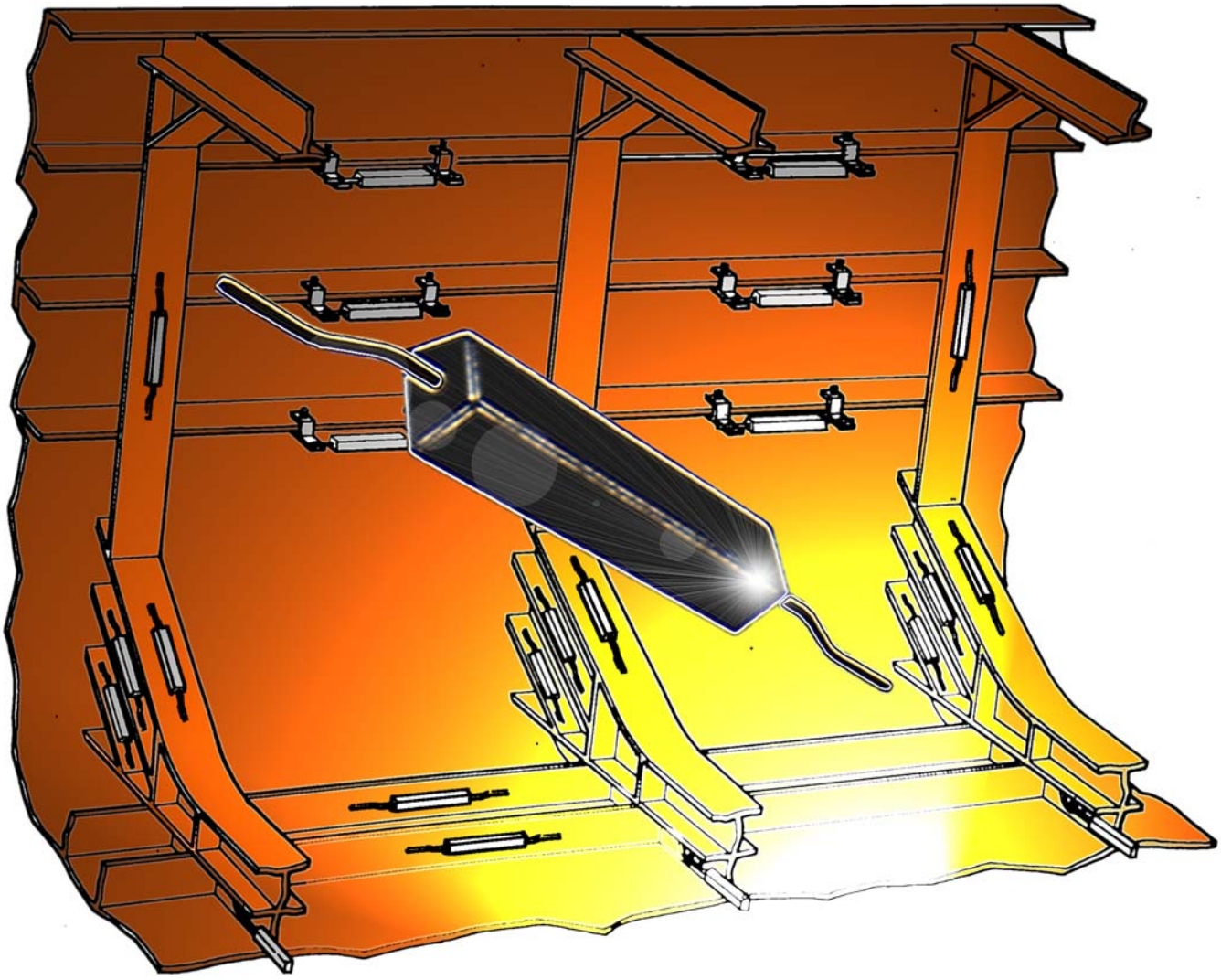
# MGDUFF

# CATHODIC PROTECTION OF SHIP'S BALLAST TANKS USING SACRIFICIAL ANODES



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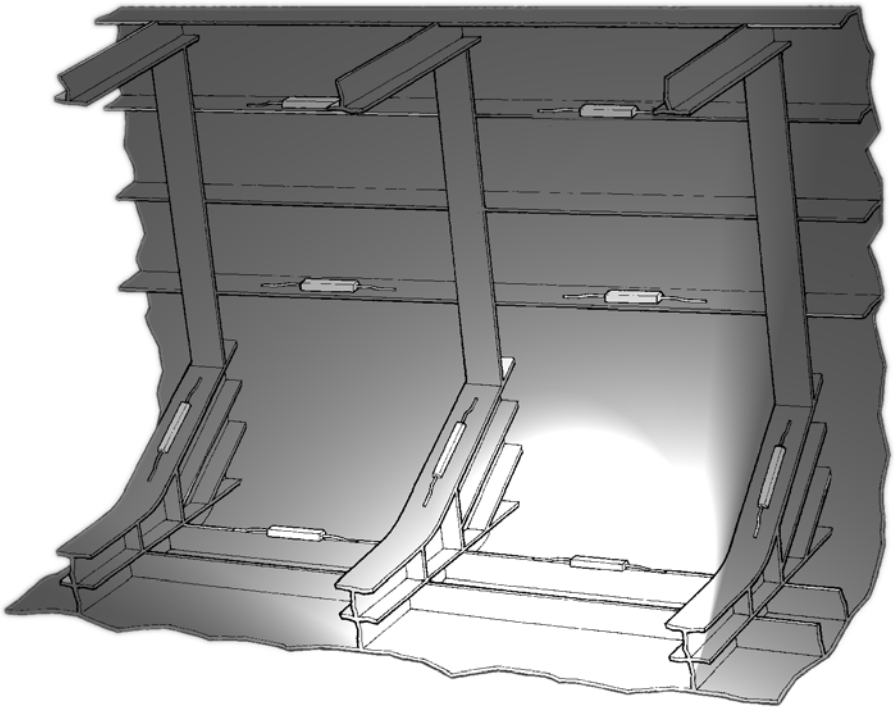
**M G Duff has been one of the world leaders in the design and supply of Cathodic Protection Systems to the Shipping Industry since 1954.**
This international service includes Design, Inspection and Testing of every type of Marine Cathodic Protection System, and is supported with the widest range of anode types, available at strategic locations throughout the world.

**Corrosion will occur to any steel surfaces immersed in a common electrolyte such as in the internal steel structure of a ships tank that is beneath the surface ballasted seawater.** The extent of the corrosion will depend on the nature of the electrolyte, the quality of the steel, methods of construction and other steps that have been taken to limit the process of galvanic activity.

**All ships tanks which are ballasted with water are subject to galvanic corrosion** and the corrosion will be more aggressive when:

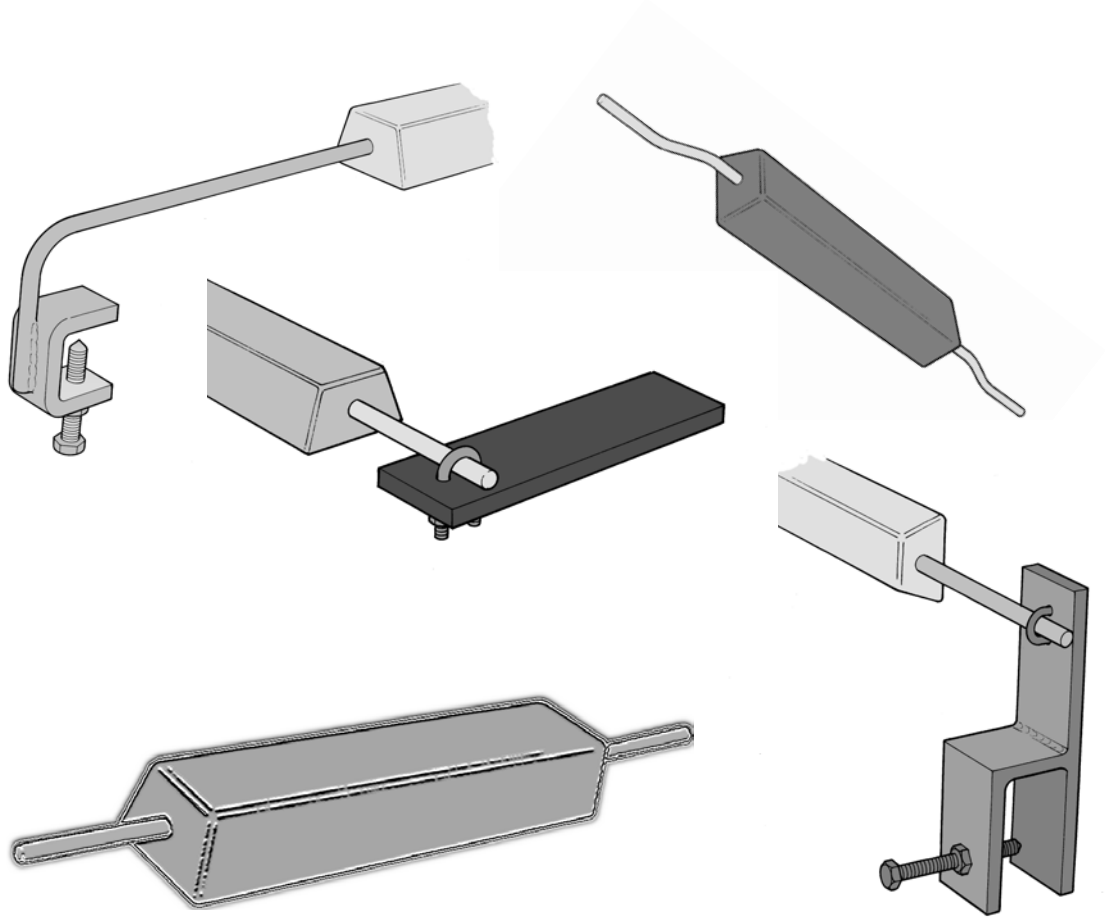
**The ballast water is saline because the lower resistivity of the water allows greater galvanic activity.**
**The paint coatings in the tank are poor and areas of bare steel are exposed.**
**A cathodic protection system has not been installed.**

**Bare steel will corrode freely** as will areas where coatings are poorly applied and water is able to penetrate and spread underneath. Clearly the first barrier is a physical and continuous layer of suitable coating between the surface of the steel and the water.
This is especially important in areas which are above the water line but in the splash zone such as the upper area of the tank and in particular the deck head where temperature and stresses in the moist environment will combine to cause aggressive atmospheric corrosion.
Coatings do have defects, become damaged or ultimately breakdown exposing small areas of bare steel that are prone to deep localised pitting corrosion which can penetrate the full thickness of steel plate quite rapidly unless other safeguards are in place.



**The only way of preventing corrosion to steelwork under water** is to apply a cathodic protection system whereby a more powerful corrosion cell is introduced and base metal anodes waste or sacrifice to protect the steel.
There are generally two metals commonly used in the cathodic protection of ships tanks, Zinc and Aluminium. These will only work effectively when alloyed with the necessary trace elements required to provide maximum performance.
All MG Duff anodes are produced from alloys with a proven and tested performance. Both of these materials will be effective in Seawater conditions but aluminium anodes offer slightly better performance when water resistivity is higher for example when ballasting in a harbour. There can be some financial advantage with aluminium anode systems in that generally less material is required for each system with lower installation costs as well as a material cost saving although the latter is subject to world metal prices which can be volatile. There is also an appreciable weight saving with a typical aluminium system being as much as 65% lighter.

**MGDuff Ballast Tank Anodes** are simple in design, generally a block casting with a central steel round bar insert which are either double cranked to facilitate weld fixing, or straight for use with reusable clamps which avoid the need for “Hot Work” in the tank space.
Other configurations are available such as flat bar inserts drilled to accommodate specific hole centres and anodes with integral clamps such as “pitguard” anodes designed for easy installation in cramped spaces such as double bottoms. The Pitguard anode will lie flat on the tank bottom clamped at one end to a steel frame.



**Anodes should not be located where they are likely to be damaged during tank operations.** Anodes will only provide protection when immersed in the electrolyte and this should be borne in mind when positioning them. Cathodic Protection can be applied to Ballast Tanks provided that tanks are immersed for 25% of the voyage time.
In Water Ballast tanks, anodes should be evenly distributed all over the tank with some emphasis on uncoated regions and areas that have large surface area of steelwork in the tank i.e. bottom longitudinals, horizontal stiffeners etc. From this it is evident that the majority of anodes will therefore be located on the bottom structure.
Some tanks may contain explosive gases and there is therefore a danger of anodes falling from a height sparking on the steelwork beneath and causing an explosion. For this reason the International Association of Classification Societies forbids the use of Magnesium anodes in the cargo tanks of tankers. Aluminium anodes also present this risk but are accepted at present for use in cargo/ballast tanks in tankers provided that they are not fitted above a maximum height where

**THE MAXIMUM HEIGHT (IN METRES) = 27 DIVIDED BY THE GROSS WEIGHT OF THE ANODE (IN KGS).**

Ballast tanks adjacent to tanks for liquid cargo with flash point $< 60°C$ can be considered as gas dangerous areas according to some classifications.
The selection of materials and installation of tank anodes should be carried out in accordance with the relevant classification society regulations and guidelines.

MG Duff have many years of practical experience on the installation and positioning of sacrificial anode systems and will prepare suitable system design and installation drawings to meet every design criteria.

**The type, number and position of anodes required depends upon several factors and the following information is required to determine the cathodic protection system:**

- ⇒ **The surface area of the tank or detailed tank drawings from which this can be calculated.**
- ⇒ **The type of coating, its coverage and anticipated breakdown over the life of the vessel.**
- ⇒ **The required life of system (In general not to be less than 4 years).**
- ⇒ **Frequency of ballasting / deballasting operations including the percentage of time the tank is filled and the nature of ballast water and in particular any cargo usage.**
- ⇒ **The preferred anode material and method of installation.**

**During routine inspections of cargo ballast tank the following checks should be made:**
Inspect the anode attachments to ensure that no clamps have became loose. Slack clamps should be tightened to ensure a good contact between the anode and the steel work. It may be necessary to remove any build up of scale or rust which can insulate the clamp from the steel.
The appearance of the anodes indicates if they are functioning correctly. An active anode will be covered with hydroxide which is a soft white deposit. A hard off white crust on the anode surface indicates that it has “passivated”, probably as a result of a ballast period in very brackish water or a poor connection to the steelwork. An anode that has passivated will not work effectively and should be cleaned back to reveal bare metal or just simply renewed.

Anode renewal should be carried out well before the old anodes have fully depleted and are only fully effective while at least 15-20% of the anode material remains.

Potential surveys can be carried out on the Water Ballast Tanks to ensure the anode systems are functioning to their desired values. These tests can either be done by MG Duff staff or by ships crew with the appropriate MGDuff testing equipment.

Readings should be taken at as many heights around the tank as there are openings i.e. accesses, tank cleaning openings etc. Readings should be taken every 3 months and a check taken on any low readings from the last date of survey. Readings will indicate whether anode systems are functioning correctly. Low readings will indicate that the tank is in need of immediate attention with respect to ongoing corrosion. For testing purposes the ballast water should be 1025RD and should have been in the tank for at least 48 hours.