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MARINE SERVICE ADVISORY

Advisory Number: MSA2010-007

DATE: April 29, 2010
TO: All Marine Distributors, Dealers, OEM Boat Builders and End Users
SUBJECT: Saildrive Corrosion
MODEL: All Saildrive Models

Yanmar America has received some reports from customers of unusual saildrive corrosion in the field. Upon investigating these reports we have identified some installation and maintenance factors that can influence corrosion and in some cases failure of the drive leg.

To maximize assistance and knowledge in the field, Yanmar is outlining the following steps that must be taken by installers of saildrives (OEM Boat Builders and Distributors/Dealers performing repowers) and items of owner maintenance to mitigate corrosion issues with the drives, along with information to assist.

Yanmar America is an advocate of the American Boat and Yacht Council (ABYC) and strongly recommends that their standards and guidelines are followed closely when installing a saildrive in a new boat or repowering a boat with a new saildrive. Refer to ABYC Standards – A-28 Galvanic Isolators, E-2 Cathodic Protection and E-11 AC & DC Electrical Systems on Boats for the information that is required to install shore power systems, proper bonding and cathodic protection.

Cathodic Protection & Hull Potential

The engine and saildrive must be connected to the boat's bonding system. Yanmar saildrives are equipped with a single sacrificial anode that is mounted between the propeller and the drive output shaft housing. The anode is sized to protect the drive **ONLY**. In most cases additional sacrificial anodes will need to be added to the boat to properly protect the other metal underwater hardware installed on the boat and protect against overloading the saildrive anode. If a bronze propeller is installed on the saildrive additional sacrificial anodes may be needed to maintain the hull potential within safe limits.

The following information comes from ABYC Standard E-2.9.2:

Stern drives, outboards, and other metallic components shall be protected with sacrificial anodes mounted on the aluminum lower units, or sacrificial anodes mounted on the hull and connected to the cathodic bonding system, or an impressed current system.

NOTES:

- 1. Aluminum lower units on stern drive and outboard engines may require cathodic protection in addition to that supplied by the manufacturer when moored or used extensively in salt or brackish waters.**
- 2. Cathodic protection supplied by the drive manufacturer may not be sufficient to provide protection to additional metallic components.**
- 3. Boats equipped to use dockside power are subject to galvanic corrosion because the boat ground is electrically connected to the shore ground via the grounding conductor. An isolation transformer, a galvanic isolator, or polarization transformer with galvanic isolator in the grounding conductor may be used to reduce this problem. (See ABYC E-11, AC & DC Electrical Systems on Boats)**
- 4. Magnesium anodes should not be used in saltwater since their negative potential is 1600 to 1630 mV. Aluminum is an amphoteric metal, and a negative potential of over 1200 mV can cause harmful overprotection which may result in cathodic corrosion of aluminum and possible hydrogen blistering of paint, also known as cathodic disbondment.**

The hull potential as defined by ABYC is, “the composite potential of the electrically-connected immersed metal parts of a hull, relative to a reference cell.” To adequately protect the aluminum saildrive the hull potential of the boat must be maintained between -950 to -1100 mV. At no time should the hull potential drop below -900 mV or any exposed aluminum on the saildrive will start to freely corrode. The desired hull potential can be achieved by using sacrificial anodes that are connected to the boats’ bonding system or by using an impressed current system. Anodes should be selected based upon where the boat is operated/moored. In salt and brackish water, zinc and high energy aluminum anodes are recommended. In freshwater, high energy aluminum and magnesium anodes are recommended. At no time should magnesium anodes be used in salt or brackish water.

The boats’ hull potential should be tested on a fully assembled boat that is placed in the water and measured using a silver/silver chloride reference electrode. A Certified ABYC Corrosion or Electrical Technician should be utilized to perform the test.

Galvanic Isolation

If the boat will be left in the water and it is equipped with a permanently installed shore power system, the electrical system should be equipped with galvanic isolation to reduce the load on the cathodic protection system and to prevent rapid anode loss. Following are the ABYC recommendations as stated in E-2.6 – Galvanic Isolation:

2.6.1 – If installed, galvanic isolators shall be installed in accordance with ABYC A-28, Galvanic Isolators.

2.2.2 – If installed, isolation transformers shall be installed in accordance with ABYC E-11, AC & DC Electrical Systems on Boats

NOTE: It is strongly recommended that any boat with a permanently installed shore power system be provided with galvanic isolation. Galvanic isolation may be achieved by use of a galvanic isolator, polarization transformer with galvanic isolator, or an isolation transformer. The electrical interconnection that occurs via shore power grounding conductor may result in the flow of galvanic current between the boat and dock structure or another boat. This can lead to excessive anode loss, or corrosion beyond the capacity of the boat's cathodic protection system.

Failure to provide galvanic isolation when connected to shore power may lower the hull potential below safe levels, which will result in rapid anode depletion and possible corrosion damage to the saildrive.

Saildrive Coatings

The saildrive coating must be maintained on a regular basis. Any abrasions to the coating must be repaired to prevent corrosion of the exposed aluminum. For boats that are moored in the water for long periods of time, an epoxy barrier coat and anti-fouling paint must be used to prevent marine growth from adhering to the saildrive leg, which could compromise the coating.

Proper surface preparation is important to insure good paint adhesion and durability. Always follow the paint manufactures' recommendations for surface preparation and paint system application. For saildrives that have already been exposed to seawater the surface must be thoroughly cleaned before applying new paint. Only use a non-metallic brush (such as nylon) to clean the drive. It is also very important to remove all soluble salts from the surface before painting. They are harmful to coating systems, are difficult to detect and hard to remove. A test kit to determine soluble salt presence and biodegradable wash are available from Chlor-rid Corporation. Information on their products can be found on their website, www.chlor-rid.com.

Only use a barrier coat and anti-fouling paint that is specified for aluminum. To be effective, always follow the paint manufacturer's recommendations as to the mil thickness of the barrier coats. Anti-fouling paint containing cooper should not be used on the drive or the hull bottom. The Interlux Trilux 33 paint system (https://secure.international-coatings.com/pds/yacht/GB_ISO_I_5000396.htm) or equivalents are suitable coatings to use. Additional coating information can be found on the Interlux website, <http://www.yachtpaint.com/usa/>.

If a bronze propeller is used in conjunction with the saildrive, to decrease the load on the cathodic protection system, a coating can be applied to the surface of the propeller blades and hub. The same barrier coat and anti-fouling paint can be used as noted above or another option is a product that is available from Prospeed USA. Information can be found on their website, <http://www.prospeedusa.com/>.

When painting the saildrive and/or propeller care must be taken **not** to paint the sacrificial anode or the mounting surface under the anode. If the anode is painted or becomes insulated from the saildrive it will become ineffective.

Maintenance

To maintain the hull potential at a safe level, the sacrificial anodes mounted to the saildrive and the boat must be inspected and replaced on a regular basis. If the anodes become 50% or more depleted they must be replaced. When replacing the saildrive anode the mounting surface on the saildrive must be clean and unpainted so there is good electrical continuity between the anode and the saildrive. If there is not good continuity the anode will be ineffective. Also, if the boat is removed from the water for an extended period of time, such as winter storage, the anode may become oxidized and will not be effective when the boat is put back in the water. The anode should be replaced before the boat is launched, even if the anode is less than 50% consumed.

When the boat is first placed in the water, is moved to a new marina or mooring or if new equipment is installed on the boat that is connected to the cathodic bonding system, it is recommended that the boat owner inspect the condition of the sacrificial anodes every 30 to 60 days to determine the rate of consumption of the anodes. At the same time that the anodes are being inspected, the saildrive leg coating should be inspected for scratches, abrasions and/or signs of corrosion and addressed as necessary. If the boat is plugged into shore power and is not equipped with galvanic isolation more frequent inspections are necessary. Once the boat owner is able to determine the rate of anode depletion and how often the anodes require replacement, the frequency of inspections can be adjusted.

Another means of monitoring the hull potential is to install a hull potential meter in the boat. The boat owner can monitor the hull potential from inside the boat, which will alert him or her when it is necessary to replace the sacrificial anodes. Information on hull potential meters can be found at <http://www.wardsmarine.com>.

Guidance Points:

- The installers' (OEM Boat Builder or repower Distributor/Dealer) should install the engine/saildrive package in accordance with applicable ABYC Standards.
- The installers' must insure that the boat and underwater hardware have sufficient cathodic protection so as to maintain the hull potential within safe limits (-950 to -1100 mV).
- If the boat is equipped with permanent shore power, galvanic isolation is strongly recommended.
- The boat owners' must properly maintain the saildrive: maintaining the hull potential within safe limits, sacrificial anode inspection and replacement, and maintaining the coating on the saildrive.
- The Yanmar part numbers for the two piece replacement sacrificial anodes for the saildrives are:
 - Zinc – 196440-02660
 - High Energy Aluminum – 196450-02500
 - Magnesium – 196450-02600

If you have any questions regarding this advisory please contact a Customer Support Representative at (770) 877- 9894.