How to set your boat up for the best economy possible

First of all, I am no expert or scientist. I am speaking here from experience learned over many years, along with training received at Mercury's Quicksilver school in Fond du Lac, Wisconsin. What works for me may not work for you.

This post will deal with saving gas and how you can squeeze every ounce out of your boat's tank so $3.80 per gallon doesn't hurt so badly. I am sure many of you know that running the correct air pressure in your car/truck tires can make a substantial difference in fuel mileage, and some of you are obsessed with maximizing that SUV's MPG's; yet many of you do not give the same consideration to your boat which burns much more fuel! We are going to cover a few simple items to help you save money and burn less fuel.

Let's first talk about hull design. There are some hulls that are just a lost cause. You are not substantially going to improve the fuel economy of a displacement, semi-displacement, or catamaran hull without major changes in design, weight, construction, or powerplant. Most of these hulls fulfill a purpose for which they were designed and are optimized for that purpose. We are going to focus on deep-vee monohulls with outboard powerplants, since that is what most of us use to fish the deep blue.

We are also going to focus on the variables we can change, like prop selection, loaded weight, and trim, and avoid the ones we cannot like deadrise and hull weight.

Weight

Weight is not your friend. The heavier your boat is in fishing condition the more fuel you will burn. It simply takes more horsepower to move your vessel through the water at a given speed. There is not much you can do about hull weight and powerplant weight, but where you can change is the gear you carry onboard.

I have found over the years that our boats become storage units for seldom used gear and items we don't really need to fish offshore. Walk-a-rounds and Cuddy Cabins are the worst for this. For example, a friend of mine carries three anchors on board, along with an additional 30ft of chain, on a 26ft boat! That is over 200lbs of excess weight right there! Now, I have no issue with carrying a spare anchor, especially if you bottom fish and dive, but doesn't a lighter aluminum or smaller steel Danforth make more since?

How many of you carry more ice than you need, or run with the live wells full when you don't have bait? Consider this; sea water weighs about 8.4lbs per gallon. A full 40 gallon live well adds an additional 336lbs to the boats weight. How many of us run offshore with a full well, only to jig bait once there, and then dump the bait at the end of the day, only to run back with a full well with no bait in it? You just carried 336lbs twice that you didn't need too! So, our first order of business is to go through the boat and remove everything we don't need to fish or be safe offshore.

Prop Selection and Motor Height

How many of you are running the same prop and motor height your boat left the dealer or previous owner with? We often assume it is correct because it has worked in the past. Well, did you know the correct prop and motor height can make as much as a 50% difference in fuel economy!!! This is a very in-depth and technical subject, so we are going to cover just a few items that the average backyard mechanic can adjust.

First, outboard engines are designed to run with the Anti-Ventilation Plate at or up to 1” above the water’s surface when in running condition. This means the plate should be visible if you are standing in the back of the boat looking at it. If it is below the water you are causing unnecessary hydrodynamic drag. Most boat manufactures set the motors down one to two holes to keep the lawyers happy. Having the motors lower keeps the props from cavitating and helps the hull turn better. By raising the engines up ½” to 1” you will often find the same benefits, but at a lower coefficient of drag. This will give you a slightly higher top speed and cruise speed from the reduced drag. Try raising your motors a hole or two and see what happens. Before you go messing with the props we have to get the engine height correct for the hull. Here is further reading on the subject.

http://www.veradoclub.com/smf/index.php?topic=137.0

Prop Selection is probably the most over looked aspect of making an outboard perform properly. Dealers often focus on one thing, WOT RPMs when selecting a prop. If the outboard it rated for 6000rpm they put whatever prop they have on hand that will give that specific RPM at WOT and that is the last time they think about it.

Let’s use a real word example. “Mr. Smith” bought a 2004 Contender 21 Open with a Mercury Optimax 250 and a 14.5X21X3 prop. WOT was 51MPH at 5400rpm and 2.2mpg at a cruise of 30mph and 4000RPM. He made the comment one day that he loved the boat, but it was not as good on gas as he had hoped. I offered to take a ride with him to see if we could squeeze any more performance out of it. Well, after raising the motor one hole and switching to a 14.75x19X3 the boat now does 54mph at WOT of 5950rpm (motor rating is 6000) and cruises at 37mph at 4000rpm and 3.3mpg! That is a substantial increase! On a trip 20 miles out and back it makes a 30 to 40% difference in fuel used! Think of the hundreds of gallons of gas burned since 2004 that Mr. Smith could have saved! You should also note here that an increase in pitch does not always lead to an increase in speed. In fact, the inverse is often true. Having a prop that takes advantage of the motors power curve is much more important that just a WOT speed.

When selecting a prop you want to make sure the boat is near its actual running weight ready to fish including passengers, all options like curtains, t-top, trim tabs, transducers, etc have been installed. You want to have the correct engine running height, and the trim angle should be neutral (the engine should not be tucked under into negative trim.) In neutral trim you should be 200-500rpm off of your WOT, so when the engine is trimmed out you do not exceed the WOT rating. Trim tabs should be fully retracted.

Once you have established that the prop is correct for your weight and WOT rating you can move on to the cruise setting. You will set the motor trim and trim tabs as they would be for running in the ocean and establish a baseline rpm to run. This RPM should be your **Best Economy** setting. Once you have done your homework and tested to find what this RPM is you can establish your **Operating Range** . You will either need to fill the tank and run an exact distance and then fill the tank again to determine fuel used, or you will need some type of on-board fuel monitoring device. (FloScan, EP-60, Yamaha CMLK+)

The Operating Range is the Best Economy setting plus 60% for the top of the range and minus 30% for the bottom of the range. A valuable tool for this calculation is Yamaha’s Performance Bulletins. Let’s use one here; this is for a Grady White 230 with a F300 and 5800rpm redline.

RPM MPH GPH MPG
1000 5.3 1.2 4.42
1500 7.1 2.0 3.55
2000 8.4 3.4 2.47
2500 9.1 5.4 1.69
3000 13.5 6.7 2.02
3500 27.4 8.7 3.15
4000 32.7 11.9 2.75

4500 36.8 15.4 2.39
5000 41.2 19.5 2.11
5500 45.6 24.5 1.86

We can see that the best economy is at 3500rpm and 3.15mpg. 3500X1.6=5600rpm and 3500X0.70=2450. Prolonged usage in this range will not harm the engine and **these rpm numbers represent the top and bottom of the power curve** . More than 5500rpms will likely not give an increase in speed and less than 2450rpm will not even come close to allowing the hull to plane.

We are going to further narrow this range. Let's assume that loaded and ready to fish this Grady White sees its best economy at 3700rpm and 3.0mpg. **If we take plus or minus 10% of this rpm we get the Economy Range.** In this case it would be 3700X1.1 and .9=3300rpm to 4070rpm. You can see from the chart that this would give somewhere around 2.75mpg throughout the 3300 to 4070rpm range. Those are about as real world numbers as you could expect from a 23 Grady with 300hp. The actual numbers will likely be less, but close to the 2.75mpg average without bottom paint.

We want to make sure we are operating in this range when running offshore to maximize our fuel consumption. And since I mentioned bottom paint, the condition of the bottom and cleanliness makes a huge difference in performance! Keep the bottom clean and smooth and minimize using trim tabs to the times you need them.

The last consideration with prop selection that I will go into is **Prop Slip** . Prop Slip is a simple calculation that gives an idea of prop performance. I will leave further discussion to the pros like Ken at PropGods and others that make blueprinting and tuning props a full-time job. We could go on for days talking about rake, cup, turning angle, blade count, overlap, pearling, diameter, hub size, vents, lift, and slip, but this is beyond the scope of this discussion.
This is what the calculation looks like:

(Pitch X RPM)/(Gear RatioX1056)=Theoretical Speed
(Theoretical Speed-Actual Speed)/(Theoretical Speed)= **Prop Slip %**

You want this number as low as possible. A prop slip of 0% would be a perfectly tuned prop. **In the real world we strive to achieve somewhere between 8% and 15%.**

I have included links to a prop slip calculator and to Ken at PropGods should you need further help.

http://go-fast.com/Prop_Slip_Calculator.htm

http://www.propgods.com/forum/

In the example of our Grady White 230 with the F300 we will calculate our prop slip for the cruise rpm. You may want to calculate the slip at several rpm ranges to determine an over-all picture of how your prop is working.
(17 pitch X 3500rpm=59500)/(1.75ratio X 1056=1848)=32.2MPH Theo Speed
(32.2MPH-27.4MPH=4.
/(32.2MPH)=0.149 or **15% prop slip**

As you can see the prop slip is rather high on our Grady White test boat, so further research into other props many result in improved economy.

Engine Tuning
What you put into it you will get out of it. When you run months old gas, contaminated fuel, dirty filters, old gear lube, and used oil you are hurting your engine's performance. Gas looses 2 to 3 octane per month regardless of what stabilizer you run. There is no way to keep gas "new". When you fill up take into

consideration how long the fuel is going to stay in the tank. If it is longer than 2 to 3 weeks fill up with 89 or 91 octane instead of 87. (some engines now require 89 or higher) It may cost a few dollars more now, but it will pay for itself later. Also, try to buy as low or ethanol fuel as you can find, and run a good fuel stabilizer. I prefer Startron. It seems to work better than Stabil or Seafoam and you don't have to worry as much about over dosing.

I do oil changes and routine maintenance items like clockwork. I run the recommended oil weights and the factory filters. I change thermostats every two years or 200 hours and water pumps get the same treatment. I also clean the VST pump screens anytime I notice a slight decline in WOT rpms or performance.

Preventive maintenance not only helps your engine run better and last longer, but keeping a record of it actually adds to the value of the boat should you decide to sell it!

I also change fuel filters (both the Racor style and the F style on the engine itself) frequently. I keep a spare filter, filter wrench, and ½ gallon of gas in a small gas can on board should I need to change a filter at sea. (you will need the gas to prime the filter) A friend of mine was recently having trouble with "ethanol issues" as he put it. I asked him what micron and type racor filter was he running. He had no idea what I was talking about and had never changed the fuel filter in the four years he had owned the boat! It was in the bilge and was so corroded that the entire base needed changing!

Also, I built a simple fuel polishing rig that allows me to transfer fuel from my boat to the truck (automobiles are much less sensitive to old, dirty fuel than outboards) whenever I want. It is a 12VDC fuel pump mounted to a piece of Starboard with 12 feet or so of fuel line attached. I simply take the primer bulb loose, connect the pump to the bulb, run the other hose to the truck (or back to the boats tank if I want to "polish" the fuel) and connect the battery clips on the pump to a 12VDC source. I pull all of the fuel through the boats Racor filter, and then I change the filter.

In the fall I pump the boats tank down to a minimum fuel level and then only add a sufficient amount for the fishing trip I am running that day. This way the gas never has a chance to go bad. It is either getting burned in the truck or the boat and is never just sitting around. The pump set-up cost about $50 to build.

Trim and Fuel Flow Data

This one is easy. You want to keep as much of the hull out of the water as you can and keep the Running Angle as parallel to the surface of the water as possible. Use your engines trim and the trim tabs on the boat, along with strategically placing heavy items (coolers full of fish or ice, anchor and chain, batteries, people) in the hull to keep the running angle as flat as possible. You probably will never notice that having a passenger stand beside the leaning post instead of behind it (or vice versa) would make a .2 or .3 GPH difference, but over a day spent offshore that may add up to a couple of gallons of gas! You would have never been able to determine this without fuel flow data! If you are serious about saving money on the gas you put into your boat you must have accurate fuel flow data from an inline fuel flow sensor!

I have used FloScan, Lowrance EP-60, and Yamaha's excellent Command Link Plus System with great results. In the case of my Pioneer 197SF with the Suzuki DF150 it was a $75 investment and an hour of time to add fuel flow data to my existing GPS/FF. Think of the hundreds or thousands of dollars of fuel you could be saving if you knew that a 50rpm increase or decrease could save you half a gallon an hour or more, or that simply moving a cooler from the back of the boat to the front could save you several gallons of gas per trip. If you do not have fuel flow data on board you should seriously consider adding it.

Aerodynamic and Hydrodynamic Drag

The last thing I will cover is drag. Both the type caused by moving through the water and by moving through the air. Take some time to look at your hull. Are your trim tabs slightly above the hull bottom when fully retracted? Are your transom-mount transducers too far down in the water or too close to the prop? Does your live well pick-up need to be shortened? These are all sources of hydrodynamic drag, along with bottom paint

and fouling. Keep your hull clean and smooth!

It doesn't seem like much, but running with rods in the t-top rocket launchers, all the curtains up, and guys standing out in the wind add to the aerodynamic drag. Try to have you passengers as low as possible (sitting on bean bags or in the seats) and behind the curtains. Put the rods in the rod lockers or under the gunnels and out of the wind.

Hopefully, you will be able to take a few thoughts away from this and find a couple of ways to cut your fuel consumption. In many case you will find that simple slowing down a few MPH will save you significant amounts of gas. We are always pumped up and ready to get there fast and fish in the morning and ready to get home in the afternoon, but sometimes a little patience is worth a lot of money. Getting to the "Spot" 15 minutes later may have saved you 3 to 7 gallons of gas on a 60 mile run to the Stream. That's $11.55 to $26.95 for 15 minutes there, and that much more for the ride back. There's $60 right there you could be saving. Also, check the tire pressure on you trailer and tow-rig and maximize economy in those areas as well. Every little bit helps.

Tim