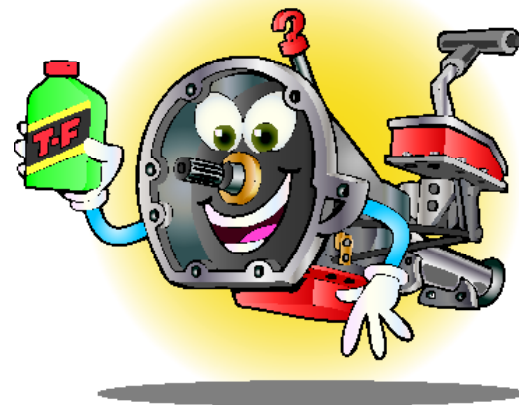


Oil, water and gasoline



By Bill Hancock

Filters and Filtration

Oil, fuel, air, and water are all part of boating, and as such, need to be filtered before going into your engine. Let's examine filtration and try to discover some of the whys and wherefores of the subject. Filtration as we apply it, involves the separation of small particles from the aforementioned fluids. Yes, air is a fluid and the same laws of Physics apply.

The particles or substances we are trying to separate from our fluids, left unapprehended, will cause great damage or result in poor performance. In many cases the particles are so minuscule they cannot be seen by the naked eye.

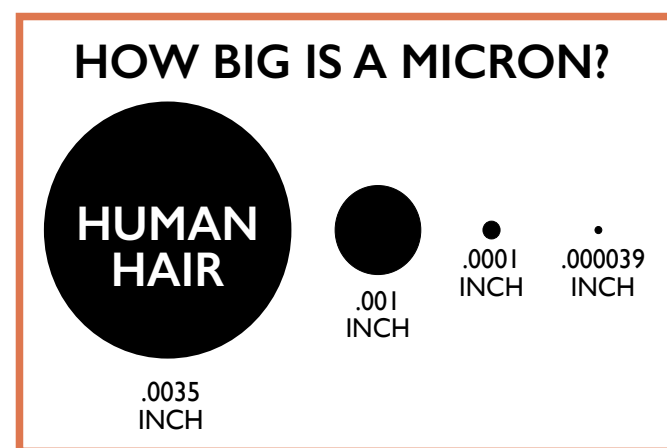


Fig 1 – Size comparison of a micron to a human hair

Let's discuss size. Fig 1 is a chart representing the relative size of various objects as compared to a micron, the standard measurement by which most filters are rated. A micron is one millionth of a meter or .000039 inches in diameter. Now let's put that in perspective. A

typical human hair is approximately .0035 inches in diameter. If we split a hair into roughly 89 equal pieces, one of those pieces would represent a micron.

Once you have had time to digest this, you will get an appreciation for the size of the bad particles. These particles can be abrasive, chemical, mineral, or simply an unwanted material or substance like water. We must choose a filter which will separate the unwanted particles from the working fluid. Let's begin by looking at the types of filters we should use in our boats and examine the reasoning behind our choices.

Gasoline

Typically, gasoline from the pump has many impurities in the form of solids or water. These solids, if not separated from the fuel before it enters the engine will eventually block or severely restrict the fuel flow. Water in the fuel will cause the engine to perform poorly and eventually not run.

We begin by using a remote combination water separator/fuel filter (Fig 2). This is a dual purpose filter which removes the larger solid particles while relying on fractional distillation to separate the water from the gasoline. Since gasoline is lighter than water, gasoline will rise to the top when mixed with water, therefore the water remains in the bottom of the filter where it is either stored until the filter is changed or drained if the filter is equipped with a drain. Having said this, it becomes important to keep your filters drained, or replace filters which do not have a drain, on a routine basis.



Fig 2 – Remote Gasoline filter -water separator

The next filter in the fuel system is an in-line filter that can be placed before or after the fuel pump to remove even smaller particles before the fuel enters the carburetor or fuel injectors. Note: If your engine is fuel injected, it will have much higher fuel pressure and therefore you should locate the fuel filter before the fuel pump to protect the fuel pump, but more importantly to ensure that the filter will not be subjected to the high pressure which could possibly rupture the filter housing and possibly create a fire or explosion. There are also special filters designed for the higher pressures found in fuel injected engines.

The final filter is often found on carburetors and is a porous bronze filter. These filters are relatively small and fit within the carburetor body near the fuel inlet. Replacement filter elements can often be found at auto parts stores.

Oil

Oil filters, like gasoline filters, separate the small particles which build up in the oil and come primarily from the by-products of combustion. Oil filters typically will trap particles larger than 10-20 microns in size. Carbon molecules can be very abrasive and when they enter the engine, they will eventually find their way into the bearings where they will score and abrade the bearing surfaces causing wear, which over time will increase the clearance and eventually wear out the bearings.

Even though engine bearings are designed with some amount of embeddability which allows the harmful particles to bury themselves into the bearing material and hopefully cause less damage, the particles are still there

Tribology

The science surrounding lubrication

The basic premise of engine lubrication is that the lubrication system must produce what is called a boundary layer of lubricant, a very thin layer of oil, which prevents metal to metal contact. If and when the boundary layer breaks down, then rapid wear occurs, and with wear comes heat which dramatically hastens the process and eventually may end with the parts welding themselves together. When a proper boundary layer is established and maintained, there is very little wear that occurs.

Wear occurs during startup where the engine oil has drained from the parts and from between the adjacent parts, thus leaving a metal to metal interface. For a brief period, until oil reaches the interface and the boundary layer is reestablished, the parts are rubbing against each other. For that reason you should never rev an engine until it has run for at least a minute and established good oil flow and hence reestablished a good boundary layer. Further, you will greatly enhance the life of your engine if you wait until everything has warmed up and the clearances have stabilized before operating the engine under load.

Proper lubrication relies on good oil delivery to all the critical areas of the engine. Oil uses pressure and flow created by the oil pump to deliver the oil. Having good oil pressure is only part of the story. Oil in sufficient volume must be available to lubricate as well as perform the equally important task of cooling. Proper running clearances are crucial to having a proper boundary layer.

acting like tiny files. The old phrase about throwing sand in the gears rings true here. As wear progresses, cast iron, aluminum, and steel particles are byproducts occurring from ongoing normal engine wear. Piston rings rub against the cylinder bores, and steel shafts and gears rub against each other in places like the oil pump and camshaft.

Oil filters are comprised of a length of porous pleated paper supported within a canister. Oil begins its journey through the engine when it is sucked through a screen mesh filter attached to the oil pump pickup and then delivered under pressure to the paper filter where it passes through the filter media and most of the harmful particulates are caught and restrained by the filter media. By now you may have noticed that we have not use the word removed, since the particles are still within the system, they are just separated. We only remove the particles when we change the filter and dispose of it.

When we do change oil filters, it is always nice to cut the filter open and inspect the contents. There can be some great clues as to how the engine is performing. We use a special tool called a filter cutter. See Fig 3. This tool utilizes a rotary cutter much like an electric can opener which cuts the filter canister without creating any shavings or residual debris. Once the filter canister is cut open, the paper filter element can be removed and cut open. The ends of the paper filter element are then cut off using a sharp knife and the pleated filter paper can be stretched out and inspected. Typically, we find some bearing material, some lint from paper or rags, and some silicone sealer which has found its way into the filter. If we find large parts of bearing material or other disturbing debris such as carbon particles it may warrant removing the oil pan to inspect the bearings. Remember; if it is in the oil filter, it had to go through the



oil pump first, so you may have already compromised the efficiency of the pump.

Water

We use water to cool our engines, and whether it be by an open loop or closed loop system, seawater is ultimately the cooling medium. See Fig 4. The seawater typically contains many impurities as well as harmful chemicals. Therefore, we must remove the particulates and, in some cases, treat the water for the chemical effects. The particulates can be seaweed, grass, sand, mud, or a host of other items. Left unfiltered, the cooling jackets of your engine will soon fill with particulate matter which will restrict the flow, inhibit the cooling and eventually ruin your engine. The first line of defense is usually a seawater intake grate located on the bottom of the boat which keeps the larger matter like seaweed from entering. Next, we have a screen filter which separates the larger chunks of debris which get past the intake grate. It is important that the incoming filter be placed to allow servicing from inside the boat while it is in the water. This is handy when you run through some sea grass and the filter becomes clogged not allowing

water to pass through the pump and causing the engine to overheat. If this happens, simply stop the engine, shut off the water inlet valve, called the seacock, and remove the filter top to inspect the filter. After cleaning out the filter screen, reassemble the filter and return the seacock to its normal open position. Check for leaks and proceed. Note: if your engine has overheated, allow the engine to cool sufficiently before allowing the cold seawater to enter the engine and run the risk of cracking a block or cylinder head. If your hull mounted water intake grate on the bottom of the boat is blocked, sometimes it can be unblocked by merely closing the seacock, reversing the boat for a short distance, then reopening the valve.

On most of our boats we typically use a positive displacement water pump with a rubber impeller to circulate the water through the engine. Eventually these rubber impellers fail and the individual pump vanes shear off, rendering the pump unable to work. Many owners typically replace the impeller and resume boating. While this may be a temporary solution, it will only prolong the eventual disaster You must remove the small bits of the rubber impeller debris which are now



Fig 4 – Seawater strainer with removable top.

spread throughout the cooling passages of your engine where they block tiny critical passages and prevent proper coolant flow. The only way to absolutely ensure that the particles are not blocking the coolant passages is to disassemble the entire engine and physically inspect the coolant passages. It is virtually impossible to “flush” the tiny rubber debris from the engine. So, what should we do? Simple! Replace your impeller frequently! Impellers are relatively cheap and simple to change. Just because you do not use your engine often, do not think

Silicone Sealer

, while a great gasket material, has a negative side if used improperly. If you use too much silicone and it oozes out of the crevice toward the inside of the engine, it will typically end up in the oil pan and either plug up the oil pump screen, which starves the pump, or even worse, it will pass through the oil pump and manage to jam the oil pressure relief valve, at which point, the oil filter will then see uncontrolled oil pressure, which will typically burst the oil filter canister. So, think twice about squeezing too much silicone sealer on a crack or on a leaking gasket. Use all sealers sparingly.

PLAZA CADILLAC

SALES HOURS
MON-FRI 8:30 - 7:00
SAT 9:00 - 5:00



SERVICE HOURS
MON - FRI 7:30 - 5:30
SAT 8:00 - NOON

8893 US HWY 441 LEESBURG, FL
787-1323
(800) 433-0976

OUR DRIVE TO BE THE BEST STARTS WITH YOU!

WWW.PLAZACADILLAC.COM

WWW.PLAZACADILLAC.NET

the impeller is not susceptible to damage. When the impeller is at rest, several of the vanes are always bent over and will eventually develop stress cracks. To prevent this get in the habit of routinely engaging the starter on your boat for a split second without starting the engine. This will rotate the pump slightly and tend to equalize the stress on the vanes. Try to change your impeller annually. A simple and cheap solution.

Lines are an integral part of filtration systems for they carry the fluids. Make sure the lines or hoses are the correct size and construction. If your lines are carrying gasoline, make sure they are rated for pressure as well as being able to withstand the effects of gasoline containing ethanol.

Depending on which side of the pump the lines are located, the fluid is either being pushed or pulled through the lines. It is extremely important to have not only the burst pressure rating but also the construction which will prevent the hose from collapsing and being sucked shut if the fluid is being pulled through it.

It should go without saying, but also make sure the lines are correctly sized to allow proper flow under all conditions, otherwise you might starve the engine under high demand. Also remember that oil lines will get extremely hot. An oil hose or line that is stiff at room

temperature may become butter soft at 200 deg F and simply collapse rendering oil flow all but impossible.

Remote oil filters – These are especially handy when trying to fit everything into a tight environment while still maintaining the ability to service the filter. They are also convenient when converting an older engine to modern filtration technology. The more accessible a filter is, the better chance it will be changed when required.

Air Filters – Marine applications rarely use traditional automotive paper media but are required to use US Coast Guard approved screen flame arrestors. These devices are required to prevent backfires from igniting gasoline vapors in the boat and causing an explosion and fire. The flame arrestors work by using overlapping layers of bronze screen which effectively allows air to pass through but because of the mass of metal in the screen they act as a thermal sponge and barrier for the heat and flame component of the backfire. Think of them as a filter for fire.

Remember, a plugged filter will cut down the flow and build pressure before the restriction, neither of which is good. Many oil filters have an internal relief valve which will allow oil, albeit unfiltered, to bypass the filter and keep flowing in order to lubricate and cool the engine. This feature was incorporated to take care of those who are either too cheap, ignorant or just plain lazy to change their oil. Decide which type of operator you want to be and buy the appropriate filter.

Until next time.

This space could be yours to advertise your boat for sale, house for sale or to promote your business.

**Call Don Taylor at 630-632-9797
or drtaylor@me.com**

Gary Scherb

Ingrid Scherb

Doug Scherb



Shop: (352) 742-0475
Cell: (352) 267-5771

P. O. Box 1245
Mt. Dora, FL 32756