

Tech Tips

by Bill Whitney

This column is a forum for sharing the vast range of practical experience accumulated by our membership and not just my favorite boat maintenance topics. It is intended to be the place where you, the reader, can ask technical questions and either obtain direct answers in this column or direction to appropriate reference material.

I love the reunions in Rockland, ME. They provide a cornucopia of problems waiting to be explored and sometimes even solved. This last year, we (I take the liberty of using the collective "we" here since "we the fleet" seem to share our problems somewhat universally) had one problem that had us stumped for a few hours. The problem was an overheating Atomic 4. Although the pedigree of this venerable power plant may be questionable, and its' recorded maintenance records nonexistent, it was evident that the patient had provided many, many years of reliable propulsion; until now. Oh it was rusty and there was evidence of a leak or two, but it had served the boat and its' owner's for many years. (I almost wrote "served its' owner's very well" but having owned an Atomic 4 once myself thought that the statement was a little too generous.) The engine ran fine at an idle, but overheated when run much above that under load. For a nautically obsessed 'techy' like me the plot had all the makings of a good murder mystery!

Troubleshooting started with the normal checks oil level and pressure, coolant flow, fouled plugs, etc. But nothing was really obviously wrong. The one thing that may have been amiss was that the exhaust had more steam in it than what you would consider normal. And yes, there was water coming out the exhaust, so you knew that the raw water pump was working, but engine seemed hotter than it should have been. Well, if the pump is OK the next possibility is the thermostat, right? So we braved the rusty nuts and got lucky. Quite to our surprise, the thermostat housing came apart fairly easily. Everything inside even looked good. The thermostat was in place, there was nothing plugging the passageways, and the thermostat still opened and closed so it seemed to be capable of operating correctly. Just to verify that this was not the problem, we decided to reassemble the thermostat housing without the thermostat and see if that made any difference in the water flow. No such luck! Even without the thermostat the water flow seemed too low and again there was steam in the exhaust after a few minutes of engine operation.

Checking the seacock on the raw water intake didn't reveal any restrictions, so next we tried looking for a blockage in the hoses. Nothing obvious here either. Using a hose connected to the fresh water spigot on the pier we jury-rigged the hose so we could back-flush the cooling system components one section at a time. Finally problems started to show up. We found a restriction at the exhaust manifold but were able to restore flow by expert application of a high tech coat hanger. Unfortunately, this fix didn't solve the overall problem because the exhaust manifold water flow is in parallel with water flow through the engine block. But (Eureka!) with the water being supplied through the hose rigged to the pier the engine was not overheating.

But why? The pump was pumping. The only thing left to do was to tear down the pump and take a detailed look at its' interior parts. At first we just removed the front cover to take a look at the impeller. The most obvious thing to look for is a broken or missing vane. The easy answer was not among the choices. The impeller was in good shape. All of the vanes were there. And when we removed the pump from the engine, observed that there was no major wear on the tips, and there was no major wear on the bronze pump housing either. But almost by accident we discovered that there was quite a bit of rotational play between the shaft and the impeller. When the shaft and impeller were removed from the housing and separated there was quite a bit of wear on the shaft in the area where the impeller mates to it. The shaft is machined in a "D" shaped pattern. This design relies on the flat side of the "D" to prevent the impeller from turning on the shaft. However, if you looked at the worn area on the shaft, you would see that the design failed. The impeller had to be slipping on the shaft in order to cause this wear pattern.

A root cause analysis of the overheating coupled with the evidence we found during the troubleshooting shows how it was happening.

1. The engine ran at an idle, not overheating.
2. Coolant flow was observed at the exhaust outlet.
3. The impeller slipped on the shaft, but not until moderate force was applied.
4. As engine RPM increases the impeller RPM increases more coolant should be pumped through the engine and exhaust system.
5. As engine RPM increased the flow rate of the coolant did not appear to increase.
6. As engine RPM increases the back pressure of the water flow through the system will increase.
7. The increased back pressure on the vanes of the impeller was enough to prevent the pump shaft, which is turning at a proportional speed to the engine, from turning the impeller at the same speed, as evidenced by the wear pattern on the shaft.

Now that we found the problem the fix was easy. Actually it was easier that we originally thought because another Friendship, with an identical power plant, had a rebuild kit aboard with a new shaft, seal and impeller. Reassembled and installed the pump back on the engine solved the problem. The engine ran cool at both low and high RPM and the water flow through the exhaust increased with the RPM just like it should.

So the moral of the story is that if you have a cooling problem with your Atomic 4 you need to check out the raw water pump impeller and more importantly the impeller shaft. The problem we experienced is somewhat unusual. I was very surprised to see the degree of wear. The design lends itself to failure unless you inspect it at least annually and know what you are looking for. I don't think that you would see this type of wear unless you removed the shaft. Happy Sailing!