Galvanic Isolators….
The e-book

essential reading for every boater **galvanic-isolator.co.uk**

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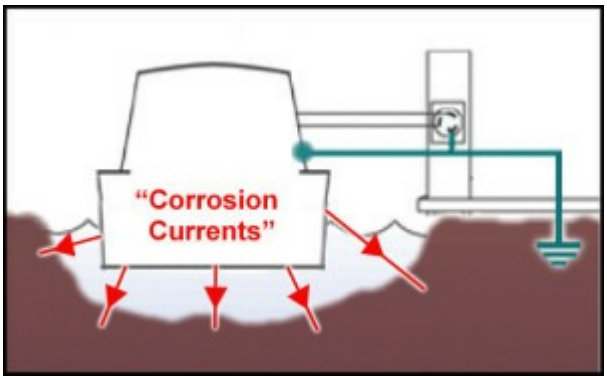
Here's a potted explanation of what Galvanic Isolators are, and why you very probably need one on YOUR boat.....

If your boat is made of metal AND you connect to a shore supply, sometimes called an "Electric Hook-Up", there is a serious risk of Galvanic Currents causing enormous damage to your boat's metal hull. A Galvanic isolator can prevent this. When metals are immersed in water, they act as a battery, and when the circuit is completed, small electrical currents flow. We call these currents "Galvanic" or "Corrosion" currents. More about that later. What you need to know is this...

> **"When Galvanic Current flows, it corrodes metal from the hull or fittings of your boat - you really don't want that"**



Although corrosion currents can be quite small, over a period of months, your boat could shed many many kilograms of its hull, leading to pitting, and even holing.

You can often see this along the water line of the boat. It's well worth checking right now!

> **Believe me when I tell you that this is no fairy tale - my own boat's hull lost around half a tonne in weight through corrosion that could have been prevented for just a few pounds with a simple Galvanic isolator (sometimes known as a Zinc Saver).**

A Tale of Two Corrosions

In fact, there are TWO types of corrosion current that are often mistaken for the same thing.

One is *Galvanic Current* - that's the current that is caused by your boat's hull's interaction with the metals that are naturally present in the bank side.

The other is *DC Leakage*, which occurs when current "leaks" from your boat's electrical circuits and follows a path to the shore supply earth. In my personal experience, this kind of leakage impacts about 1 in 3 boats. When it happens, it can damage your boat with devastating speed.

If you moor on a marina, the problem can be particularly serious. That's because all of the boats are connected together by the earth of the shore supply. If the zinc anodes on any of the other boats in the marina, or even on the pontoons are corroded away or missing, the anodes on YOUR boat will try to protect the other boats, not to mention the marina's structures too. So if your anodes don't seem to last as long as you'd like you may have just found out why. **And it gets worse still!**

As the hull starts to corrode, pits begin to form in it's surface and because the pits have a larger surface area than unpitted metal, the corrosion speeds up. Before long, the anodes will have been dissolved away, and your boat is left entirely at the mercy of corrosion - the boat-killer.

Fortunately, the problem is not difficult (or expensive) to resolve. In a nutshell, what you need to achieve is to SAFELY break the electrical earth that connects your boat to the shore supply. This interrupts the electrical circuit through which corrosion currents flow.

> **The easiest way to achieve this is with a "Galvanic Isolator", a simple electronic device that blocks corrosion currents from flowing, while allowing the safety electrical earth to remain intact.**

There are two types of Galvanic isolator:

- **Plug in Galvanic isolator that simply connects in-line with your mains connecting cable.**

- **Wire in Galvanic isolator which is part of your boat's internal electrical wiring.**

Which is better??? Plug in or Wire in....

Both Plug in and Wire in galvanic isolators do *exactly* the same job. Neither is better than the other. The difference is in the *installation*.

Plug in Galvanic isolators simply plug onto the end of your electric hookup cable, so (in the case of our own Galvanic isolators) you don't need any tools or electrical knowledge to fit them. This is a MAJOR advantage. There is nothing to do wrong.

Wire in isolators aren't difficult to fit, but they absolutely MUST be fitted correctly. An incorrectly fitted isolator may not work at all, and could even be dangerous. You'll need to gain access to the power inlet connector on the boat, (which, on some boats, can be a challenge in itself). You also need to be able to use simple tools, and to work safely around electricity. The Voltages can be lethal, and the system must be fully isolated and powered down before working on it. If you're 100% confident in your ability to do this, a wire in device could be a good choice for you. If not, a Plug in device would be a better option.

From the above, you probably conclude that my personal favourite is the Plug in device - simply because it's SO easy to use even if "electrics" are a complete mystery to you.

So there you have the basics of Galvanic isolators, but if you'd like to know even more, read on….

Italian Luigi Galvani knew very little about boats – even though he was born in the early 1700's, just a few years after James Brindley made a name for himself helping creating the UK canal system.

Luigi, if you recall, was the chap who liked to watch frogs legs twitch when an electric current was attached to them. At the time, this phenomenon became known as "Animal Electricity", but eventually, the name "Galvanism" took over.

Galvanism also became the name for electricity generated by chemical means, and is the foundation on which the batteries on our boats work. So the next time you turn your ignition key, and the engine springs into life, think of….. FROGS.

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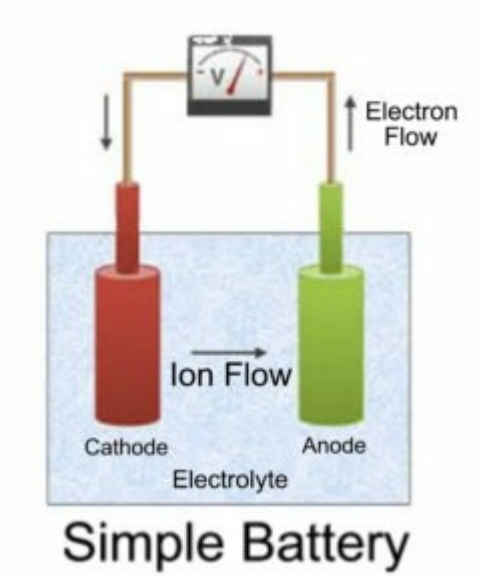
> **Skipping over the theory a little, we can say that Galvanic Current, (aka Galvanism) results from two pieces of metal being submerged in a liquid, (which nerds like me call an electrolyte).**

A fundamental law of physics is that whenever two different metals are submerged in an electrolyte, a voltage always appears between them.

Generally, our boats are often made of steel – or aluminium. And they are immersed (hopefully only partially) in water. So we have two of the components required to make a simple battery.

All we are missing from our Galvanic Current Generator (aka Battery), is a second piece of immersed metal. This is supplied in the form of pontoons or submerged metalwork, other boats, or the bankside / shore, which of course are laden with minerals.

In the case of boats with non metallic hulls, it's the underwater metalwork, such as outboards and saildrives etc that suffer.



You can confirm this for yourself by knocking a spike into the ground and, with the mains cable disconnected, wire a sensitive multimeter on the 2 Volt range between the spike, and the hull of your boat. You'll measure a small fraction of a Volt. This is the Galvanic Voltage we've discussed.

Unfortunately, Galvanic Voltages aren't sufficient to boil a kettle, or even charge your 'phone. But they are more than enough to erode your boat's anodes, hull, propeller etc.

The brass & aluminium found in props, outdrives etc is especially vulnerable to Galvanic corrosion, as they are "Soft" metals.

To avoid these Galvanic Currents flowing, we need a way to isolate the boat from the mains earth. This will break the circuit for the Galvanic Current. But for safety's sake, we can't just disconnect the earth connection. In fact, don't even THINK about disconnecting the earth connection.

Isolation Transformer

There are two ways to isolate your boat from the mains earth. One is to use an Isolation Transformer. This is a perfectly valid way of achieving DC isolation, (but please don't be mislead into believing that you have an earth-free system, because there will still be a path to earth through the boat's hull).

! Always ensure that the transformer is rated for an adequate duty cycle, depending on the load. Some isolation transformers are rated for intermittent duty cycle, and could easily overheat.


Wire in Galvanic isolator


Plug In Galvanic Isolator

The other way to isolate your boat from the mains earth is to use a Galvanic isolator.

Galvanic Isolators provide isolation in a completely different (but no less effective) way - by using semiconductors to block small Galvanic Voltages, whilst allowing larger "fault currents" to flow.

In that way, the safety electrical earth is maintained – which turns out to be EXACTLY what we want.

How to select a Galvanic Isolator

You choose a plug in Galvanic Isolator based purely on the capacity of your shore supply. The connectors must match your supply current, (or they simply won't fit) If you're not sure what supply capacity you have, just measure the connectors. Most supplies are 16A.

The other important rating is the Surge Current. The higher the better. This is the current that the isolator can handle in the event of a fault. 500A is a good figure to look for.

AC Bypass Capacitors

The latest and most effective Galvanic isolators are fitted with an AC Bypass capacitor. This simple component greatly enhances an isolators performance. That's because many electrical systems have a small amount of "leakage", meaning that some of the current "leaks" out and flows to earth. The amount is usually tiny - nowhere near enough to operate a trip, but it can spoil the effectiveness of a Galvanic isolator.

An AC bypass capacitor "re routes" any leakage so that it doesn't pass through the isolator, and it does this in such a way that the isolator STILL blocks Galvanic currents. (We fit AC Bypass capacitors to ALL our products, but not all manufacturers do). To check, look for the symbol.

We've covered pretty much everything you need to know about Galvanic isolators, but if you'd like to become a Certified Galvanic Isolator Nerd, there is still a bit more.

What is the difference between Galvanic Currents and Earth Leakage?

Galvanic Currents, and Earth Leakage are often lumped together as one. But they are actually quite different.

Galvanic Currents, (AKA Corrosion Currents), are small currents that flow in the earth conductor of a boat's shore connecting cable. They are quite low voltages, typically under 1 volt. They cause corrosion of a boat's hull and stern gear, prop etc., and fast depletion of anodes. **All** metal boats connected to a mains supply have Galvanic Currents. They are NOT the result of a faulty system - they are down to the Laws of Physics.

Earth Leakage comes from faults in the boat's wiring or equipment, and also from "interference" from electronic equipment (TV's, Battery chargers etc., etc) that's connected to the boat's electrical system. Not all boats have earth leakage, but many do. And it's very, very damaging to your boat's hull, propeller, anodes etc. If you have earth Leakage, you probably won't know about it until your boat comes out of the water for maintenance.

Types of Earth Leakage:

AC Leakage. This is what the RCD (Earth leakage circuit breaker) on your boat and shore post are intended to protect against. AC leakage is potentially dangerous to life, but doesn't directly cause hull damage.

DC Leakage. Also known as Stray Currents. Your boat's circuit breakers do NOT protect against this! Stray Currents can flow as a result of faults in the boat's DC wiring or equipment. Often, you won't be aware of these currents, as there may not be any obvious symptoms. Stray Currents are very damaging indeed, because the voltages are higher than Galvanic Currents – 12 or 24 Volts.

Galvanic Isolators are now available with circuits built in that monitor the current flowing in the earth conductor. Of course, there shouldn't BE any current in the earth conductor, but if there is, our isolators alert you by illuminating LED's. One LED lit indicates DC leakage, and two LED's lit indicate AC leakage.

So, to confirm…. DC Leakage Currents are FAR more damaging than Galvanic currents. Why? Because the voltages involved are greater. Whilst ALL boats connected to a shore supply will have Galvanic Currents, DC Leakage Currents are less common, but still affect around 1 in 3 boats. Because DC Leakage can be SO destructive, it's a something to be taken very seriously indeed. When choosing a Galvanic isolator, it's recommended that you choose one with Earth Leakage detection.