

# Marine Galvanic Corrosion Made Easy.



Brought to you by Marine Protection Systems Pty Ltd





# Introduction

Made possible by the generous invitation and support of  
Sandringham Yacht Club

Presented and Supported by

- ✓ Marine Protection Systems – Jeff Bullock
- ✓ Logix Group – Brian Gatt



# Seminar Objectives

Understand and identify:

- ✓ Common issues including electrolytic corrosion (electrolysis), galvanic corrosion, growth, paint blasting and timber rot.
- ✓ How a bonding system works, learn how to repair and maintain an efficient bonding network.
- ✓ Appropriate anode selection.
- ✓ Strategies to prevent corrosion, marine growth and reduce on-going repair and maintenance expenses.
- ✓ Understand international standards and industry best practice.



# Types of Corrosion

Two basic types of corrosion for primary concern:

1. **Electrolytic Corrosion**; is stray current induced and often referred to as Electrolysis.
2. **Galvanic Corrosion**; relies on two dissimilar metals connected and in the same electrolyte (sea water).



# Other Common Issues

Secondary effects of poor corrosion protection

These other common issues are all related to cathodic protection and are also preventable:

- ✓ Paint blast
- ✓ Zinc passivation
- ✓ Wood rot
- ✓ Excessive growth
- ✓ Dezincification
- ✓ Galvanic couple

[Refer Corrosion ID poster for picture and explanation](#)

# Electrolytic Corrosion

Where did my prop go?



# Electrolytic Corrosion

*What is*

Caused by stray currents from a power source:

- ✓ Faulty or damaged wiring leaking current.
- ✓ Faulty on board device leaking current.
- ✓ Shore power connection / no galvanic isolation.



# Electrolytic Corrosion







# Electrolytic Corrosion

*Shore Power*

Plugging in to marina shore power connects your vessels submerged metal to others in the marina via the common earth conductor.

Unless isolated, your vessel can receive damaging current that will prematurely destroy anodes and then put your expensive metals at risk.

Isolate your vessel with an Electrolysis Blocker installed by a marine electrician.





# Electrolytic Corrosion

*On board*

A damaged appliance or wiring that is leaking current to ground via the hull (metallic hulls) or via common earth to submerged metal is causing Electrolytic Corrosion (EC).

EC can also rot bearings, washers, oil and water coolers and cause major engine damage quickly.





# Electrolytic Corrosion

## *Prevention*

You can very easily make quick observations to see if your vessel is or could be suffering from Electrolytic Corrosion. Look for signs of obvious action or leakage like the wiring pictured here.

A qualified marine electrician can perform an earth leakage test from the marina or on board electrical devices.

For real piece of mind and cheap insurance schedule an annual or twice annual earth leakage test.



# Galvanic Corrosion



Caused by dissimilar metals in contact and in the same electrolyte with out anode protection.

Stainless screws used on aluminium keel slipper

**PREVENTABLE**



# Galvanic Corrosion

dezincification or pinking

Caused by dissimilar metals in contact and in the same electrolyte with out anode protection.

Here the manganese bronze rudder has started wasting to protect the more noble metals it is connected to like stainless steel.

Many people would paint over this, however critical structural damage has been done. This rudder will not perform as intended and could even break.

**PREVENTABLE**



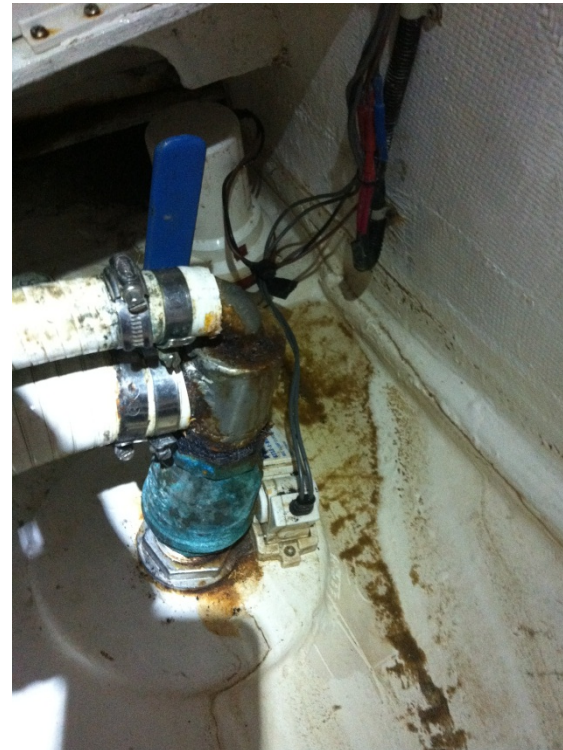


# Galvanic Coupling

Very common sight internally around skin fittings. Seen here on a toilet intake that has stainless through hull, bronze gate valve and custom stainless top fitting.

No bonding connection exists to an anode so a local galvanic coupling as been established.

**PREVENTABLE**



# Secondary Issues

Don't put up with them

Blasting and peeling of coatings and antifoul

Hard growth and weed attraction

Timber Rot or Alkaline degradation



# Paint Blasting

Over protection







# Paint Blasting

Over protection

Hull antifoul blasted from bronze skin fittings.

The mV potential of zinc has removed the paint from all fittings bonded to it, damaging them and leaving them exposed to growth attack.

**PREVENTABLE**



# Growth Attachment

Over protection





# Growth

Over protection

A lot of hard growth on all submerged metal.

Marine organisms are attracted to the high electrical current generated by Zinc.

Anodes with a lower mV potential will not attract the same level of growth.

**PREVENTABLE**





# Eliminate Growth

12 Months in the water with one 2.5kg Maddox anode fitted.

Maximum efficiency with reduced annual operating and maintenance costs.





# Timber Rot

## Alkaline degradation

Electroplating action between metals leaves an electrochemical reaction which provides cathodic protection.

This reaction is very similar to the production of caustic soda which is used to dissolve timber.





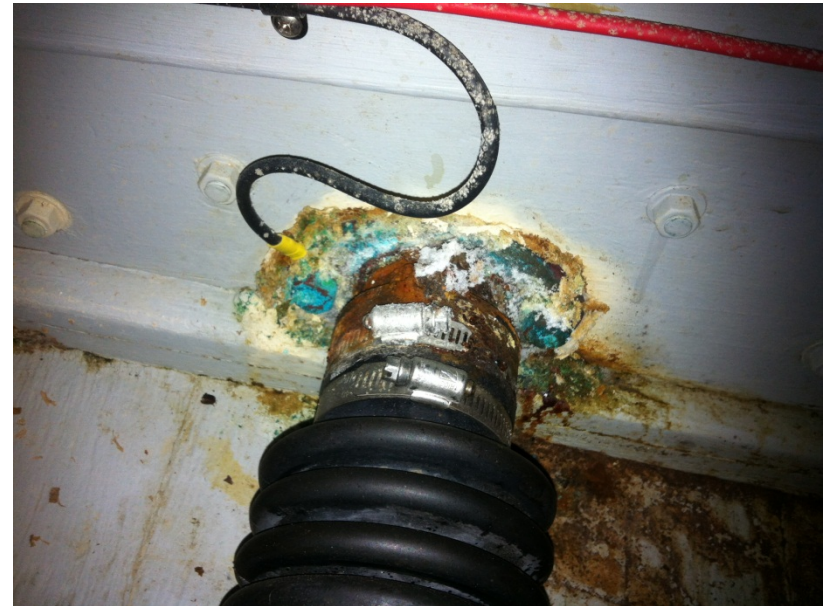
# Timber Rot

## Alkaline degradation

Seen here around the shaft seal of a well known Perth wooden boat.

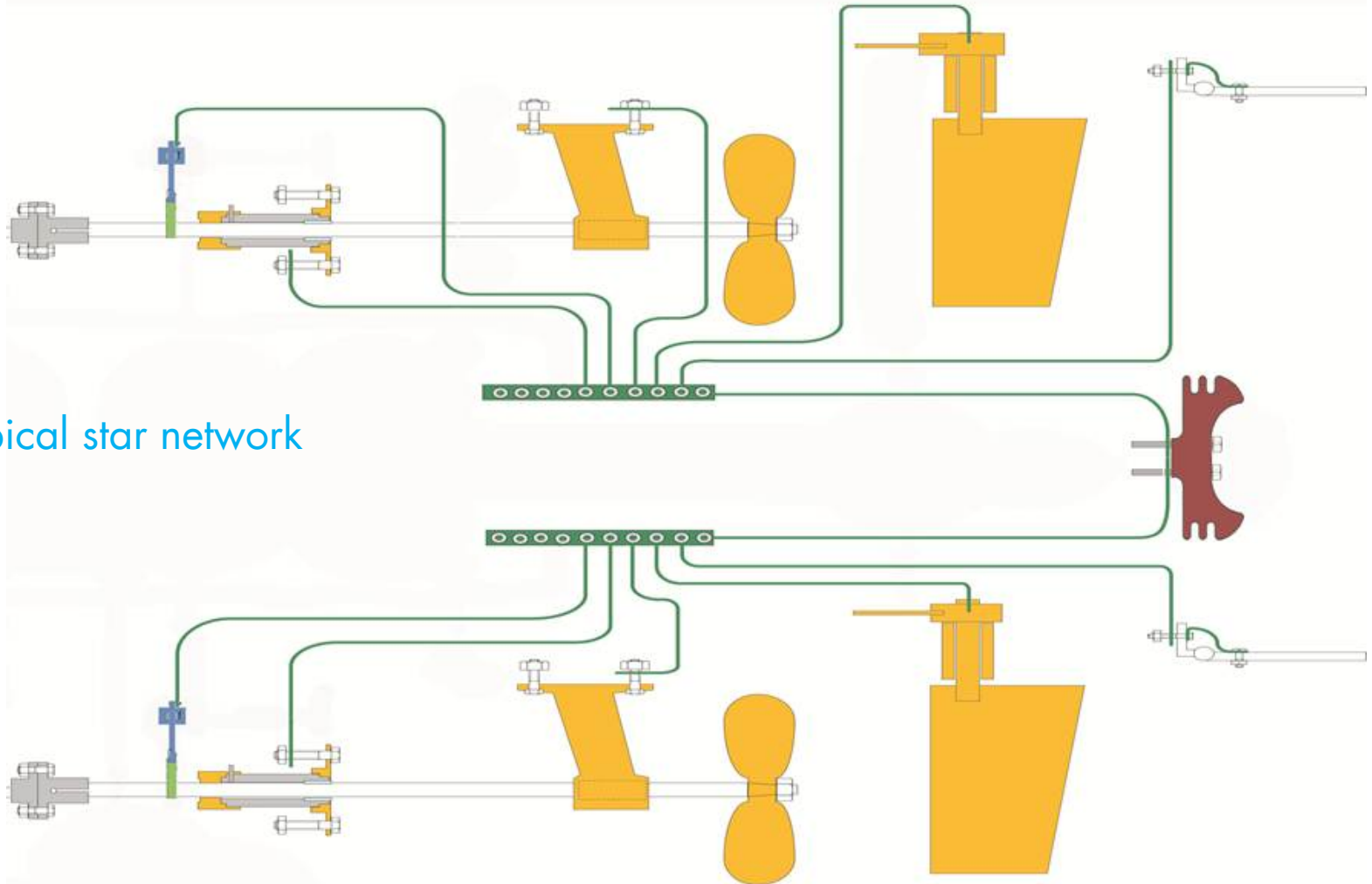
The high potential of a zinc shaft anode has destroyed the cellulose fibre in the wood. By international standards, zinc is not the recommended anode material for a timber boat.

**PREVENTABLE**



# Bonding Systems

A typical star network



# Bonding Systems

More important than you think





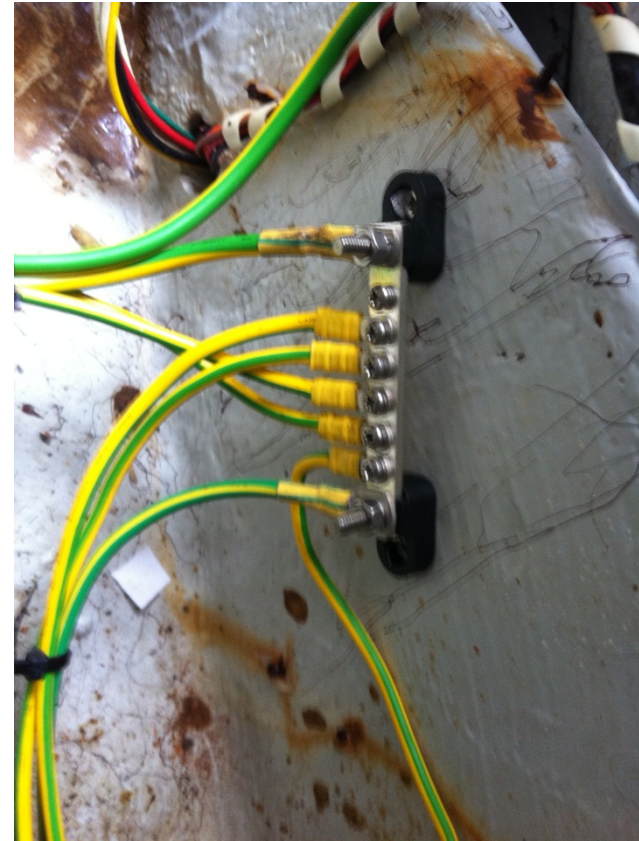


# Bonding Systems

A bonding system links all submerged metal to be protected with each other and the anode on the transom.

The system ensures the submerged metals have the same mV potential as the anode. If a connection is broken or is of poor quality, little or no cathodic protection is available.

Almost every vessel will have one, [do you recognise yours?](#)





# Bonding Systems

best practice

An effective and efficient bonding system;

Is connected in a star network to all submerged metal to be protected and to the transom anode.

Uses multi stranded wire which is tinned copper and green and gold insulated. Minimum 4mm, recommended 6mm & 10mm AWG.

Use zinc plated copper or stainless steel ring tongue connectors with heat shrink ends.

Is engineered to ensure the integrity of all connections in its network to the lowest ohms resistance possible.

Is maintained by the owner or marine trade at periodic intervals to ensure contact and performance.

# Sacrificial Anodes

There are other options



# Sacrificial Anodes

First experimented with in 1824 by the Royal Navy. Iron on copper sheath.

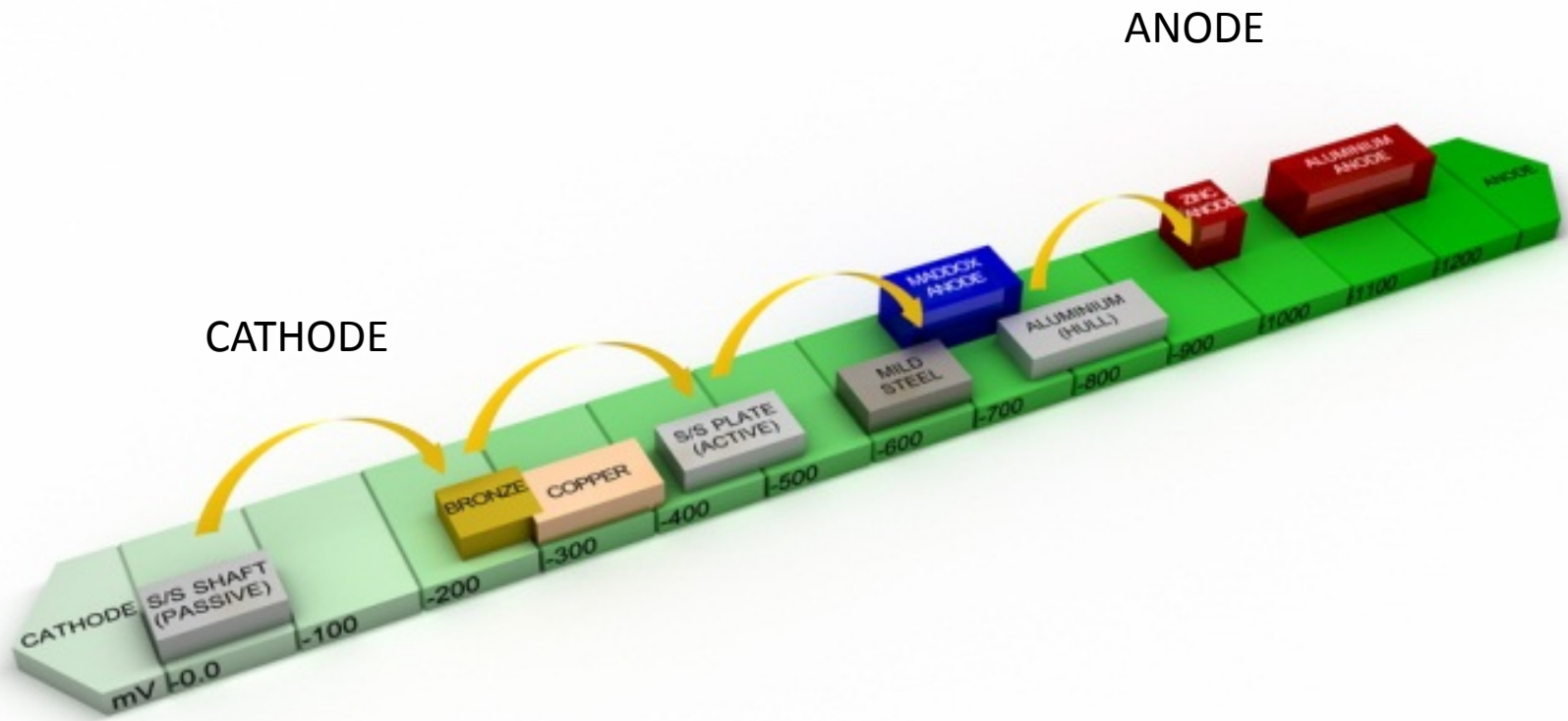
Designed to waste before the important parts of the vessel.

DNV & ABYC standards state no less than -200mV and no more than -300mV **differential**

Most non metallic vessels are over protected with zinc.

Zinc is recommended for protecting aluminium hulls and aluminium drive parts **only**. See Galvanic Series of Metals.

# Galvanic Series of Metals





# Anode Selection

mV potential

Known / accredited anode material mV potential tested independent to other metals using an Ag/AgCl reference electrode.

Compound	Application / Environment	Voltage
Magnesium	High negative driving potential. Fresh water – high resistivity.	-1.50V
Aluminium	Driving potential higher than zinc. Salt and brackish water.	-1.10V
Zinc	Salt water – very conductive electrolyte.	-1.05V
Maddox	Salt and brackish water. More passive than Zn/Al/Mg.	-0.75V

Metallic hulls or aluminium drive parts like stern drive, outboards and sail drives.

Stainless and bronze on fibreglass and timber boats



# Recommended Range -mV

ABYC recommended range for effective cathodic protection

HULL MATERIAL	mV	mV
Fibreglass	-550	-900
Wood	-550	-600
Aluminium	-900	-1100
Steel	-800	-1050
Non-metallic with Aluminium Drives	-900	-1050

As measured by an Ag/AgCl reference electrode.



# Anode Maintenance

Anodes must be visually and physically inspected for connection and performance at appropriate intervals.

MPS recommend regular;

- testing for appropriate mV potential for your vessel.

- testing for sustained mV potential across the bonding network.

- visually inspect and physically tighten anode bolts and bonding contacts

The initial periodic performance of these tests will create its own ongoing maintenance schedule.





# MPS Guarantee

MPS guarantee that a vessel improved and repaired with respect to these worlds best practice instructions will experience:

- ✓ Significantly less opportunity for corrosion or electrolysis
- ✓ less growth on hull and drive parts
- ✓ more efficient running performance
- ✓ less annual maintenance costs associated with anodes or the repair of corrosion, paint blasting and timber damage.



# Who is Responsible

Marina Operators - Australian Standards state that a marina operator must inform members that an Electrolysis Blocker or isolation transformer will help reduce corrosion. **SYC has done this.**

Marine Trades – Offer the industries best practice work standard, focus on continual education, consider products and services with better proven results.

Owners – Ask more questions regarding the condition of your vessel and learn to identify preventable issues, consider preventable maintenance solutions.



# Products and Services

MPS are manufacturers and suppliers of;

- ✓ High performance composite Maddox anodes.
- ✓ Shaft grounding solutions.
- ✓ Australia's only ABYC, ASNZS and NATA approved Electrolysis Blocker.
- ✓ Testing and monitoring equipment.
- ✓ Vessel bonding design and installation.
- ✓ Marine corrosion specific education and training.

The future costs and condition of your vessel are in your hands. Recurring issues once dealt with year after year have long been identified as preventable.

What will you do about it?



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