December 2017 Newsletter

After a fall boat show hiatus, the SDMC Newsletter is back on watch.

Photo Essay:

Exhaust Back Pressure Measurement

It's an all too common refrain, one I hear from survey mechanics on a regular basis, "I can't measure back pressure, I don't have the tools" or, among my favorite, "Why do you want to measure that, if it was wrong the engine would tell me". In fact, no commonly available recreational marine engine or genset measures back pressure.

Back pressure is a measure of the resistance or effort required to enable exhaust gasses to travel from the engine to the point at which they exit the vessel, the hull side/transom for a wet exhaust, or the top of the dry stack for dry exhaust. The more resistance that's present, the more effort that's required to move these gasses, and water for wet exhaust systems, the harder the engine must work. The horsepower expended on exhaust gas and water removal isn't available to the prop, effectively robbing propulsive power from the engine. The result is often an inability of the engine to achieve its maximum rated rpm. Additionally, excessive back pressure can increase an engine's harmful emissions, violating EPA (Environmental Protection Agency) guidelines.

In many cases those commissioning a new vessel incorrectly interpret this as a miss-match between engine and propeller; they then proceed to reduce propeller pitch, which, while increasing the rpm, masks the underlying problem. It's a case of fixing the symptom rather than curing the disease, hence the need for a definitive back pressure analysis.

Measuring exhaust system back pressure is among the easiest and most valuable tests you can perform during a sea trial. The information it provides will allow a user, or buyer, to quickly determine if the vessel's exhaust system is properly designed, installed and free of defects or heat damage, and the tool required to measure it is simple and inexpensive, you can even make one yourself.

A water tube manometer, shown in the image that accompanies this column, is no more than a length of clear tubing and a scale. The test does require accessing the dry section of the exhaust system after the turbocharger, and before the mixing elbow of a wet exhaust system. Every marine propulsion diesel exhaust system should be equipped with test port; sometimes they are hidden under blanket or wrap insulation. On older engines removing them can be tricky, particularly if a steel rather than stainless or brass plug has been used.

Virtually every engine manufacturer provides back pressure specifications. Although it varies from manufacturer to manufacturer, these are typically 30" of water column for turbocharged, and 39"-48" of water column for naturally aspirated engines. Again, check the specifications for your engine, or the one you intend to buy.

Generators can also suffer from excessive back pressure. While few small genset exhaust systems include test ports, if necessary they can be drilled and tapped. Manometers are also available in analogue, mercury and electronic formats.

When a mechanic tells you he or she can't measure exhaust back pressure for any other reason than the test port isn’t present, look for a new mechanic.

Ask Steve

Hello Steve,

Thanks for your answer on raw water algae prevention.

If you disconnect the strainer body from the ship’s grounding system, aren’t you inviting leaching of metal from the strainer body itself?

Do you have an opinion on replacing the conventional 30 amp shore power cable plugs from Marinco/Hubbell/ Charles etc with the 30 Amp SMART PLUG?

Kind Regards,

Phillip Legare

Phillip:

It’s so very unlikely as to be a virtual non-issue. The fact is the bonding wire on the strainer will only prevent stray current corrosion, which is rare unless the strainer is submerged in bilge water. The strainer is much too far from any of the sacrificial anodes to be protected by them. If it’s a good quality strainer (I prefer Groco ARG models) made from zinc-free bronze, it’s unlikely to be a problem

Having said that, you can try the copper in the basket with the bonding wire connected first, if it works, leave the wire in place.

I like the Smart Plug. I've written about it a few times, here is one article in which I've made mention of it https://www.proboat.com/attention-to-detail-may-13-2010.html.

Steve,

My disabled neighbor had a local mechanic change oil in his Volvo 280 DuoProp outdrive which only had about 50 hours use and later it would not shift right so had it inspected at another shop and they said it contained synthetic oil which damaged the bearings and other internals to such extent that it could not be saved. Said that it contained metal chips, etc when drained.

They claimed that normal oil, when hot, will absorb the built-up moisture and that synthetic oil will not, so apparently the remaining water damaged the unit. I cannot believe that story about the oil with only a few hours use on the outdrive and prior oil change a year earlier. Is that possible?

Gordon Whitbeck

Gordon:

How does the shop know the oil that was used is synthetic? Also, no gear oil "absorbs" water. While it may emulsify while underway, it ultimately separates, and either way it's harmful. Furthermore, Volvo specifies that only synthetic gear lube be used in many Duo Prop models; you don't say which one is used here, however, a chart is available detailing lube requirements, it's available here http://www.volvopenta.com/SiteCollectionDocuments/Penta/Misc/drive_2_oil_rec_7745608.pdf. Early Duo Props called for conventional API GL5, while late model Volvo stern drives, single and Duo Props, require synthetic oil. It stands to reason, if it's acceptable for those, why wouldn't it be for others? The only reason synthetics were not specified on old stern drives is it either wasn’t available yet, or it wasn’t available in the required specification.

Regardless, while using the proper gear lube is of paramount importance, it’s highly unlikely that using synthetic oil caused the failure unless it was the incorrect specification, i.e. the wrong weight or API rating. There should be no water in the gearcase (and moisture doesn’t “build up”, it leaks in), and if there is a leak, and if there is water in the gear case, the bearings will come to grief quickly. It’s possible that this is exactly what happened, water entered through a failed seal or bellows, through a fill or drain plug if it wasn’t tightened or if the O ring was missing or damaged. However, it is highly unlikely that any type of oil could contend with the water, at some point the oil’s lubricity would be diminished, after which wear and heat would take their toll.

Steve,

My name is Marc and I was going through your website and need an answer to this question.

Used diesel engine oil sample indicated the presence of appreciable amount of iron, copper, antimony, tin and silicon.

What subsequent investigation would you make to find the cause and also find a remedy?

Regards,

Marc Alfred

Marc,

Without seeing the report, and knowing more about the engine, lube and unit time, application, and its use, it’s difficult to respond definitively. However, these results are indicative of contamination of the oil with foreign matter, in this case common dirt, dust or sand (I presume you meant 'silica', and not 'silicon'), which is then creating excessive wear within the engine, which in turn has led to elevated wear metal levels. Iron comes from cylinder walls (and internal engine surfaces where no bearings are used), while copper and tin are bearing materials, and antimony is from bushings.

The engine's air filter system should be inspected to make certain is in good working order and not dislodged, damaged or clogged. The new oil supply that is used for this engine should also be checked to be certain it is not contaminated and is being dispensed from a sealed container.

For more on oil analysis you may want to read http://issuu.com/spinsheetpublishingcompany/docs/aug_pt_2015/25 and http://www.proboat.com/reading-oil-analysis-reports.html.

Steve,

At what loading is it safe to run a mechanically-controlled diesel over the long run without shortening life span?

We are doing energy audits and find most displacement-hull vessels are grossly overpowered, using only 10 to a max 30% of available horsepower in normal operations. This results in excessive fuel consumption as well as unnecessarily high capital and maintenance costs, weight, and space use. It may contribute to shortening engine life, though we don't have data to prove it. Our data suggest that advice to owners should be to "right-size" engines at new construction or repower time, choosing models rated at only about 120% so of actual power demand for hull speed plus parasitic loads. That is, under normal operating conditions the engine should run at around 75-85% of maximum rated power for peak efficiency. Is it safe to run contemporary mechanical (or electronic) diesels, not necessarily continuously but consistently, at that power setting?

Thanks

Terry L. Johnson

Terry,

Congratulations, through careful analysis and good engineering you’ve identified what escapes so many boat builders, over-powering, and thereby chronic under-loading, is wasteful and detrimental to engines, potentially shortening their lives and increasing maintenance costs.

Yes, there’s little if any good reason to grossly over-power a vessel. A margin for fighting currents, head seas and heavy weather makes good sense.

Your question regarding safe, long-term loading is, or could be, a function of an engine’s M rating, as well as each manufacturer’s recommendations for extended use. This is a function of the ‘conservativeness’ of an engine’s design, which is somewhat subjective. M rating, on the other hand, is objective. The lower the M number, the higher the duty rating, beginning with M1, which is rated for full power 24 hours per day, in other words very conservative.

The John “Deere Marine Engine Pocket Guide” defines these as follows.

M1: The M1 rating is for marine propulsion applications that may operate up to 24 hours per day at uninterrupted full power. These applications typically operate more than 3,000 hours per year and have load factors over 65 percent. The M1 rating is the ISO 8665 standard power rating and the SAE J1228 crankshaft power rating. Both are defined as the power level at which an engine can run continuously between recommended service intervals. Possible applications: Line haul tugs and* *towboats, fish and shrimp trawlers/draggers, and displacement hull fishing boats over 18 m (60 ft). M2: The M2 rating is for marine propulsion applications that operate up to 3,000 hours per year and have load factors* up to 65 percent. This rating is for applications that are in continuous use, and use full power for no more than 16 hours out of each 24 hours of operation. The remaining time of operation must be at cruising † speeds. Possible applications: Short-range tugs and towboats, long-range ferryboats, large passenger vessels, and offshore displacement hull fishing boats under 18 m (60 ft). Marine auxiliary power engines for dedicated hydraulic pump drives, dredge pumps, or other constant-load marine applications should use the M2 rating.*

** Load factor is the actual fuel burned over a period of time divided by the full-power fuel consumption for the same period of time. For example, if an engine burns 160 liters of fuel during an eight-hour run, and the full-power fuel consumption is 60 liters per hour, the load factor is 160 liters / (60 liters per hour x 8 hours) = 33.3 percent.*

† Cruising is any operating time where the engine speed is more than 200 rpm less than the maximum attainable engine speed.

M3: The M3 rating is for marine propulsion applications that operate up to 2,000 hours per year and have load factors up to 50 percent. This rating is for applications that use full power for no more than four hours out of each 12 hours of operation. The remaining time of operation must be at cruising† speeds. Possible applications: Coastal fishing boats, offshore crew boats, research boats, short-range ferryboats, and dinner cruise boats.*

M4: The M4 rating is for marine propulsion applications that operate up to 800 hours per year and have load factors below 40 percent. This rating is for applications that use full power for no more than one hour out of each 12 hours of* *operation. The remaining time of operation must be at cruising† speeds. Possible applications: Inshore crew boats, charter fishing boats, pilot boats, dive boats, and planing hull commercial fishing boats.*

M5: The M5 rating is for marine recreational propulsion applications that operate 300 hours or less per year and have load factors below 35 percent. This rating is for applications that use full power for no more than 30 minutes out of each eight hours and cruising† speed the remainder of the eight hours, and do not operate for the remaining 16 hours of the day.*

Possible applications: Recreational boats in the U.S., tactical military vessels, and rescue boats outside the U.S.

† Cruising is any operating time where the engine speed is more than 200 rpm less than the maximum attainable engine speed.

Finally, an engine's ability to operate at a given load is, or should be, irrespective of whether it's mechanically or electronically injected. Electronically controlled engines are somewhat better at contending with light loading, however, they are not immune from its effects. For more on this subject see http://stevedmarineconsulting.com/the-perils-of-chronic-under-loading/