

INCORR ENGINEERING & TRADING

*** Cathodic Protection Materials Manufacturer/Stockist**

61 KAKI BUKIT AVENUE 1 #03-18

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INCORR MAGNESIUM ANODES

APPLICATIONS OF MAGNESIUM ANODES FOR CATHODIC PROTECTION

Magnesium has the highest driving voltage of the materials used for sacrificial anodes and is most commonly used onshore (in higher resistivity electrolytes) where the use of zinc and aluminium would be uneconomical. The most common applications are:

TEMPORARY CP SYSTEMS

The high current output of magnesium in seawater assists in the rapid achievement of polarisation potential. This approach has been used where the zinc or aluminium system originally installed has failed to provide sufficient current to achieve polarisation. Recent systems have included magnesium to provide the initial polarisation as part of the system design.

Temporary protection of land and other pipelines during construction and before the energising of the impressed current system. The anodes are easily installed within the pipe trench as construction proceeds; additional excavation is not required.

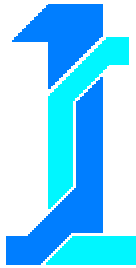
De-scaling of tanks. The high potential and consequent hydrogen evolution at the cathode leads to rapid removal of surface scale.

External protection of ships' hulls whilst in fresh or brackish water. This often consists of anodes suspended over the vessels' sides.

PERMANENT CP SYSTEMS

Land pipelines. Magnesium anodes have a particularly effective role in urban areas or where there are other buried services in the immediate vicinity.

Service pipes to domestic and commercial premises. For small diameter and short length pipes, the current required is very low and the anode mass is usually between 0.3 and 1.0 kg. Two types of anodes are in common use. The first type consists of an insert that screws directly into a "blind tee" that is fitted into the service pipe. This is cheap and easy to install but does not allow the performance to be monitored. The second type consists of a small cast or extruded anode that is packaged in the same way as the larger anode types. Connecting the cable via a test point allows for monitoring.



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Short pipelines including river crossings.

External surfaces of buried storage tanks, particularly oil tanks in hazardous areas.

External surfaces of caissons in fresh or brackish waters. The higher resistivity of these electrolytes prevents a cost effective protection system using zinc or aluminium anodes.

Internal surfaces of water storage tanks and treatment plants. The deposits are non toxic and magnesium anodes may be used in potable water systems.

Internal surfaces of calorifiers, heat exchangers and condensers.

Protection of "hot spots" on otherwise unprotected pipelines. "Hot spots" are areas where soil conditions are highly aggressive.

Supplementary protection on pipelines with impressed current CP systems in poorly protected areas, often due to coating damage.

Where space is very limited, for example the internal protection of pipelines or within a narrow pipe trench. In the latter case the use of a continuous or semi-continuous magnesium ribbon usually results in an even current density.

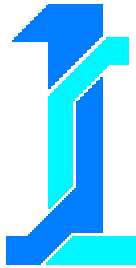
The protection of short steel/iron pipe lengths or fittings (flanges, valves etc.) within non-metallic pipe systems. Some end users require the application of cathodic protection to all buried metallic plant. Service anodes are often used for this application.

As an inexpensive monitoring electrode in large range, high temperature, high resistivity electrolytes, such as water tanks for boiler feed.

ALLOYS AVAILABLE

Magnesium anodes are available with several different chemical compositions, but in two basic generic types with voltage outputs of approximately 1.55 and 1.75 volts (with reference to a copper/copper sulphate reference electrode).

The 1.75 volt material is an alloy specially formulated from pure virgin magnesium and other elements to produce the higher voltage. It has several advantages over the 1.55 volt material that is often produced from recycled material. In particular, the higher driving potential (about 25 to 30% greater depending on the cathodic protection system design) may allow fewer anodes to be used for a given project. Its higher capacity (up to 4% greater) results in improved performance, with the possibility of longer anode life.



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Very often, magnesium anodes for soil application are backfilled with chemical. The low resistivity chemical backfill has four functions:

- a) Improve the anode efficiency by preventing direct contact between the anodes and soil.
- b) Prevent passivation of anode when anode is in contact with some undesirable elements present in soil.
- c) Retain the moisture.
- d) Reduce the anode to field resistance.

Many types of chemical backfill are available and the common backfill for galvanic anodes are as follows:

Type	Gypsum (CaSO_4) %		Bentonite Clay %	Sodium Sulphate %	Approx. Resistivity in ohm-cm
	Hydrated	Moulding Plaster (Plaster of Paris)			
A	25	-	75	-	250
B	50	-	50	-	250
C	-	50	50	-	250
D	75	-	20	5	50

1. Backfill mix (A) is useful in low soil moisture areas and utilises the moisture holding characteristic of the bentonite clay.

2. Backfill mix (B) commonly used with zinc anodes.

3. Backfill mix (C) useful with zinc or magnesium in very wet or marshy soils to prevent rapid migration of backfill from anode surface.

4. Backfill mix (D), with low resistivity, is useful in high soil resistivity areas to reduce the anode resistance to earth.

5. Various anode mixes are commercially available for installation around galvanic anodes and are supplied in packaged anodes.

CURRENT OUTPUT

The following table of current outputs may be utilised in general design calculations and is based upon the following parameters:

- i. The current outputs given are approximate only and are calculated taking the polarised potential of the cathode to be 900 mV (with reference to a CuCuSO_4 reference electrode).
- ii. The maximum useful life of magnesium alloy anodes is generally limited to about 10/12 years regardless of the theoretical life.
- iii. The final steady current output is given in milli-amperes.



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Only the most commonly used packaged anodes are considered in this table. For more information on other anodes please contact Incorr.

Electrolyte Resistivity (ohm-cm)	Anode nett weight / current output (mA)					
	4.1 kg		7.7 kg		14.5 kg	
	1.55 V	1.75 V	1.55 V	1.75 V	1.55 V	1.75 V
500	130	170	150	200	180	230
1,000	65	85	75	100	90	120
5,000	15	20	15	20	20	25
10,000	5	10	8	10	10	12

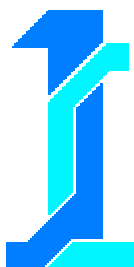
SPECIFICATIONS - INCORR MAGNESIUM ANODES

Incorr magnesium anodes are produced from the highest purity materials. Alloy compositions conform to Australian Standard AS2239.

Magnesium Alloy M3 Standard 1.55 V		Magnesium Alloy M1 High Potential 1.75 V	
Element	Percent	Element	Percent
Aluminium (Al)	5.3 - 6.7%	Manganese (Mn)	0.5 - 1.3%
Zinc (Zn)	2.5 - 3.5%	Aluminium (Al)	0.01% max
Manganese (Mn)	0.25 - 0.4%	Copper (Cu)	0.02% max
Silicon (Si)	0.05% max	Iron (Fe)	0.03% max
Copper (Cu)	0.05% max	Nickel (Ni)	0.001% max
Iron (Fe)	0.03% max	Magnesium (Mg)	Balance
Nickel (Ni)	0.003% max	Other	0.05% max
Magnesium (Mg)	Balance		
Other	0.03% max		

PACKAGED MAGNESIUM ANODES

Incorr magnesium anodes can be supplied packed in a gypsum bentonite backfill contained within a cotton bag. The anode is fitted with a cable for attachment to the structure (type and length at your request). All aspects comply with Australian Standard AS2239.



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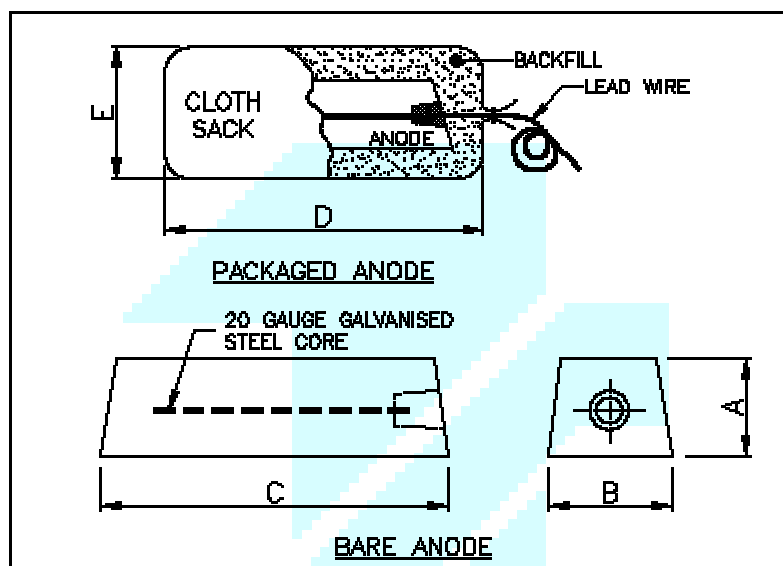
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ANODE SIZES



Standard Dimensions and Shipping Weights							
Anode Type	Nominal Dimensions in (mm)					Nominal Weight lbs (kg)	
	"A"	"B"	"C"	"D"	"E"	Bare	Packaged
3IM3	3 (76)	3 (76)	4.5 (114)	6.5 (165)	6 (152)	3 (1.4)	9 (4.1)
5IM3	3 (76)	3 (76)	7.5 (191)	13.5 (343)	6 (152)	5 (2.3)	14 (6.4)
9IM2	2 (51)	2 (51)	27 (686)	31 (787)	5 (127)	9 (4.1)	36 (16.3)
9IM3	3 (76)	3 (76)	13.5 (343)	17 (432)	6 (152)	9 (4.1)	24 (10.9)
17IM2	2 (51)	2 (51)	51 (1295)	55 (1397)	5 (127)	17 (7.7)	61 (27.7)
17IM3	3 (76)	3 (76)	25.5 (648)	30 (762)	6 (152)	17 (7.7)	42 (19.1)
20IM2	2 (51)	2 (51)	60 (1524)	62.5 (1588)	5 (127)	20 (9.1)	70 (31.8)
32IM3	3 (76)	3 (76)	45 (1143)	61 (1549)	6 (152)	32 (14.5)	90 (40.8)
32IM5	5 (127)	5 (127)	21 (533)	30 (762)	8 (203)	32 (14.5)	70 (31.8)
40IM3	3 (76)	3 (76)	60 (1524)	64 (1626)	6 (152)	40 (18.1)	105 (47.6)
48IM5	5 (127)	5 (127)	31 (787)	34 (864)	8 (203)	48 (21.8)	96 (43.6)
60IM4	4 (102)	4 (102)	60 (1524)	64 (1626)	6.75 (171)	60 (27.2)	130 (59.0)

QUALITY CONTROL

Laboratory certificates are issued for all alloy melts from which all anodes are numerically identified.