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How to Choose a New Engine for Your Vessel

By Jennifer Oredson

When the time comes to decide what to do about your aging engine, there are a lot of factors to take into consideration. The first is to figure out what kind of a repower is right for you. Should you rebuild your engine or purchase a remanufactured engine? Or should you buy a new one?

Rebuilding an engine means it is repaired only to the point of failure. The benefits of this route are the minimal cost and your familiarity with the engine, and you also won't have to worry about meeting emissions requirements. Although rebuild costs are typically the lowest of the options, many of the older engines used in today's market were based off an on-highway or an off-highway engine that has gone out of production. This means you might find it difficult or more costly to obtain the parts to rebuild your current engine. Sometimes rebuilding an engine costs more than purchasing a new one. Rebuilding has other disadvantages as well.

"You're only going to see a slight improvement in reliability, and your engine will be less durable because a rebuild typically does not last as long as the original build," says Carl Micu, product manager of sales support for John Deere Power Systems, which manufactures marine diesel engines. "You're also not going to see any improvement in your fuel consumption or vessel speed, and the warranty probably won't be any longer than 90 days."

A remanufactured engine means the engine core is completely disassembled, cleaned and inspected. Some advantages of a remanufactured engine are that it's less costly than a new engine, you are familiar with the engine, and you'll know the new engine is compatible with your vessel's systems. Also, you won't have to worry about meeting emissions requirements, and many manufacturers offer good warranties with remanufactured engines.

"One big advantage of a remanufactured engine over a rebuilt engine is that you're going to see improved reliability, and the durability will be similar to that of the original engine," Micu says. "However, the same applies here as in a rebuild: You won't see any improvements in fuel economy or vessel speed."

The final option is buying a new engine, and even though it might be the more costly option initially, the benefits often make it more than worthwhile.

"With a new engine, you're going to get improved durability and reliability, and this is the only option where you have a potential for improved fuel economy, faster vessel speed, and reduced noise and smoke," Micu says. "The owner/operator must also consider that the vessel systems need to be reviewed when

There are many variables to consider when repowering your boat, whether you buy new or rebuild an existing engine. Photo courtesy of John Deere Power Systems.

buying a new engine, and with new engines, emissions requirements must be met."

So figuring out which route is best for you is as easy as determining what your goals are.

If You Choose New

If you decide that purchasing a new engine is right for you, pay attention to your current engine's performance so you know what to look for in a new engine. If you establish a baseline of your vessel's performance, then you'll also be able to better assess your goals and what it will take to achieve them. A sea trial will give you this baseline information. Consult with the new engine representative to identify the best way to conduct the sea trail to obtain the data that will provide you the best information for your situation.

An important factor to use in determining what engine power you need is the load factor, which is the average power or fuel consumption the engine will produce or consume in a given period of time. In other words, your load factor will tell you, on average, at what percent of maximum power you run your engine. If you run it at 100 percent load factor, the life of your engine will be shorter because it is working as hard as it can. If you typically run it at 40 percent, the engine will last much longer. Engine manufacturers use the load factor and expected life to help determine the ratings on the engines.

"The ideal load factor is different from application to application, and it all depends on how many hours you expect to get out of the engine," Micu says. "Let's say that an engine of a given displacement, such as the John Deere 8.1L marine engine, is going to be used in a tug boat. It may have an 80 percent load factor and an expected life of 20,000 hours or more. We would recommend our lowest rating of 235 bhp (175 kW). The same engine in a trawler yacht that only wants to cruise at slow speeds may have a load factor in the 20 to 30 percent range. This same engine will provide many more hours of service compared to the tug application. A fishing vessel may expect 10,000 to 15,000 hours of service, so they will use a mid-range rating of 330 bhp (246 kW) with a load factor between 45 and 50 percent."

In order to calculate load factor, you can rent a fuel-measurement device, use electronic data to pull load profiles from the engine control unit or use trip data to determine the amount of fuel used in a trip and then compare that to the rated fuel that could have been used in the same amount of time. For example, let's say you determine that you use 84 gallons of fuel in your regular 10-hour trip from point A to point B. That means you consume 8.4 gallons of fuel per hour, and if you consult your engine's performance curve, you see that your engine consumes 20.9 gallons per hour at rated power and rpm. Then you divide measured fuel by rated fuel: 8.4 divided by 20.9 gives you a load factor of 40 percent. Another way to determine load factor is to work with an engine manufacturer representative, marine engineers or naval architects to calculate a value based on your estimated operation profile (usage).

Will Adding Horsepower Increase Your Vessel Speed?

Vessel speed is dependent upon many variables. One is the hull shape. For displacement hulls, there are some reliable empirical formulas that can estimate how much power is required to increase your vessel speed. Let's look at a simple example.

Say your current engine in a 72-foot displacement hull gives you a maximum vessel speed of 11.4 knots at 485 hp. If you want to be able to get two extra knots out of your vessel, you're going to need 62 percent more power, and if you want to get an additional four knots out of the vessel, you'll need a 147 percent increase in power. These kinds of increases will typically mean a physically larger engine, which is more costly, consumes more fuel and would potentially require structural modifications to the vessel. You'll have to decide whether the additional speed is worth it.

"One more important thing to consider here is that increasing power typically means increasing propeller size," Micu says. "You'll need to take into consideration how much room you have between the tip of the propeller and the bottom of the hull. Too little tip clearance can result in noise, vibrations and hull damage."

Side-by-Side Comparisons

As you shop for your new engine, you will want to compare the current model and the new model side by side, and you'll need to take into consideration each engine's specs:

- Engine's physical size (length, width, height, weight, maximum installation angle)
- The requirements of the air inlet system (air flow, radiated heat and maximum allowable temperature rise)
- Cooling system requirements (fresh water and raw water flow, heat rejection, water pump inlet restriction, and maximum coolant temperature)
- Exhaust system requirements (exhaust flow, maximum back pressure and exhaust temperature)
  - Is your muffler sufficiently reducing exhaust noise? Are there modifications that could be made to improve it?
  - Does the exhaust exit the hull in a location where the exhaust is coming back into the air intake or into living or working spaces? Can it be improved?
- **Fuel system requirements** (fuel flow, fuel filter micron size, maximum fuel pump inlet suction clean filter, maximum inlet temperature)
  - Is it time to clean out those fuel tanks?
  - Will a polishing system be beneficial to you?
- **Electrical system considerations** (battery cold cranking amps @ 32°F)
  - Battery size should be sufficient for starting

- Is charging system sufficient for additional loads due to electronic engine?
- Are you adding additional electronics?

- **Control systems**
  - Do you want to use your current control system? Does the engine supplier provide a simple electronic throttle device to interface with your mechanical system?
  - New displays can interface with the engine control unit communication bus, providing more information at the bridge

Calculating Your Fuel Economy

Comparing the fuel consumption of your current engine to that of a new engine is a big step in the decision-making process. With the current cost of diesel fuel, a small difference in fuel economy between two engines can mean a big difference in the bottom line at the end of the year. Use these steps to calculate how much you spend on fuel in a year:

- Consult the engine's performance curve, which will give you the maximum fuel consumed at the engine's maximum power
- Multiply that number by your average load factor
- Multiply by the average number of hours the vessel operates in a given year; this will give you the gallons of fuel you consume in a year
- Multiply that by the cost of a gallon of diesel, and you'll have how much money you spend on fuel in a year

"If you go through these steps with multiple engines as you're shopping around, you'll see that you might be able to save thousands of dollars every year by choosing one engine over the other," Micu says. The engine manufacturer representative may be able to do a more detailed analysis for you. With today's electronically controlled engines, the fuel consumption difference at partial load may be even bigger than just using the average load factor and rate fuel consumption values.

"You should also take into account how much oil you'll have to go through, and there might be some significant cost savings there as well," Micu adds. "Some engine manufacturers can provide you with an estimate of oil consumption based on fuel consumption. This value can be different between engine manufacturers and engine models, so consult with the manufacturer's representative."

For example, let's say you determined your load factor is 40 percent, and engine A's performance curve says it consumes 20.9 gallons per hour at maximum power. You also know that your vessel works 50 hours a week and that diesel costs $3 a gallon. The calculation would look like this:

(20.9 gallons/hour) x (0.4 load factor) x (50 hours/week) x (52 weeks/year) x (3 dollars/gallon) = $65,208 per year.

If you compare that to engine B, which burns 22.3 gallons an hour at maximum power, it might not seem like a big difference, but at the end of the year, it would add up:

(22.3 gallons/hour) x (0.4 load factor) x (50 hours/week) x (52 weeks/year) x (3 dollars/gallon) = $69,576.

That would be a $4,368 savings in fuel if you choose engine A.

So at the end of the day, if you decide to repower with a new engine instead of a remanufactured engine or rebuilding your engine, you have a lot of factors to take into consideration. Cost is always a factor, and a rebuilt or remanufactured engine may be simpler. The benefits of a new engine include improved reliability and serviceability and reduced operational costs, and not only do you have the potential for trade-in value on your old engine, but you may also increase the resale value of your vessel. And because new engines have to meet emissions standards, you also have a more environmentally friendly power source.