Corrosion Protection For Metal Fittings

by John R. Marples

The most common fault in boats that1 have surveyed in the last ten years, is lack of proper corrosion protection of metal fittings, both above and below the waterline. Since ocean-going vessels are literally sailing in an electrolyte, or electrically conductive fluid, electrical activity between dissimilar metals is encouraged. In a bad case, the lack of protection underwater, can reduce stainless steel to something resembling Swiss cheese rather rapidly.

Above the water, the potential activity rate is much slower in the salt-laden air and spray, but evidence on most boats is easy to see; blistered paint and pitted winch mountingpadsonaluminummasts, and fasteners frozen in place by festering oxides. The guidelines given here can prevent losses due to what is commonly called "galvanic corrosion."

Fortunately, the prevention of the problem is simple and inexpensive, but the consequences of ignorance can be costly.

The first step should be to use metals that are compatible with each other whenever possible. Table 1 shows basic compatibility both above and below water. Note that brass or bronze in contact with aluminum is a bad choice, and a common problem. In many cases, it is difficult to avoid; for instance, winches with bronze bases screwed to an aluminum mast. In this and similar circumstances, it is necessary to insert a plastic isolation disc between the active metals. The disc should extend l/4" or more beyond the edge of the base (make it l/2" larger in diameter), to prevent salt buildup from bridging the gap. Thin plastic films will not do the job — use l/32" to l/16" thick, strong, non-conductive plastic like nylon or polypropylene (or even Formica).

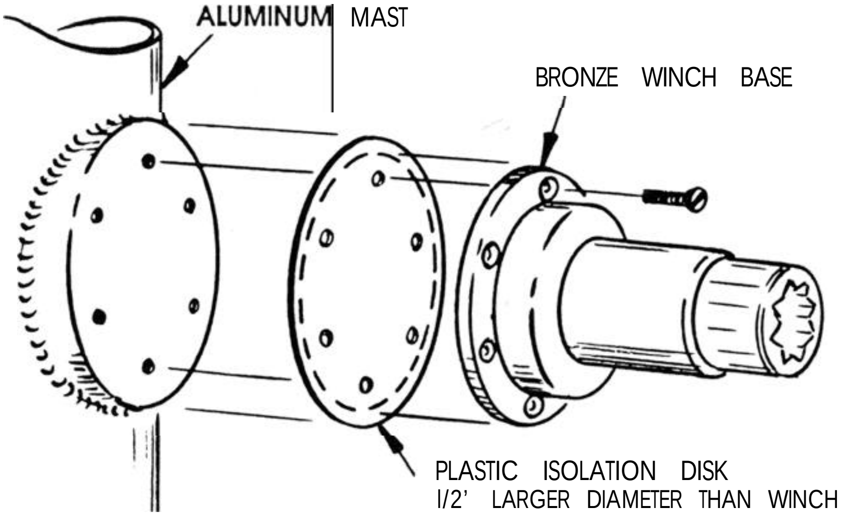
Although stainless steel fasteners are shown in the table to be compatible with aluminum, they must be protected with an anti-seize compound (the aluminum-colored automotive type) before insertion, to insure that they can be easily withdrawn later. In fact, anti-seize compound is a good idea on all threads. Be warned however, that the aluminum-colored compound has a tendency to appear in smudges all over the boat, unless extreme care is taken to work cleanly.

Underwater, the corrosion potential is quite high. The best choice of metals is: titanium (if you can afford it), monel, bronze (only silicon bronze, manganese bronze is actually a brass alloy), and stainless steel, in that order. Aluminum is a poor choice, as evidenced by the frequent problems with outdrives and the lower units of outboard motors. Make sure that lower units stay painted (touch up even small scratches), check the protective anodes frequently, and use compatible bottom paints. Follow the manufacturer's instructions to the letter.

All fittings immersed in seawater, including the engine, should be wired, or electrically "bonded" together. A single large conductor, such as a piece of #10 copper wire (don't use aluminum!), running through the bilge is sufficient. Clamp or solder on shorter lengths of copper wire to connect each fitting or its fasteners. Secure the wire with a soldered terminal or between double nuts to get a good electrical bond, preferably in a dry location. This 'bonding" of all these fittings is intended to prevent any difference in electrical potential (voltage) from occurring between them, which is the cause of the corrosion.

Finally, fasten a sacrificial zinc anode (available at marine supply stores) underwater, with the stud or studs (bolts) through the hull. The anode is best located near the stem. A zinc plate l/2" thick, 4" wide by 6" long is adequate for 30 to 40-foot

Typical Winch Installation



Galvanic Compatibility of Metals in Seawater

FITTING	FASTENER: Galv. Steel	Alum. Alloy	Steel	Brass(1) Bronze	Monel	Stainless Steel
Galv. Steel	N	?(2)	C	X	X	C(3)
Aluminum	C(6)	N	C(3)	x	C(3)	C(3)
Steel	X	X	N	C(3)	C(3)	c
Brass, Bronze	X	X	X	N(1)	C	C
Monel	X	X	X	X(5)	N	?(4)
Stainless Steel	X	X	X	X(5)	C(5)	N

N = Neutral
C = Compatible
X = Not Compatible (severe corrosion of fastener will occur.)

(1) Includes aluminum bronze, silicon bronze, all brasses, copper, maganese bronze, gunmetal, and solder.
(2) Better to use galvanized steel.
(3) May lead to local corrosion of fitting around fastener.
(4) Higher chance of pitting under fastener head.
(5) Better to use same metal for fastener as fitting,
(6) Do not use immersed.

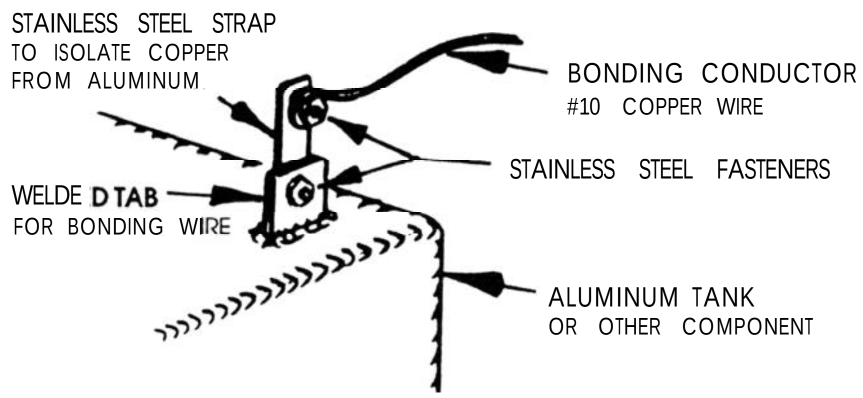
Note: Brasses and manganese bronze tend to dezincify underwater. Stainless steels tend to pit underwater in wet wood.

vessels. Connect the bond wire to this plate via its mounting stud or bolt. All fittings electrically connected to this plate are then "cathodically" protected, which means that the zinc anode plate will corrode first to-save the fittings.

Replace the plate yearly, or more often if severe activity is present. Marinas often have much stray electricity in the water, so inspect the plate every few months, to begin with, to insure continued protection. There is nothing so agonizing as walking down the dock to find your boat sunk, due to a corroded through-hull fitting that has fallen apart from lack of protection. That exact situation is the most common cause of sinkings.

Some fittings will be difficult to wire into the system-like rudder pintles and gudgeons low down on the rudder. In this case, they may be attached to individual zinc anodes made just for the job, half teardrop shaped, with a copper wire cast in for connecting to the fitting. It's important to remember that no underwater fitting should be left unprotected. The propeller shaft can be fitted with zinc collars, screwed

Typical Bonding of Aluminum Components



together in halves, made for all sizes of shafts. These collars will extend protection to the propeller too, but they are usually rather small, so use two of them each time.

None of these things are difficult to install and at the worst, will require hauling the boat, either on the beach or in a yard. The cost of the haul, weighed against the potential losses due to corrosion, is small. Maintenance of the system only requires yearly replacement of zincs and a check of the bonding wires-all very simple, and a good form of insurance.

In conclusion, boats with fewer metal fittings will require a less extensive bonding system and will probably have fewer problems. That is the best argument I can think of for using plastic through-hull fittings, as they will never corrode. But they are not as structurally strong as metal ones, and they do need to be protected from physical damage. The use of plastic fittings is strongly recommended whenever possible, except for applications involving heat, like the engine exhaust.

This is, by necessity, a simplified treatment of corrosion protection technology. For those who wish to learn more, an excellent book is available for the non-engineer; *Metal Corrosion in Boats,* written by Nigel Warren and published by International Marine Publishing Company; Camden, Maine. ■

Typical Bonding of Underwater Metal Fittings