

## ***Tartan 37 Technical Resources***

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### **Chapter 3: Engine, transmission and prop**

#### **Section 1: Engine Replacement**

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Replacing an engine is not a job for folks of very limited mechanical skills, but if you have some comfort with general mechanics (aligning the engine, taking stuff apart and competently reassembling, some familiarity with fibreglassing) it can be done. Let me say at the outset: if you cannot slip through the starboard lazarette, don't even think of doing the work yourself. You are going to have to go down through that door hundreds of times to replace the engine. I am 6ft and 195 lbs and in relatively good shape and it is back breakingly hard work and a narrow fit to get in and out of that hole.

The benefits of doing it yourself are quite a few. In addition to saving money (a couple mechanics have said that the labor cost would be equal the engine cost to do it right), you will gain a much deeper understanding of maintenance issues and the mechanics of your new engine that you will never get any other way. You will have access to things you will not get a better chance to fix, replace or maintain with the engine in place. And, of course, you will have the certainty that things were done right—there is a lot to go wrong in this effort. I seriously doubt that I would have accepted even a fair billing for a professional to do the work I did during my repowering—it would have been astronomical.

What follows is a walk through of the process with the hope that this will help you avoid some of the mistakes I made. It will be very valuable even if you are hiring the work done; there are a lot of things you should consider as you embark on this major rebuilding.

First: Should I replace???

If your engine is running OK now, I strongly recommend that you invest in some maintenance and retain it. What is OK??? Well, a little blue smoke at start up is fine. Black smoke is probably not the fault of the engine but of the propeller pitch setting. Replacing an engine properly will cost you somewhere between \$14K and \$25K (the lower price is what I am paying just for engine and materials in 2007) and requires the rebuilding of most of the systems on your boat. It should not be undertaken lightly. A properly maintained and used engine could last for 5000 hours or longer (my abused engine lasted 4500 hours). HOWEVER.....

If you choose to retain your engine here are some things you should do NOW if you have not done this in the last few years:

1. Take off the exhaust elbow and replace it if it is at all occluded. I had replaced mine 1000 hours ago, run it on my long 7000 trip (no short trips) and it was 30% occluded—increased back pressure blew off my manifold and probably contributed to the demise of my Westerbeke 50. The exhaust system is pathetically undersized on the T37 at 1 7/8" on the water lift muffler and tube. It needs every millimeter of diameter to keep from destroying

your engine. This all causes back pressure which is an express lane to valve failure and the engine's failure. I can tell you from experience. All the new engines of similar horsepower require much larger exhausts.

2. Have your valves checked for clearance. No matter how talented you are, I would suggest having a very busy diesel mechanic do it for you as it takes a feel that is acquired by experience.
3. Make sure you have changed your oil and filter (every season or each 140 hours) and transmission (450 ml of ATF each season in the Hurth 150 transmission—the dipstick is measured when “out”—do not overfill or you will blow the gaskets—I know this from experience.) My guess is that you may have ignored the transmission.
4. Check the weeping of the freshwater pump (replace it if there is any sign or you will be marooned somewhere) and the saltwater pump (carry a spare) and preemptively check the salt pump impeller. My experience is that the saltwater pump is a weakness on this engine: I went through a number of them in 3000 hours and found that the impellers had wildly varying lifetimes (200 to 600 hours), even though I never ran them dry. If either pump is weeping water through the bearing you need to replace it, NOW.

If you are like me, you will not do this. And you will be very, very sorry when the bill for your negligence comes due with the engine replacement. So, if you have a running W-50 and do not do the above, you are going to be interested in what follows sooner or later.

## 2. Which replacement engine??

Well, here is something that will give you some cause for consideration.

NO MATTER WHAT ANYONE TELLS YOU, THERE IS NO “DROP IN” REPLACEMENT FOR THE W-50 on the Tartan 37. Every engine option I looked at; Westerbeke, Vetus, Yanmar, or Beta all require significant modification of the engine bed; which means major geometry and fiberglass or metal work. So my advice is to assume that whoever offers “drop in replacement” is documenting that they do not understand the W-50 (it has its shaft in an odd position—lower than the bed) and Tartan 37 and you should discount the rest of their recommendations.

Some folks will try to sell you a bigger, or at least more powerful engine. They will tell you things like “engines are more powerful and smaller now” and “why not???”. Well, it is true that engines are somewhat more powerful for their size (more particularly their weight rather than volume, however). With a properly pitched propeller (which your stock propeller is most likely not), my estimation after 20,000 miles is that the W-50 was somewhat overpowered to drive my T37 and a 105 Amp alternator. Is that a problem?? Yes. Diesels want to be driven at 70-80% power most of the time or you will be destroying the engine with glazing of cylinders (they way many recreational diesels die) and you need a balance of power for this. I am guessing that the reduction of power in later T 37's to the W-40 was, at least in part, due to this realization. Putting something larger than 40 hp in this boat is not only unneeded, I would question whether it is a good choice for the engine's longevity. If you have trouble driving this boat with your W-50 engine, start by looking at your prop pitch. My stock prop was grossly overpitched and this certainly contributed to the demise of my W-50.

There are a lot of choices and you should make your own. I chose Yanmar 3JHE4, a 3 cylinder, 40 hp engine. Here were my reasons:

1. It was the right HP for this boat. Nominally two less horsepower than the W-50, but it actually turns out more torque (which is what matters) than the old engine.
2. On my two year cruise through Central America, Yanmar was the only real international dealer with parts availability in other countries. You might think this is not a problem with DHL serving the world, but it is. When you try to import parts to a foreign country you will understand the

value of local parts. I would not have anything other than Yanmar if I was considering a world cruise.

3. Yanmar makes all the stuff themselves and they do an exceptional job of fitting everything together. Most other “manufacturers” of marine diesels are just marinizing a small Japanese tractor block. The W-50 was a marinized British taxi engine. If you want to see the difference in design and construction, compare the engine mounts on a Yanmar to any of the other engines. The Yanmar will not necessarily be the least expensive option, but reliability, parts availability and repairability are important to cruisers and recreational sailors.
4. Yanmar is about the right size—Surprisingly, the engine is about the same size as my old W-50 despite all the claims that new engines are smaller. I have no idea how some folks have crammed a 62 HP or 55HP engine into this space. Nor can I imagine why someone would do it. If you do the math of what it takes to drive a fully loaded (even over loaded) Tartan 37 and a high output alternator, anything larger than 40 hp is going to be running at a fraction of its capacity in the heaviest seas. If you are underpowered, look at your prop. I have some experience with the T 37 in large seas from my trip from California to Maine via the Panama Canal. There were times we had some head seas (17 feet, 25 knots at one point) that slowed us down to a few knots, but pounding, not a bigger engine was the issue. I never wanted for power with the W-50 and the adjustable, feathering, three bladed Martec Autostream prop.
5. The price was about the same as other options. I paid \$9500 for the engine with an upgraded panel and 80 amp alternator including delivery. Buy it from a high volume dealer as they get significant discounts from Yanmar. Your uncle Ned doesn't.

What else should I think about?

You are going to have to replace a lot of systems while you are doing this major work. Here is a list:

- ◆ You will need a completely new exhaust system. The new engines need at least a 2.5” exhaust system and you have a 1 7/8” system. That may not sound like much, but there is no quicker way to burn your new engine's valves than by running it with too small a muffler and exhaust. Cost for parts \$600. The tubing is about \$18 a foot for about 17 feet, the new muffler is about \$200 and you will need a fabricated stern fitting for at least \$150. Just the stainless tube clamps will run you about \$70. Oh, and you will need to get someone to make a new exhaust port—mine was \$200 in time and materials. Installation extra. How are you doing? You are just getting started.
- ◆ You will probably need a new water heater as the original was made of sheet metal and this is your big opportunity because the engine must be removed to get the old one out. One that is a direct replacement is about \$580. Plus some new hoses and fittings and time to install. The fittings you will need to get this in and out of your engine will cost you something like \$200 for new hoses and pipe fittings. Maybe you can save the old ones.
- ◆ You will need to modify the cutout for the instrument panel if you want it to be water tight. This won't cost much but time if you can do it yourself. We will set aside \$100 for a West system epoxy set up that you will use for a bunch of stuff. No labor figured here. Because it almost fits, it is a major pain in the butt to do correctly.
- ◆ The engine bed and shaft will need to be modified. This is labor intensive and if you are really really handy, have some good geometric skills and can fiberglass you can save some money here. You will probably need the services of a good machine shop for some shims for the engine and a new shaft. The new shaft and facing will be \$600. If someone suggests you can simply add a shaft extension, I strongly suggest you do not do this. You probably have a worn

shaft anyway and the connections are going to complicate alignment and not be worth it. You may need a new strut if yours is pink from corrosion; \$350 for the part. You might need a new cutless bearing if you have not replaced it recently and that will be another \$100. Again, there is a lot of labor involved and this is only the parts.

- ◆ You will probably want to put new sound deadening materials in the engine compartment while everything is out. Set aside about \$200 for materials as it takes more than one kit to do this. Three sets of sound deadening for my boat. I used three complete kits to do my engine room.
- ◆ You should probably take this opportunity to replace the cockpit drain and propane drain (if you have one) hoses as you will never get another chance. This stuff is about \$75 in hoses and clamps.
- ◆ You should probably look at your steering cable and replace this if it has meat hooks on it because you will never get a better shot at it with everything out of the boat. Figure about \$125 for the parts. Tension the cables and oil them while everything is out.
- ◆ I suggest you put in a new through hull. The original through hull was probably supposed to be  $\frac{3}{4}$ " but it was really about  $\frac{1}{2}$ ". Take the old one out (a nice job for a day) and put a new 1" in. I spent about \$100 on parts as you need to replace the valve and fittings if you have not done this before.
- ◆ You are going to need new fuel lines. This is required because your old lines are probably copper and will leak soon if they are not already. Fortunately, you can use rubber hose. Unfortunately, you will spend an enormous amount of time getting all the fittings laid out for the minimum 5/16" fuel supply and return lines.

◆ Are we having fun yet??

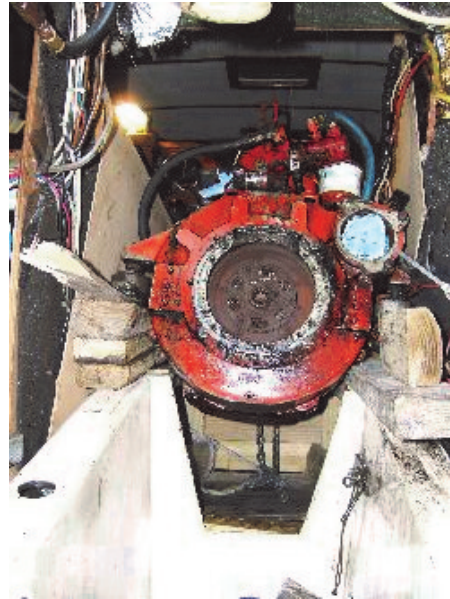
#### Replacing Process

1. Get everything out of the boat you can. I mean all the junk that you have been toting around for ever—you are going to be using every tool you have and you will need the room to store parts and work, and things are going to get very dirty. Lay some thing down on the floor of your cockpit and cabin sole to protect it. I used  $\frac{1}{4}$ " masonite and it worked fine.
2. Take everything off the engine you can: Alternator, manifold and transmission. All the plumbing, all the wiring. Take out the panel. Save your Morse cables for the throttle and gearshift as you can use them with your new engine. You can hope to sell your engine, but it may be worth more in parts. I donated mine to a technical school and kept the new parts to sell.

(See picture: Westerbeke ready)



3. You are going need a temporary bed to slide your old engine out and on to for removal (see in picture above). You will also need this bed to help you insert the new engine. I made my temporary bed out of the 2X4's with a screws and it worked beautifully.
4. Once everything is removed and the engine is unbolted you can try to move it out of the engine bed. This is not as easy as one would think. I ended up having to use a block and tackle tied to the mast step. You will find that the bell housing is so big that it will need to be jacked up above the plane of the engine mounts before you can move the engine forward. (See the pictures: aft Westerbeke 1 and 2, Westerbeke coming out)



5. The engine will go though the companionway (just) without the transmission, alternator, and manifold. The new engine will just fit with removing nothing (it is a bit shorter, but really no different in the other dimensions). (See picture: Westerbeke out)



6. The T37 engine bed must be modified for just about any engine. The W-50 with the Hurth transmission puts the shaft out about 1.57 inches lower than the plane of the engine's mounting feet. Since most new engines have the exit of the drive shaft at exactly the engine feet height, you must carefully cut down the engine bed by a bit more than that. Remember that it is much easier to shim the engine up, than to discover that you have done all the work to glass in a new bed and it is STILL too high! Also, you probably will not be able to cut it perfectly square so the

shims are going to be very important. I cut my engine bed down 2 1/2 " and ended up putting shims under all four feet from 3/8" to 5/8". (See picture: Bed with tops off)



7. Once the bed is cut down, you need to form a new bed. The old one is nicely glassed to the hull on all sides so using this framework seems like a good thing to do. You could probably get someone to fabricate a metal cap, but there were too many angles and my machinist friend and I decided that glassing would be easier and faster. We made 1" insert board for the gap in the bed on each side and wrapped each board in a couple layers of glass then we temporarily supported them in place with wire. The next day we glassed each side with three layers of glass over the top of the boards. The dirtiest part of the job is grinding down the gelcoat on the bed to accept the glass. I am still breathing the stuff a month later, even though I was running a vac all the time we were grinding. I later ran four bolts through the sides and through the boards to make sure that nothing moved. I am a belt and suspenders kind of guy. Here is a picture of the final result: (see picture; new bed 1)



8. Now you are ready to remove the water heater, water lift muffler (you need a bigger one) exhaust tube (wait till you get to the stern! What a lot of fun that is) and the shaft. This is your only chance. I have taken the shaft out by removing the rudder and the skeg housing. You may want to do this sometime to reinforce the skeg bolts and replace the rudder pintle (or is it gudgeon?) bearing—but that is another project for another time. But you are going to need a new shaft with nearly every engine you might put in this anyway. Also, you will want your new shaft coupling faced (machined) while it is on the shaft to ensure that it is true. Buy a new shaft. While you are at it, you might look at your strut—is it pink instead of bronze?? You need a new one. Also this would be a dandy time to do a cutless bearing in your strut if there is any play in it at all. This is fun, isn't it? You are also going to want to replace the stuffing box if you have not in recent haulouts since this is the time to do it—it's just another \$80.
9. With everything out and while you are waiting for the machinist to make you stuff, this is a dandy time to clean up all the old oil you spilled when taking the oil filter out and your venerable Westerbeke dripped and sprayed all over the inside of the hull. I bought some degreaser detergent at Wal Mart and it worked great. You might also want to paint the inside of your hull, but this might be a little early as you are going to be scraping around in there. You might look at your wiring to clean up the rat's nest.
10. With everything pristine, you are going to have to work backwards now. I put in the Yanmar recommended 3" tubing for exhaust. I think this is an excessive requirement, but I agree that you could not get along with the 1 and 7/8" tube you currently have. I considered going to 2.5", but that would have meant having some reducers made, so it was actually easier to just go with the larger size. You have to buy tubing (you are going to need about 16 feet of whatever you buy: it comes in 12 ft lengths and costs about \$18 a foot. You will need just over 12 feet (about 18" more) to get from the new position of the water lift muffler to the tail pipe you will need to get made. The rest you will need to get from the engine to the water lift muffler. The water lift muffler will need to be set to the aft and lower than its present position in order to get the required clearance with the exhaust manifold. You will need to make a bracket extending from the current one to hold a new, larger plywood support for your new Vernalift muffler (you will want the side in, top out model that fits the size of exhaust hose you have chosen). You will figure out how to run the piping. I glued 2X2 strips to the hull with 5200 fast set and used 3" plastic conduit clamps (Home Depot) and it worked very well. This is a couple of days of real fun. You really cannot get the loop too high. With the larger exhaust hose, you probably cannot run it over the top of the instrument panel as they did at Tartan, but you should get it as high as you can.
11. Somewhere here, you will run into a delay with the engine ordering or machinist or something. It always happens. You could begin work on the new through hull fitting. Tartan buried their flush through hull fittings (a classy idea). This makes them a bitch to remove. I drove a pine emergency peg into the outside and drilled the old one out with a 1 and 1/4" hole saw set in the center. Came out beautifully. You will probably have to chip some of the remaining ring from the flange out of there. You know how to put a flush through hull in (don't use 5200!) or you can look this up on the internet. There is very good description by a guy here in Maine who owns a Catalina. Don Casey's advice on this is, in my opinion, a host of bad ideas. Remember to use a larger size than the ID of the tubing you are going to use. In other words, use a 1" for your 3/4" full flow system. You are going to use 1" ID hose all the way through most new engines, where your W-50 had 3/4". You need more water for this new engine than they thought was needed for that Westerbeke. I put a sea strainer in my line—this is just too expensive an engine to get hooked up. I am a big fan of Vetus sea strainers as they are installed above the water line and can very easily be seen and cleaned -had one for 15 years and loved it. It is a very very tight fit, however. You should have started this in October if you thought you were going to sail this season.

13. Now you will discover that your new Yanmar has much narrower stance than your old Westerbeke. You could have built the bed from metal and built ledges out to accommodate the standard mounts. I chose to have my machinist friend rebuild the mounts to a wider stance. I am told by folks who know: do not simply shim the mounts out from the engine without welding them to something and be very careful to use bolts that fully thread into the engine. I had the engine delivered to my machinist friend. He did this modification in his shop before we lifted the engine into the boat. One way or another, you are going to need to address this issue. Cost was about \$250 to get it all set up.
14. OK. Now it is time to set the new engine in the hole. If you have done everything right, this is a lot easier than pulling the old one out.. Then comes the tricky part of shimming the engine against the shaft (immobilize the shaft in the right position with dowels so that the shaft is approximately in the correct position: fore and aft as well as as close as you can get to the tolerances of the facing coupling. **You should not adjust the engine mounts yet.** We are trying to adjust the position to determine how thick the shims should be for each foot—so you want the adjustments of to be in the middle of the range. Also, we will eventually be figuring out where to drill the holes for the mounts to the bed. My machinist friend made some nifty cleats that were tapped and fit to the underside of the bed so that the bolts through the feet screwed into them instead of nuts. Classy and very strong. So much better than bolts. Not much more work when you figure he was there to measure for the shims.



15. I think you can figure out the rest. You are going to have a devil of a time getting the Yanmar instrument panel to fit where the Westerbeke's formerly fit. It comes very close, but leaves a gap (perfect for admitting rain water) at the top. I ended up making a template from 1/4" plywood and dousing it in epoxy and putting that over the Westerbeke panel opening. Worked great. I will not go into how many hours I worked on alternatives before coming to this.
16. Especially read the instruction about breaking in your new engine. This is different that what you think. They are right.

There are things you will have to figure out for yourself. There is a Yanmar installation Manual and a Service Manual. Neither one comes with the engine. I would buy the service manual as it has a lot of useful information like wiring schematics and other stuff that is helpful. The installation manual is generic to all their engines and while I guess it was reassuring to read it, I would not think it essential.

It is a huge job. After I do the cosmetics (varnish and buff out) and replace the rigging, I hope to be ready for another 20 years of carefree cruising.