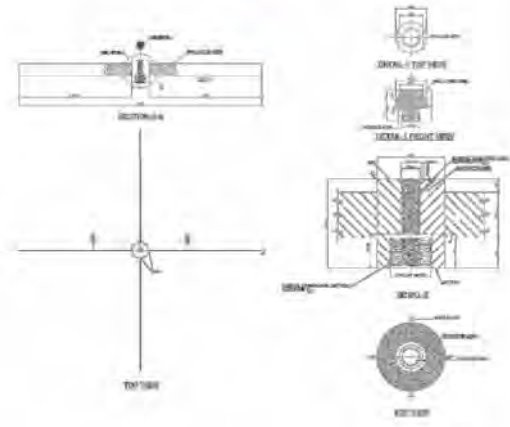
Applications for NMT® Electrodes Mixed Metal Oxide Pyramid Anodes include use in platforms, sheet piling, jetty piles and all similar offshore facilities.

ADVANTAGES

- Low cost
- Dimensionally stable

NOTES:

- Pyramid Anode setup is as per drawing. For more information please refer to data sheets



IMPRESSED CURRENT ANODES FOR THE PROTECTION OF SHIP HULLS

An effective way to diminish seawater corrosion of metallic structures such as ship hulls is cathodic protection in conjunction with a barrier coating.

Generally, sacrificial anodes or impressed current cathodic protection (ICCP) are used for this purpose.

Sacrificial anodes are composed of zinc or aluminium alloys and it is often necessary to use large, heavy anodes to attain a long service life which may create resistance when positioned on the ship hull. These are, therefore, applied to small vessels.

Large ships employ ICCP, which uses several anodes on the hull of the ship and provides a substantial amount of protective current from a power source.

This is advantageous as there is less drag created on the hull, a longer service life and the ability to control the potential of the ship's hull.

NMT® Electrodes produces the anode body of the ICCP for the protection of ship hulls.

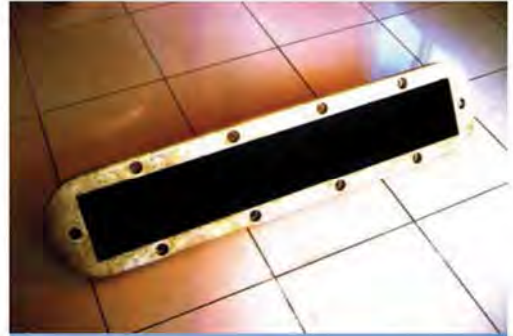
Despite lead-silver alloy having long been used as an ICCP anode due to the formation of a conductive lead peroxide film (which makes it partially inert) it is not as advantageous as MMO-coated titanium anodes as it is large, heavy in weight, has a high density and is harmful to the environment.

The inert (dimensionally stable) MMO-coated titanium anodes possess a large current density, a low consumption rate, good conductivity, long life in extreme environments and have low cost. The MMO-coated titanium anode has conductive metal oxides which act as the catalysts, tailored to cater for the requirements of different working environments. In seawater, the chemical reactions taking place at the anode surface is primarily chlorine evolving. At high over-potentials an environment of low pH can be created around the anode, however, MMO coating is resistant to acid attack.

The titanium plates are used as the anode body, with a titanium conducting bar welded in the centre at one side.

Platinised anodes are also used in the application of ship hull cathodic protection. A thin layer of platinum is applied to the titanium metal substrate through a plating process.

Platinised anodes perform extremely well in seawater environments exhibiting a large current density and an extremely low consumption rate; therefore, the substrate remains nearly constant throughout the design life of the anode. This provides a consistently low resistance anode.



TECHNICAL DATA



Technical Data Sheets