March 2017 Newsletter

Photo Essay: Core Exposure

Virtually every fiberglass vessel afloat today, even those that boast of solid fiberglass hulls rely on core material to add stiffness and strength to a variety of structures, from decks and cabins to stringers and longitudinal supports, as well as hulls both above and below the waterline. In spite of the fact that solid fiberglass has about it an aura of resilience and indestructibility, cored composite construction offers stiffer structures, at a fraction of the weight of solid composite; the inner and out skins act like the horizontal panels of an I-beam, with the core as the web or interconnecting structure. I-beams, for their weight, are immensely stiff.

While this design concept has been proven in the construction of thousands of fiberglass composite vessels, it’s not without its weaknesses. Core material can range from the commonplace, plywood or solid timber, to the exotic, synthetic foam and honeycomb. Regardless of which product is used, it must be securely adhered to the inner and outer skins, and the core itself must remain sound; if that bond is broken or if the core deteriorates in any way (the latter often leads to the former), then the I-beam concept is compromised. If the cored structure is a deck or cabin top, it may forfeit stiffness, becoming flexible or spongy. If it’s a hull, or stringer, repeated flexing caused by movement in a seaway can lead to resin crystallization and eventual structural failure or weakness that is revealed during a collision or gounding.

In the accompanying image, a hole has been drilled through a plywood-cored stringer, exposing the wood’s end grain. Plywood is a suitable core material, when oriented vertically, as it is here, it is very stiff. However, because of its long grain structure it is susceptible to water migration. That is, water enters an area like this limber hole can travel through the stringer for long distances, upwards of several feet. If exposed to water for long enough, even marine plywood will deteriorate, thereby compromising the stringer’s, and possibly the vessel’s, structural integrity.

This scenario can be avoided by properly closing out *all* penetrations into cored structures, decks, cabins, hulls and support structures like stringers. Proper “close out” often means more than simply slathering the end grain with resin, such coatings are too thin and too fragile to offer more than marginal water resistance. Visit core closeout for more on the correct approach.

Ask Steve

Steve,

Thanks for a very interesting article on conventional stuffing boxes. The only type I would have aboard my vessels.

Although your article does not give exact instructions for making mitered cuts on the ends of the packing material, many other articles do, and they do it wrong… They show it being cut in one of the two methods shown in the attached sketch. One of which leaves the piece too short and the other leaves it too long when cut against the shaft or a mandrel of shaft size.

Better to hold the razor blade parallel to the shaft and cut down at a 45 degree angle.

John Brooke

John:

Thanks for your comments and sharing this information. Indeed, properly cutting and packing a stuffing box is a bit of an art form, professionals with whom I've worked pride themselves on their ability to do it well, resulting in stuffing boxes that leak little and don't require frequent adjustment.

Personally, I've always done my packing cutting on the work bench, rather than on the shaft itself. Because I've nearly always carried this out in a boat yard environment, I've had the luxury of having a section of shaft on the bench to enable me to adjust the length until I have it just right. Boat owners can do the same thing by getting a short section of shaft, the same diameter as theirs, from a shaft shop or boat yard (the latter often have stacks of discarded shafts, the former can cut a section for you). A section of pipe of the exact same outside diameter will suffice, but I prefer an actual shaft.

Hi Steve,

Thanks again for your many contributions to the marine industry. Your thoughtful consideration of important issues that so many of us face is greatly appreciated.

My question today has to do with the best practices for operating Diesel engines for maximum efficiency while preventing engine damage from under loading.

As I understand it from attending one of your seminars, your rule of thumb is that engines which run at very low loads all day should be run at 80% load for at least 15 minutes at the end of the day. My boat has twin Series 60 Detroit Diesels which are 825 hp each. So following the aforementioned rule obliterates my fuel economy for the day. I noticed recently that I can monitor oil temperature on these engines and I have since logged the following temperatures at various loads.

Load(%), Oil Temp(F)

45, 180

50, 196

65, 197

80, 202

I assume, the specific best practice is to raise oil temperature to a certain level for a certain period of time. Is that correct? If so, what temperature and period of time do you recommend. Of course, I am hoping that 196F is hot enough to keep my engine healthy.

I’ve been surprised by how little help the engines manufacturer has provided on this topic so I am looking for your advice.

Best Regards,

Mike Davis

Mike:

It never ceases to amaze me how often this subject comes up, and that's a good thing, I'm gratified to see so many boaters who are aware of this all too important issue. It's one I've written about on many occasions.

It sounds as if you are well-acquainted with the problem and its causes, however, for the benefit of other readers I'll detail them briefly. Chronic under-loading leads to a variety of maladies, including carbon accumulation on piston rings, exhaust valves, turbo exhaust turbine and in the exhaust system; wet-stacking, a phenomenon wherein unburned fuel accumulates inside the exhaust system and turbo intake air turbine; and sludge and varnish accumulation in crankcase oil. All of these issues can be reduced by operating an engine at higher load, typically over 50% and ideally at about 75%. However, I realize that's not practical, as most boats are over-powered, running at these loads is uneconomical. The root cause of the problem is over-cooling, or under-heating as it were, the engine combustion chambers and crankcase oil run comparatively cool, even if the coolant, which is thermostatically controlled, operates in the normal 180-195F range. Most vessel skippers operate in this over-cooling zone because there's no practical alternative. There are however, ways to mitigate if not eliminate entirely, these issues. Operating the engine at increased rpm periodically, roughly 75% load for 10-15 minutes, will heat up the exhaust system and oil, reducing soot, carbon and sludge accumulation. For crankcase oil, the ideal temperature is between 180F and 220F (it sounds as if you are hitting that), and a dry exhaust gas temperature over 500F. If you are achieving these in your high power run, regardless of load or rpm, you are in the sweet spot.

In the absence of a permanently installed gauge, oil temperature should be read using an infrared pyrometer, shooting the mid-level of the side of the oil pan. Ideally, the area you shoot should be flat black, and certainly not shiny silver or gloss white as these highly reflective surfaces can confuse IR pyrometers. Exhaust temperature is a bit more challenging. In the absence of a probe in the dry exhaust stream, you can shoot the outside of an uninsulated (it should all be insulated, you'd have to carefully peel back a portion) portion of the dry exhaust immediately after the turbo. This isn't as accurate as measuring the exhaust gas itself, however, for these purposes it's close enough. Once you established the temperatures of these areas under various rpm, you wouldn't have to re-measure them often as they aren't likely to change unless there's a malfunction.

Alternatively, you could try, for longer runs, operating on one engine at a time, alternating every four hours, at a higher load. Doing so will load that engine more, achieving the desired effect. Check your transmission manufacturer's instructions for their trailing engine protocol.

Hi Steve,

Just read Nigel Calder's article in PassageMaker about stacking inverters to smooth out and supplement a smaller generator for high start loads.

My magnum inverter (not installed yet) is not stackable. I am taking a look at the Victron products showcased in his article.

I didn't know this capability existed before, but it seems to me that by stacking 2 inverters and thereby supplementing the generator to meet high 240 start loads (e.g. AC), I get the best of all worlds – a smaller generator and running 240 "appliances" such as the Grunnert pack or an electric BBQ grill off the batteries.

When the inverters decide the banks are too low, the generator is auto started to charge them. This keeps the generator running at a nice load rather than just biding its time most of its life waiting for a start load, the rest of the time running way under loaded.

We had redesigned the electric system into 2 shore cords, one dedicated to AC, the other for everything else. Seems to me we might even be able to lose the second shore cord with this system at the same time as stepping down from the 20kw northern lights to something substantially smaller. Maybe that's going too far, but if anything I could really reduce the size of the genset.

Where are the pitfalls here?

Thanks!

Paul Weismann

Paul:

You've posed some good questions, and wisely asked about the associated pitfalls. Magnum, by the way does offer power sharing capability, although that's fairly recent. Let's begin with the argot of inverters, as I believe you are mixing or misusing inverter terminology. "Stacking" refers to increasing inverter capacity by ganging or connecting two or more units together. Most modern high quality inverters, including Magnum, are capable of being stacked. Stacking in parallel simply increases capacity, essentially more 120 volt Wattage capability. Series stacking can provide 120/240 volt capability, enabling you to operate 240 volt appliances from an inverter. Not all inverter models are capable of stacking and load share/support, however, it’s often not necessary as large single inverters are available. Caution is, however, the watchword, as the battery capacity to operate these loads could be substantial. In many cases this arrangement is used to operate both light and heavy loads, 120 and or 240 volts, while the engine is running, and supplying DC current to the battery bank via a high output, externally regulated high output alternator.

Load sharing, as described by Magnum is as follows, *“Available on all ME, MS Magnum models, it is related to the shore, or input AC amps setting. Output loads are always a priority. Based on the input amp setting the total input between the charger amps and load amps will try to equal the input amp setting. As load amps are increased the charger amps will decrease in order to equal the input amps. If the charger amps equal 0 and the load amps exceed the input breaker, the breaker will still trip.*

Load Support on all MSH Magnum models is also related to the shore or input AC amps setting. Again Output loads are the priority. The charger amps will still reduce to 0 but with the MSH the inverter will pull current from the batteries in order to support the ac input amps. The Load Support mode will continue until the batteries reach +.5VDC ABOVE the Low Battery Cutout set for the inverter.”

This arrangement can be used to support or augment either shore power or a generator, particularly during momentary, high current start up loads.

Victron has received a great deal of press from folks like Nigel for its ability to do this, however, once again, thanks to the growth in photovoltaic energy generation, most modern inverter manufacturers offer this capability, including Magnum. Most of these manufacturers produce far more gear for this industry than for boats, which is good because of they were making it only for our needs, their research and development funding would be much smaller, and consequently inverters would be far less capable than they are today.

Using the load support/sharing function, yes, it is conceivably possible to install a smaller generator. The cost savings in installing a smaller genset may be marginal, however, as it's offset by the need for a larger, more capable inverter. However, there are other benefits, chief among these being a heavier load being placed on the genset, staving off the effects of chronic under loading.

Additionally, while generator auto start sounds attractive, it can be complex and even dangerous. In order to operate without unduly stressing the genset, the auto-start/stop mechanism must be able to disconnect and reconnect loads before starting and stopping the genset, i.e. it should not be started or stopped under load. Also, the notion of a generator starting and stopping automatically gives some genset manufacturers, engineers and marine systems consultants, pause.

Finally, keep this in mind, if you opt for the load sharing route, it's a technically sound approach, if your inverter packs it in, you have no redundancy, which means you may not be able to use air-conditioning…while on vacation in the Bahamas; not a pleasant thought. It is here that Nigel and I differ, he takes more of a shop bench, knows his own boat and its systems, theoretical approach (we need folks like this to investigate and adopt bleeding edge technology), while I, as a former marine electrician and mechanic, and boat yard/boat building shop manager, take more of a 'from the trenches' bullet proof, been there done that, redundant tack.

Dear Steve,

I had to smile this afternoon. As I was opening up your monthly email, I was thinking I ought to unsubscribe. After all, I am a firm believer in simplicity. I would never own a boat with wheel steering, let alone an inboard engine, and you specialize in nautical complexity. Imagine then my delight in finding a very informative article on hose clamps. I learned a lot. And even on a very simple cruising boat, I'd have a cockpit with the two through-hull seacocks, hoses and clamps (although Peter Tangvald famously ripped out his cockpit on Dorothea, decking it over and having a hull completely free of through-hull fittings).

I am hoping that in next month's article on clamps, you might address their use in cobbing together a jury rig, especially their use in splinting broken spars. Are they strong enough for this application? I would think they would be better than a Spanish windlass made of synthetic line. It would have to long enough to encircle the broken spar and all the splints too, perhaps 24″. Since industrial hose comes in all diameters, no doubt there are very large clamps available too. Do they comes in 316 stainless? Am I correct in thinking galvanized steel clamps would suffice for a jury rig since they'd be used for no more than eight weeks.

I'm hoping you might comment on clamps for this application next time. In any event, thank you for an interesting and informative article. I remain your faithful subscriber,

Paul J. Nolan

Paul:

Thank you for your note and comments, they are always appreciated.

I hadn't intended to cover jury rig (this phrase, by the way is derived from the word "injury", I'm a nautical etymology enthusiast as well) uses for hose clamps in that column, however, I'll do so here.

Hose clamps are available in a wide range of sizes and diameters (and in 316 stainless steel), and I have used them for a variety of ‘field expedient’ repairs both ashore and afloat. The drawback to hose clamp use in an application of this sort is their limited range, making it difficult to get the right size into place, and then being able to fully tighten it, it’s challenging. As the (nautical) axiom goes, however, any port in a storm, stainless steel, galvanized, spliced clamps, use whatever you have. Having said that, I wouldn’t dismiss the time-tested Spanish windlass for emergency repairs by any means, it’s just one simpler tool to keep in your damage control kit.