

Cathodic Protection of Aluminium Hulled Vessels in Salt

MGDUFF

Corrosion occurs in salt water with dramatic effect!

Metals of differing electrochemical potential when in contact with one another form Galvanic cells. The metal with a lower potential in the galvanic cell will be anodic and will corrode. The same effect can occur in areas of different electrochemical potential in a single piece of metal such as an aluminium plate. Any craft moored and operating in salt or estuarine water is at risk from corrosion and the effects can be costly.

Corrosion on Aluminium vessels can be identified as either areas of localised pitting to the hull plate, rudders, bilge keels and particularly in way of weld seams, or less obviously in the form of general wastage of the hull plating often occurring below the paint coating. Pitting can lead to the complete penetration of the hull below the waterline. General wastage of the aluminium can be just as critical weakening the hull possibly necessitating expensive replating.



What can be done to prevent corrosion?

The selection of materials is of prime importance in the construction of craft. Generally naval architects and boatbuilders ensure that they select metals which are, as far as possible, suitable for marine applications and that any combinations of different metals are compatible. When this is not possible metals must be isolated from one another. There will always be occasions when fittings or metalwork require replacement or repair and it is important that the same criteria is adopted. In particular ensure that fastenings and split pins are compatible and of the highest quality.

The paint system on any boat is an important first barrier against corrosion. Seek advice from the paint manufacturers for their recommendations on the most appropriate coating system and follow the application instructions completely. Ensure that a good anti-corrosive primer is applied if anti fouling is to be used. When using a copper based anti-fouling none of the paint must be applied directly to bare metal surfaces. Vegetable oil based paints, although far less widely available than in the past, should not be used with cathodic protection systems as the paint tends to saponify.

The correct installation of electrical systems on your boat will reduce the possibility of stray current leakage and the following actions are recommended:

- **Use only high grade insulated wiring of suitable capacity. Undersized wires will cause resistance and consequent voltage drop.**
- **Clip or support all wires at suitable intervals to prevent fatigue and eventual fracture.**
- **Use only corrosion resistant terminals and connectors and make sure that all are clean and tight.**
- **Fit an isolation switch on the positive side of the battery circuit.**
- **Ensure that all battery circuits are correctly fused.**
- **Keep all wiring, connections and junction boxes above the bilge area and other areas likely to become wet.**
- **Make sure that when fitting additional equipment the work is carried out in accordance with the manufacturer's instructions. The polarity of connections should be correct and each circuit must be correctly fused. Where necessary use an earthing plate isolated from the hull.**
- **Electrical and Electronic work is best carried out by a qualified marine electrician.**

On going maintenance on your boat is essential. Metal work, paint coatings and electrical installations all require regular inspection. In particular you should inspect the wind and water line area. This area is particularly vulnerable because it is often prone to mechanical damage but derives no protection from an anode system being above the water line.

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What is Cathodic Protection?

CATHODIC PROTECTION IS AN ELECTROCHEMICAL PROCESS WHICH HALTS THE NATURAL REACTION (CORROSION) OF METALS IN A PARTICULAR ENVIRONMENT BY SUPERIMPOSING AN ELECTROCHEMICAL CELL MORE POWERFUL THAN THE CORROSION CELL.

Sacrificial Anodes are fitted or bonded to the metal to be protected, this results in an electrical potential difference and the metal becomes cathodic causing the sacrificial anode to waste instead. In a correctly installed MGDUFF Cathodic Protection System corrosion only occurs to the sacrificial anode which is replaceable. The number and size of anodes is determined by the type of material and the surface area being protected.

Several factors determine the type of cathodic protection system fitted. Firstly the environment in which the vessel is operating, secondly the size and type of construction and finally the length of time that the vessel is likely to be afloat before the next maintenance slipping.

MGDUFF recommend the use of Zinc anodes for vessels permanently kept on a salt water berth.

Anode Selection

The number, type and positioning of zinc anodes for full underwater hull protection is dependent upon the following factors:-

- a) Area of immersed plating and structure.
- b) Efficiency of underwater paint coatings.
- c) Anode life required.
- d) Type and area of other underwater metalwork.
- e) Type of anode considered most suitable.

The following anode selection table, assumes conventionally designed vessels - whether pleasure or working craft, having good underwater paint coatings with minimal paint loss (less than 10% over 24 months).

To select the correct type and size of anode, calculate the wetted surface area (see below) and enter the table with wetted surface area.

Wetted Surface Area Calculations

Using the main dimensions of the vessel in metres, i.e. length (waterline), breadth and draft (mean loaded), calculate area by the following formula: $L \times W \times L \times (\text{Breadth} + \text{Draft})$. The resulting area applies to tugs, trawlers ferries, motor cruisers, launches and full bodied sailing craft.

Note 1: Resulting area $\times 0.75$ for medium displacement sailing craft.

Note 2: Resulting area $\times 0.5$ for light displacement sailing craft.

ANODE SELECTION TABLE			
for craft operating in salt water			
Wetted Surface Area	ZD42 Zinc Strip Anodes	ZD55 Recessed Zinc Anodes	ZD72BM Zinc Hull Anodes
Assuming a good paint system	12 month anode life	24 month anode life	24 month anode life
(0 - 15.0m ²)	2 x ZD42/36"	2 x ZD55	2 x ZD72BM
(15.1 - 30.0m ²)	2 x ZD42/54"	2 x ZD55	2 x ZD72BM
(30.1 - 45.0m ²)	4 x ZD42/36"	4 x ZD55	4 x ZD72BM
(45.1 - 60.0m ²)	4 x ZD42/54"	4 x ZD55	4 x ZD72BM
(60.1 - 85.0m ²)	6 x ZD42/54"	6 x ZD55	6 x ZD72BM
(85.1 - 110.0m ²)	6 x ZD42/72"	6 x ZD55	6 x ZD72BM

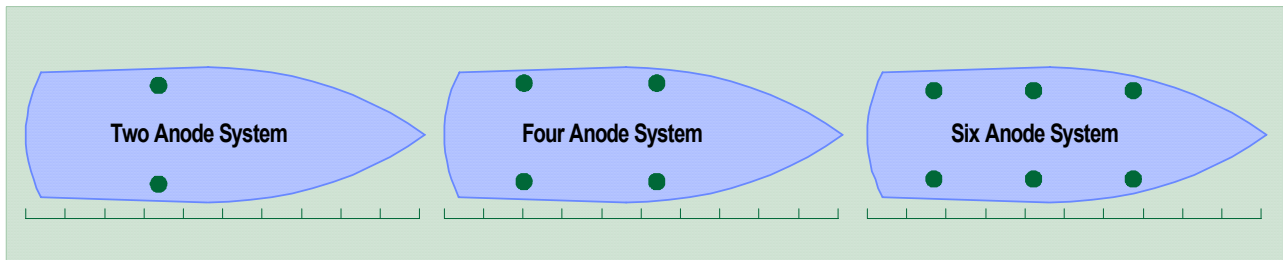
ABOVE 110.0M2 CONTACT MGDUFF FOR SPECIFIC ADVICE

Anode Positioning

- 1) Position anodes around underwater hull as shown Below. Positions may be adapted slightly to suit individual vessels.
- 2) Prepare and paint the hull in accordance with a reputable paint manufacturers specification before anodes are fixed.
- 3) Fit anodes using galvanised mild steel set bolts with fan disc washer making sure that the anodes are pulled up tight against the hull.
- 4) No paint must be allowed to fall on the surface of the anode itself at any time.

Maintenance

To ensure correct level of protection anodes should be replaced when 80% consumed or if it is anticipated that they will be more than 80% consumed at the next scheduled docking.



The zinc anodes described in this leaflet are those selected from our anode range as suitable for general small and intermediate size craft of various types.

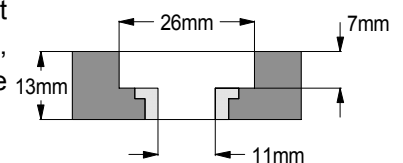
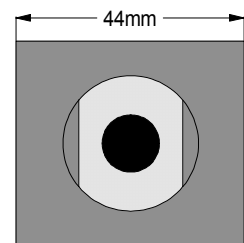
The methods of fitting the various anodes are detailed below.

Type ZD42 strip anodes:

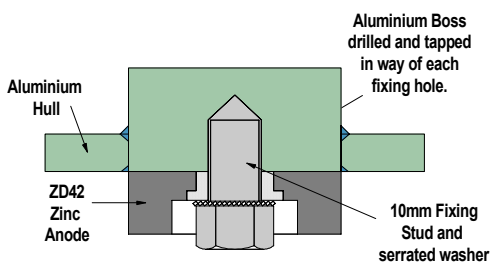
This is a low profile zinc anode with a non reactive aluminium insert, ideally suited for fitting to high speed aluminium hulled vessels. The anode is not recessed but prominent on hull surface and can be attached after construction. Each anode requires 3 or more fixing positions:-

ZD42/36" and ZD42/54" -3 fixing positions
 ZD42/72" -5 fixing positions (7 on fast craft).

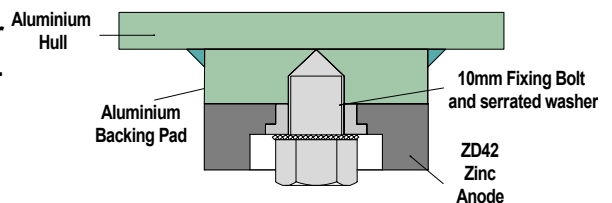
The ZD42 anode is supplied in 6ft (1830mm) lengths and may be cut to length. It can be supplied un-drilled or drilled and counter bored to standard centres. Fixing holes are drilled to suit 10mm studs and it is imperative that the fixing hole is counter bored down to the aluminium core.



This shows a typical installation (suitable for attachment after construction).

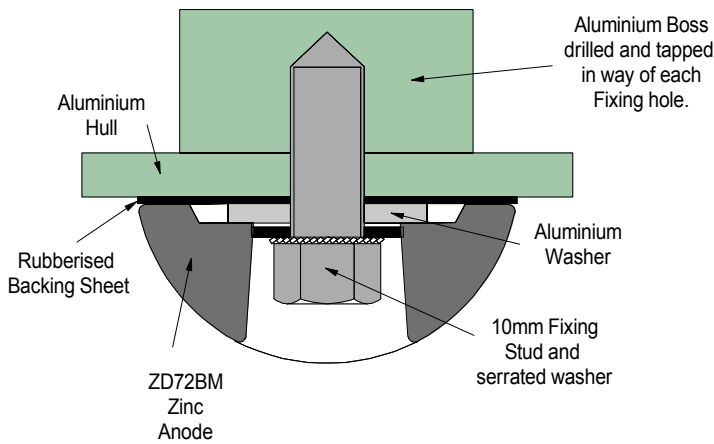
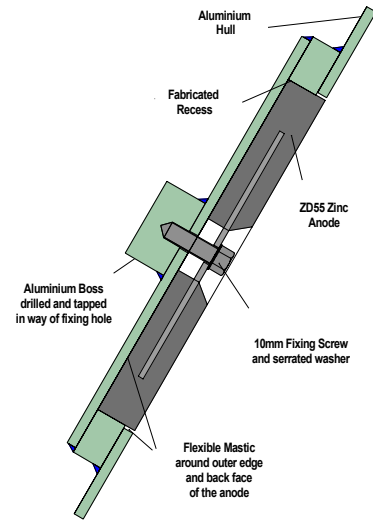
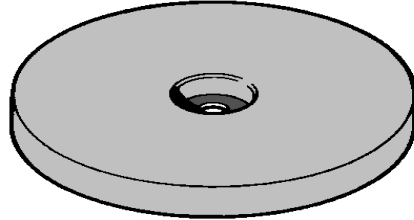


This shows a typical installation (showing fitting arrangement for new buildings).



Hull mounted ZD55 Recessed Disc Anodes

This 9" (225mm) diameter anode is generally utilised for flush mounting when minimum drag is required and is therefore normally incorporated on new construction where the circular recess can be arranged more easily

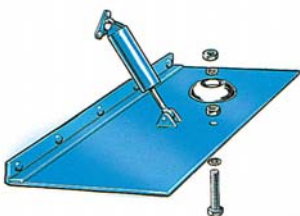


Type ZD72B(M) Zinc Hull Anode:

This low profile cast anode is suitable for lower speed craft, where the surface mounting will not



Trim Tabs and Rudders



Trim Tabs and Rudders will require additional anodes and we recommend that a ZD56 button anode is fitted on to each side of the rudders and to the top side of each trim tab. If the surface area of each side is greater than 1m² the size of the anode must be increased to a ZD58.

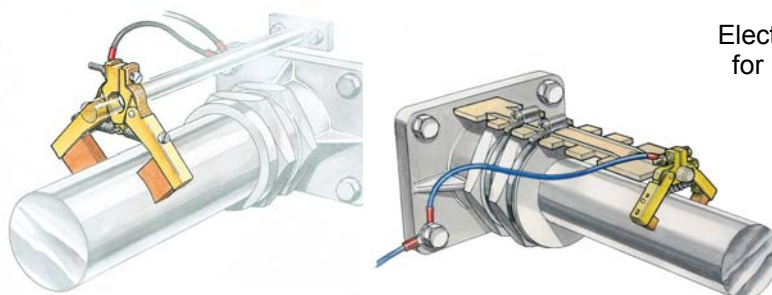


Shaft Bonding

To provide the best protection to the stern gear of your boat the shaft should be fitted with an MGDUFF Electro Eliminator Brush.

The MGDuff Electro-Eliminators offer the most effective shaft bonding solution. Running directly onto the propeller shaft the electro eliminator puts the anode in constant low resistance contact with the propeller shaft. The copper graphite brushes will give at least 2000 running hours under normal conditions. The electro eliminators will also remove the irritating interference to electronic equipment caused by the rotating shaft.

Electro Eliminator Number for 2" - 8" diameter shafts.



Electro Eliminator Number 1 for up to 2" diameter shafts