REFERENCE ELECTRODE ASSEMBLY

IMPORTANT: This document guides our dealers, boatbuilders, and company service personnel in the proper installation or service of our products. If you have not been trained in the recommended servicing or installation procedures for these or similar Mercury Marine products, have the work performed by an authorized Mercury Marine dealer technician. Improper installation or servicing of the Mercury product could result in damage to the product or personal injury to those installing or operating the product. Always refer to the appropriate Mercury Marine service manual for component removal and installation instructions.

NOTE: *After completing installation, place these instructions with the product for the owner's future use.*

Component Contained in Kit

Qty.	Description	Part Number
1	Reference electrode	8M0135998

What is Marine Corrosion

Marine corrosion can be a challenge for any boat owner. All metal parts under water are primarily subjected to two basic types of corrosion: galvanic corrosion and stray current corrosion. Corrosion damage is almost always controllable. To control damage caused by these two types of corrosion requires knowledge of what causes the corrosion and the proper maintenance steps that must be taken to protect the product.

Mercury Marine has published several guides and manuals to educate dealers and vessel owners about corrosion and what steps should be taken to prevent corrosion from causing significant and costly damage to submerged drive components. All Mercury dealers should be familiar with these publications, understand the primary causes of corrosion and know what to do to prevent marine corrosion in all types of boating environments. If a boat owner has a complaint about corrosion damage, perform the necessary inspection and testing procedures to identify the source of corrosion. Proper grounding throughout the power package, including the propeller and trim cylinders is imperative to mitigate corrosion problems.

The first sign of galvanic corrosion is paint blistering. This first sign usually starts on sharp edges below the waterline. A white powdery substance forms on the exposed metal areas. As the corrosion continues, the exposed metal areas will become deeply pitted.

There is a form of corrosion that effects many metals (particularly stainless steel), called crevice corrosion. A crevice may be formed under any of the following: deposits (such as sand or silt), plastic washers, fibrous gaskets, or tightly wrapped fishing line. It can also form where moisture can get into and not get back out, forming a stagnant zone. Stainless steel is an iron-based alloy containing chrome and nickel. The quality that causes it to be stainless (nonrusting) is its formation of a thin, tightly adhering surface layer of chrome oxide.

If this surface is deprived of oxygen, the oxide layer breaks down and the stainless steel will rust like plain steel. Stainless steel is only stainless when it has access to oxygen. In a crevice where there is moisture depleted of oxygen, stainless steel rusts. The simplest prevention for this condition is to seal out the moisture or clean off any deposits.

1. **Galvanic corrosion:**
   - Galvanic corrosion is an electrochemical reaction between two or more different or dissimilar metals. The metals must be different because one must be more chemically active or less stable than the others for a reaction to take place. In galvanic corrosion, an electrical exchange occurs between the dissimilar metals. All metals have an electrical potential because all atoms that comprise the metals have electrons.
   - Galvanic corrosion of the more chemically active metal can occur whenever two or more dissimilar metals that are grounded (connected either by actually touching each other, or through a wire or metal part) are immersed in a conductive liquid that can transfer electricity. Saltwater, freshwater with a high mineral content, and polluted freshwater (brackish) are very conductive. Conductivity increases when the water temperature rises. This is why saltwater vessels in Florida experience more corrosion than saltwater vessels in Maine.
   - The simplest and most common example of galvanic corrosion, is an aluminum drive housing with a stainless steel propeller. Aluminum is the more chemically active metal and is considered to be the anode. Stainless steel is the less chemically active metal and is considered to be the cathode.
2. **Stray current corrosion:**
   - Stray current corrosion is any electrical current flowing along or through a metal conductor and leaving the metal for a water path to ground. This will cause ionization of the metal and an area of extremely rapid corrosion. Stray current corrosion is commonly a result of connecting a vessel to a shore power. It is the same basic chemical reaction as the previously described galvanic corrosion, only it is significantly accelerated by the addition of shore power electricity. If the metal in question happens to be an aluminum part like the drive unit, it can be destroyed within a few days.

The Effects of Water Velocity on Corrosion Rates

An increase in water velocity through currents or tides increases the corrosion rate of metals. This is because flowing water puts more water in contact with the metal and therefore, more oxygen in contact with the metal as well.

For example, the corrosion rate of zinc in still saltwater is less than one mil (0.001 in.) per year. In the same saltwater with a velocity of 6 feet per second (four miles per hour), the same zinc has a corrosion rate of over eight mils (0.008 in.) per year. It is difficult to provide corrosion protection in flowing water. If sacrificial anodes are used, adding more anodes and distributing them on the drive is necessary.

If an impressed current system (MerCathode System) is used, increased output is necessary. In the case of a MerCathode System, the output is limited by the controller to prevent draining the battery; in some cases, depending on the water velocity and conductivity, the output may not be enough to provide protection. For example, if it takes 45 milliamps per square inch to provide protection in still water, it can take 370 milliamps per square inch in water moving at 10 feet per second (approximately seven mile per hour).

Testing Procedure

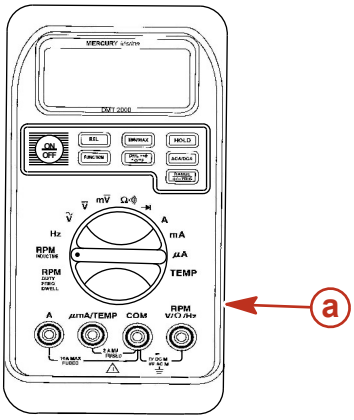
NOTE:

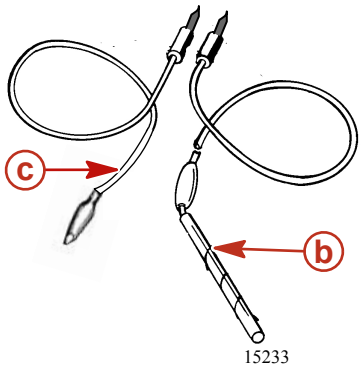
- *The following corrosion protection test supersedes all previously issued tests. This test can be used on applications with or without a MerCathode system.*
- *This test should be performed on all boats annually where the boat is moored to ensure that the system is functioning properly.*

The test requires the use of a Quicksilver reference electrode tester and a digital multimeter.

IMPORTANT:

- **A standard analog meter will give an inaccurate reading. Do not use an analog meter for the following test.**
- **The Quicksilver reference electrode tester is equipped with a special connector containing a resistor to provide the proper scale reading when used with a digital multimeter. Corrosion testing must be performed with a Quicksilver reference electrode tester and digital multimeter.**





Digital multimeter and Quicksilver reference electrode tester

a - DMT 2000A tachometer/ multimeter

b - Quicksilver reference electrode tester

c - Black meter lead

IMPORTANT:

- **Ensure that the battery is fully charged (12.6 volts or above).**
- **Boats recently placed in service usually will produce a reading higher than normal because the drive unit is protected by a good finish and new sacrificial anodes. To obtain an accurate diagnosis, test after the boat has been in service at least one or two weeks.**
- **Boats should be moored without being operated for at least eight hours before performing tests. The mooring time allows the MerCathode system and the sacrificial anodes to polarize the surrounding water. Be careful not to rock the boat excessively while boarding to perform the test as this will alter the test reading.**

1. Set meter on the scale required to read 0–2000 millivolts.
2. Connect the negative meter lead to the negative (–) battery terminal or other convenient engine ground.
3. Connect the Quicksilver reference electrode tester lead into the positive (+) receptacle of the digital multimeter.
4. Immerse the Quicksilver reference electrode tester in the water within 15 cm (6 in.) of the drive.

   IMPORTANT: The type of MerCathode system you are testing and the specific operational environment of the boat will affect the voltage readings obtained by the testing procedure. The tables give a range of acceptable readings.
5. The specifications listed on the following table indicate the corrosion protection status of the drive unit. Refer to the **Mercury Marine Corrosion Protection Guide** for additional information.

	Digital multimeter	Corrosion protection
Freshwater	750–1050 millivolts	Drive is protected
	Below 750 millivolts	Drive is corroding
	Above 1050 millivolts	Drive is overprotected

	Digital multimeter	Corrosion protection
Salt, Polluted, or Mineral Laden-Water	850–1100 millivolts	Drive is protected
	Below 850 millivolts	Drive is corroding
	Above 1100 millivolts	Drive is overprotected

NOTICE

Washing the MerCathode assembly can damage components and lead to rapid corrosion. Do not use any cleaning equipment such as brushes or high-pressure washers to clean the MerCathode assembly.

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