

## CORROSION SURVEYS

An exact method of determining the correct amount of corrosion protection is to read the voltage of the immersed metal against a stable reference. The portable Corrosion Test Meter from Yacht Corrosion Consultants, Inc. is an accurate meter with a silver/silver chloride reference.

The Noble scale is a list that was determined by reading each metal's voltage and placing them in order. Gold at one end is approximately 1500 millivolts (1.5 volts) from Magnesium on the other end of the scale.

The water in which the metal is immersed will vary in temperature and salinity. Read a test metal voltage in proximity to the vessel to be corrosion surveyed. Most surveyors use a small piece of zinc. The voltage will vary on the Analog (dial) meter from 920 to 1050 in sea water, depending on the quality of the zinc and the temperature and salinity of the water. Read a known solution (say 6 to 1 salt and water) at room temperature to check accuracy of meter.

In purified water, we would read nothing. Purified water is sometimes used as an isolator and cooler for high tension wires. As impurities and minerals are added, the water becomes more conductive. In clear northern lakes, we could get very small readings. Galvanic corrosion would be insignificant but stray current could still destroy the boat. Our Digital Meter reads through the resistance of fresh water better than the Analog meter. The color scales on the Analog (dial) Corrosion Test Meter are for the basic metals in sea water. The 0 to 1500 scale is for all waters. On some lakes, the water is more conductive than sea water due to impurities like iron.

### TO CORROSION SURVEY

We are at the boat (fiberglass with twin I/O's). The vessel side test zinc voltage is recorded on the CORROSION SURVEY CHECKLIST - (see also blank worksheets in the Corrosion Workbook). Mark each immersed metal's voltage on the outline of a boat. If the bonding system is sound, all readings are the same. If the voltage of the bonding system is in the normal Noble scale voltage range, the metal is not being protected. The normal 'FREELY ERODING' voltage in sea water for Bronze is 200, Steel 425, Aluminum 550/625. The voltage must be at least 225/250 millivolts above the metal's Noble scale 'FREELY ERODING' or normal position on the scale to be protected.

### EXAMPLE

The normal reading of Aluminum in sea water is approximately 550/625. The protection for a metal is at least 225/250 above its freely eroding reading or approximately 800 for Aluminum. Place enough zinc in contact or wired to the Aluminum so that the voltage is above 900 to so. The voltage should stay above 800 for many months. You can hang a zinc over the side as long as it is electrically connected to the metal you wish to protect. Aluminum and Steel can be damaged by overvoltage (approx 1200 in sea water). Zinc, whose Noble scale or normal voltage is 1050 cannot hurt Steel or Aluminum. Impressed current system can.

With the Portable Corrosion Test Meter connected to the I/O: Disconnect the batteries. Do not just shut off the master switch, there might be equipment wired around the switch. Verify that the bonding system voltage does not change. Re-connect the batteries - Verify voltage.

Disconnect shore power - Verify that the voltage does not change. If the voltage rises, it could mean that the boat's ground is connected to the shore ground (as it should be) and there is no galvanic isolator or isolation transformer in the system. See our widely used product 'ZINC SAVER'. It keeps the safety A.C. ground while breaking the galvanic connection. The ZINC SAVER has been tested to pass all requirements by us, several major boat companies and TERRALAB Engineers, an independent testing laboratory.

Another way to test if you are losing zinc through A.C. ground wire is to disconnect the A.C. cord from the side of the boat - place a milliammeter in line from the boat receptacle ground to the A.C. cord ground and read milliamp current flow. This is the amount of zinc you are supplying to other boats and the dock metal. Re-connect the shore power - verify bonding system voltage.

Your boat is now galvanically sound. The bonding complete - the voltage is over freely eroding by 300 or more for sufficient protection for the boating season and you are not supplying your zinc (or valuable boat metal) to other boats and the dock. If a part corrodes and the zinc voltage is correct - check with a digital continuity meter from zinc(s) to the part. Resistance of over 300 ohms is a problem. 20 to 30 ohms is possible. Most I/O companies have a jumper kit.

### STRAY CURRENT

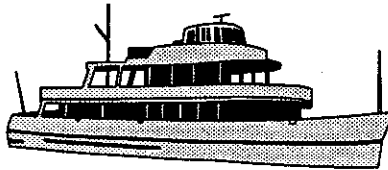
With a Portable Corrosion Test Meter connected to the bonding system of I/O: read the voltage.

Turn the A.C. & D.C. breakers on and off.

Check for and operate equipment that bypass the breakers; ie: bilge pumps, emergency radios, etc.

Make sure equipment operates; ie: water heater with hot water in it will not operate - turn on hot water until it gets cold.

Any permanent change of over 10 millivolts (40 on digital) while a breaker is on is a stray current problem on that particular circuit.



## CORROSION SURVEY CHECKLIST

DATE: \_\_\_\_\_

NAME OF BOAT: \_\_\_\_\_

STYLE AND MAKE OF TEST EQUIPMENT: \_\_\_\_\_

HIGHEST VOLTAGE METAL IN UNDERWATER SYSTEM: \_\_\_\_\_

(METAL VOLTAGE (IN SEAWATER): -ALUMINUM-625, STEEL-425, BRONZE-200, SS STEEL-50/450)

READ TEST ZINC BESIDE BOAT - VOLTAGE IS: \_\_\_\_\_

ALL IMMERSSED METAL IS ELECTRICALLY CONNECTED (BONDED) AND THE VOLTAGE IS: - \_\_\_\_\_

DISCONNECT BATTERIES - BONDING SYSTEM VOLTAGE IS: \_\_\_\_\_

PULL SHORE CORD-BONDING SYSTEM VOLTAGE IS: \_\_\_\_\_

DOCK A.C. GROUND READING IS: \_\_\_\_\_

PLACE MILLIAMETER BETWEEN BOAT RECEPTACLE GROUND AND SHORE GROUND. AMPERAGE IS \_\_\_\_\_

CONNECT SHORE CORD-BONDING SYSTEM VOLTAGE IS: \_\_\_\_\_

ALL D.C. EQUIPMENT OPERATED AND NO VOLTAGE CHANGE: \_\_\_\_\_

ALL A.C. EQUIPMENT OPERATED AND NO VOLTAGE CHANGE: \_\_\_\_\_

### ZINC SAVER TEST

DISCONNECT WIRES ON ONE SIDE OF THE INSTALLED UNIT:

READ CONTINUITY BETWEEN WIRES STILL CONNECTED TO DISCONNECTED WIRES. THERE SHOULD BE NO CIRCUIT. CONTINUITY: \_\_\_\_\_; NO CONTINUITY: \_\_\_\_\_

READ CONTINUITY ACROSS ZINC SAVER. CHANGE LEADS AND READ OPPOSITE DIRECTION. BOTH READINGS SHOULD BE APPROXIMATELY THE SAME BOTH WAYS  $\pm 5\%$ . READINGS WILL VARY BETWEEN STYLES OF METERS AND DESIGN OF THE UNIT.

CONTINUITY - LEFT TO RIGHT \_\_\_\_\_ RIGHT TO LEFT \_\_\_\_\_

### BONDING CONTINUITY TEST (OUT OF WATER)

READ FROM ZINC TO ALL PROTECTED METAL PARTS IN BONDING SYSTEM.

ALL PARTS CONNECTED-NO RESISTANCE: \_\_\_\_\_

READ FROM ZINC(S) TO ALL BOLTED AND ASSOCIATED METAL PARTS OF I/O OR OUTBOARD MOTOR

ALL PARTS CONNECTED-NO RESISTANCE: \_\_\_\_\_

USE DIGITAL OR 50,000 OHMS SENSITIVE ANALOG CONTINUITY METER.