Ask Steve

July 2014

Steve:

Good luck with your new venture. Always enjoyed your articles.

I just returned from a trip on a 2 year old Viking 50 that lost a prop blade while running offshore at 30 knots due to prop burn.

Have you heard of this? How widespread is it?

Can it be fixed? Viking is giving my friend the boat owner the run around.

Thanks for your help.

Tom Masterson

Tom:

“Prop burn” is a term that refers to a specific type of erosion that occurs near the root of propeller blades, the technical term is cavitation erosion. Cavitation is the formation of voids or bubbles, however, instead of being filled with air, quite the opposite, they are a vacuum or void. The bubbles form in areas of very low pressure, usually on the propeller blade back (counterintuitively, that’s the side the faces forward; the blade face is under pressure and faces aft). The low pressure on this side of the prop, much like an aircraft wing or a sail, can be thought of as drawing or sucking the prop forward.

If the pressure in this area becomes too low, vacuum voids can form, they then migrate down the blade to the root area and slip over to the blade face, where they encounter high

pressure, at which point they violently implode, and herein lies the problem. With each implosion, a few molecules of metal are scoured away. Multiply this by several hundred thousand implosions and enough metal can be removed to weaken the blade's root to the point of failure.

Cavitation erosion of this sort is often the result of an over-pitched prop (it would begin occurring on the very first day of use, and should be visible at haul out), which in itself may be the result of the incorrect propeller being used, i.e. not enough blades or not enough surface area, thereby necessitating too much pitch to achieve a proper match with the engine and transmission reduction ratio. Or, it could be the result of a damaged blade, which then creates excessive low pressure and voids.

If it is a propeller selection issue, all of the blades should be suffering the same "burn" in the same region that the failure occurred, near the root. If those aren't present, then it's unlikely to be cavitation erosion, or it occurred as a result of damage to that blade, in which case evidence of the erosion should still be visible. If no such evidence is visible, then the failure likely occurred for another reason, again, damage, or a defect in the propeller's casting.

Sincerely,

SD'A

Steve:

In your article, you clearly state that both the absents of oxygen and the presents of moisture are necessary to cause corrosion in stainless steel.

I recently purchased a 1979 45 foot ketch that has been sitting in a slip for many years.

I know the previous owner replaced the propeller shaft. I

replaced the packing in the propeller stuffing box and found roughness where the packing rides. I suspect this is corrosion and I will need to make or purchase a new shaft. I do have machine shop capabilities.

In addition, the rudder shaft is set up with a stainless steel shaft log, hose and stuffing box just like the propeller shaft. This makes me think that the shaft log for the propeller shaft is likely stainless steel also. Having a shaft log break would not be a pleasant. I read about one such experience.

After reading your article, I am concerned about the stainless shaft logs and realize I should replace them both when I haul the boat for a bottom job. What to replace them with is one question I have as making them from fiberglass will require them to be thicker and that complicates things.

If I should replace the shaft logs with stainless steel, can I be comfortable bonding them with epoxy? Is epoxy a good enough moisture barrier to prevent corrosion in stainless steel?

Another topic and question:

On another boat, I have sealed the fiberglass shaft log with epoxy and installed a grease zerk in the stuffing box so as to fill the area aft of the stuffing with marine wheel bearing grease. I read where the water pressure would keep the grease against the stuffing and keep it lubricated. It seems to work ok as it is drippless and does not get hot.

Will the marine wheel bearing grease promote or reduce corrosion in a stainless steel shaft?

Fresh water tank:

I have a stainless steel freshwater tank that is secured in the floor with fiberglass. A pipe sleeve is welded to the

tank. I judge the weld it leaking. I can access the inside of the tank through and inspection plate. I am wondering about cleaning, drying and sealing that area with epoxy. Again, is epoxy a good moisture barrier for preventing / reducing corrosion?

Thanks in advance for your reply.

Chris Collins

Chris:

You've posed some very good corrosion questions related to stainless steel corrosion. I have covered this subject on many occasions in articles for various magazines, as well as on this website, the latter is available at http://www.stevedmarineconsulting.com/ezine/index.php?p=18 You might wish to review that column.

Stainless steel, when used in a constantly submerged environment, can be problematic. In order for it to maintain its tough oxide barrier, it must be exposed to the atmosphere, as it would be above the waterline, in the cabin, on deck or, or dissolved oxygen in flowing sea or fresh water. When exposed to stagnant water, which is oxygen depleted, the oxide barrier breaks down, at which point the stainless steel becomes, as we say in the world of corrosion, active rather than passive, it is affected by a process known as crevice corrosion. The electro-chemistry of this process, while interesting, isn't as important as the practicalities of how this alloy is used.

Ideally, avoid using stainless steel in these environments, and this would include embedding hardware in the hull, including fasteners, through hull fittings and shaft logs. The above-mentioned column opens with a photo of a severely corroded, "wasp-waisted" strut fastener removed from the fiberglass hull of a twenty year old vessel.

The preferred alloy for these scenarios is zinc-free bronze, or bronze alloys whose zinc content does not exceed 15% (less is better). Fiberglass, particularly for shaft logs, is even better in that it is corrosion-proof. Alternatively, if stainless steel must be used, it should be 316 series (not 304) for underwater hardware. Shaft alloys should be proprietary AQ 22, rather than AQ 17, or high corrosion resistance duplex stainless steel in Europe, and never ordinary stainless steel, regardless of alloy. If it is to be welded, it must also carry an L suffix, such as 316L, denoting its low carbon content, making it suitable for welding. Failing to use low carbon stainless steel in welded applications will often lead to a phenomenon known as carbide precipitation, weld decay or weld migration, wherein the chrome content of the alloy adjacent to the weld is depleted, making it, and I'm simplifying, essentially ordinary steel, which rusts. The rusting can occur very quickly after welding, above the water line, regardless of access to oxygen. It's a common problem with welded stainless steel tanks, the welds discolor quickly and begin to turn brown with surface oxidation or rust.

Creating a barrier between the stainless steel and oxygen depleted water, using an epoxy coating or primer, may stave off this problem for a while, however, it can also have the opposite effect. If water manages to migrate under the coating, in an area where it's cracked or chipped, the lack of oxygen in this region will promote corrosion. While better than nothing, relying on a barrier coat to prevent corrosion of stainless steel is not a long term solution. Grease will not promote corrosion on a stainless steel alloy shaft as it excludes both air and water, the latter is needed for crevice corrosion to occur.

Finally, you can attempt a repair of a stainless steel water tank using epoxy (it should be of the food-grade variety). The leak could be a case of weld decay. Thorough

cleaning and abrading of the surface will be necessary. Any flexing will likely lead to failure of the patch, so make sure it is not exposed to pressure of any sort.

Sincerely,

SD’A

Steve,

Hope everything is going well. Enjoy reading your blog and articles. I was wondering if you’ve ever done an article on “how to keep your engine and engine room clean.” I’m sure you don’t just spray a hose on everything and hope for the best. What products work best with wiping down the engine, etc.?

Also, thinking about putting in a water maker. Do you have any personal favorites? Our genset finally died a slow death, and rather than go through all that again we maxed out on solar with 800 watts on the boat, plus adding a little more capacity to our battery bank (our previous “new” batteries had to be replaced after only two years). Now we rarely get below 90% on any given day, even with that big 24 v fridge motor running. It’s a great feeling to be energy independent finally. And we finally have enough power to run a water maker.

Cheers,

Walter Conner

S/V Flying Cloud

Taswell 44

Hailing Port: Seattle, WA

Lying: Iles des Saints, Guadeloupe

Walter:

You've posed two very good questions.

You are correct in your suspicions; it's inadvisable to simply blast your engine and other critical gear with a stream of water. For the engine, my preference is for running it to get it warm. After shutting down turn off the main battery switch. Then spray the areas that need cleaning with a good emulsifying cleaner, I have used Spray Nine for years with great results, but there are others. After letting this soak for a few minutes, scrub and wipe areas you can reach with a parts cleaning brush, available at auto parts stores, or a pot scrubber works well, the long handle allows for better reach. After scrubbing, carefully spray water to rinse, try to avoid directly spraying the starter, alternator, oil pressure sender, air intake (you may want to cover this with tin foil) and obvious electrical connections. The fact is, most of these items can get wet occasionally, they simply aren't designed to endure a stream of water. After rinsing, start and let run to dry off. Your engine is mechanical, which means electronic components are pretty much non-existent. For electronic engines, more caution would be used around the ECM and connections. However, once again, these systems are designed to get wet occasionally, and with a light spray of water. Most of the electrical components were originally designed for over the road trucking use, where they are exposed to heavy, often salty, road spray.

Where watermakers are concerned, I've had very good results with those from Parker Village Marine Tech. I've visited the facility where they are manufactured in California (they provide water makers for the military, including the US Navy's submarine fleet, whose standards are predictably very high), the quality and attention to detail are both excellent. Alternatively, you could also use a product from Spectra, a well-respected manufacturer that is very popular

with sailors. Both offer DC models, which is what I assume you would use aboard your vessel.

SD’A

Ask Steve questions should be addressed to asksteve@stevedmarineconsulting.com. Please include your full name and home port. Concise questions are more likely to be answered.

For more information on the services provided by Steve D’Antonio Marine Consulting, Inc. please e mail Steve at info@stevedmarineconsulting.com or call 804-776-0981.