CORROSION

by John Benge, Shrimper 433 (*Grace of St Just*) (Spring 2000)

Corrosion, its causes and consequences, can take many forms and whilst it is not generally a matter for great concern amongst Shrimpers, it is useful to have some knowledge of the subject. As many boats with galvanised fittings age and replacements become difficult to obtain, problems can arise.

We will consider two types here - Electrolytic and Galvanic. Electrolytic corrosion is caused by a current from an external source, more often than not the boat's battery. The metals affected may be the same or dissimilar. The "stray" current usually arises as a result of a below standard electrical installation or damp conditions. Preventing this type of damage is usually a matter of good electrical practice. The installation should be checked at regular intervals, loose connections tightened and the battery always disconnected when not in use. Make sure the battery isolating switch is fitted on the positive side or is a double pole type. The underwater metal item which "grounds" any electrical leakage will corrode, and bronze or brasses will have a shiny appearance.

Galvanic corrosion.

It is usually this type that will be of more concern to Shrimper Owners. Galvanic corrosion occurs when two dissimilar metals create a cell and an electric current flows between them. Place two different metals in seawater and a galvanic cell is set up. A wire and meter connecting them will show a current flow - in fact a battery - and the result is that one of the metals is rapidly corroded.

The liquid surrounding the metals has to be a good conductor - sea water is one, fresh water much less so and distilled water a poor conductor. The degree of conductivity directly influences the rate of corrosion.

Different metallic combinations result in varying electrical potentials. The resultant electrical "rating" is called the galvanic series. The metals high up in this series are known as more "noble" than those lower down, which are called more "base". Other terminology is cathodic (noble) and anodic (base). The rate of corrosion that takes place depends more on the current flow than the voltage difference; thus the exposed areas of metal have a very significant effect. The more "base" metal is the one that generally corrodes and the further apart in the galvanic series they are the worse the corrosion, depending of course on the surrounding liquid.

Some common metals and their position in the galvanic series are shown in Table 1

Table 1: Common Metals & their position in the Galvanic Series

Galvanic Position	Metal	Typical Use on a Shrimper
Noble	Stainless steel type 316 (A4)	Fittings & fastenings
↓	Other stainless steels	Fittings & fastenings
	Nickel - Al - Bronze	Some propellers
	Gunmetal	Hull fittings
	Manganese Bronze	Some propellers
	Copper	Misc. fittings & fastenings
	Brasses	Misc. fittings
	Mild steel	Older rudder blades & all centreplates, galvanised
	Aluminium alloys	Outboard engine casings and propellers
Base	Zinc	Galvanised fittings

The potential between the metals and the resultant current flow is also affected by:

Temperature - Potential generally increases at higher temperatures

Salinity - Potential generally increases at greater densities.

Velocity - Strong tidal flows have a variety of effects, mainly negative.

Stainless steels often have a tough oxide skin and cause less corrosion to their "base" partner than would normally be expected by their position in the galvanic table.

Galvanic action not only takes place underwater, but also in the often damp salt laden atmosphere above. Anybody who has fitted a brass bolt in an aluminium alloy stanchion will be able to testify to this!

General rules to avoid problems:

1. Make all parts of the same metal or alloy.

2. If, as is often the case, this is not possible, make the smaller item the more "noble" if this is the more important (i.e. the fastening).

3. The respective areas of metal should be the right way round so as to spread the attack i.e., the larger area the more "base" metal. (Galvanised mild steel centreplates vs stainless steel stern fittings)

4. Whenever possible paint the metals, most particularly the more "noble".

5. Antifoulings. Copper based products can cause extensive galvanic corrosion. Never paint aluminium alloy outboard drives with this type, although a barrier coat may solve the problem. Paint companies will normally give good advice on this. Galvanised coatings can be similarly affected. Copper free antifoulings are available and are suitable for all "base" metals.

6. Anodes - both hull and on outboards. Renew when more than 60% worn. Never paint these! A good rate of corrosion indicates the anode is working well thus preventing damage to other metals.

Finally, be aware that on drying mud berths bacteria and pollutants in the top layers of mud can corrode exposed steel, i.e. rudder blades, pintles, gudgeons and centreplates. Paint provides protection but see earlier remarks on copper based antifoulings. Use an etch primer first.