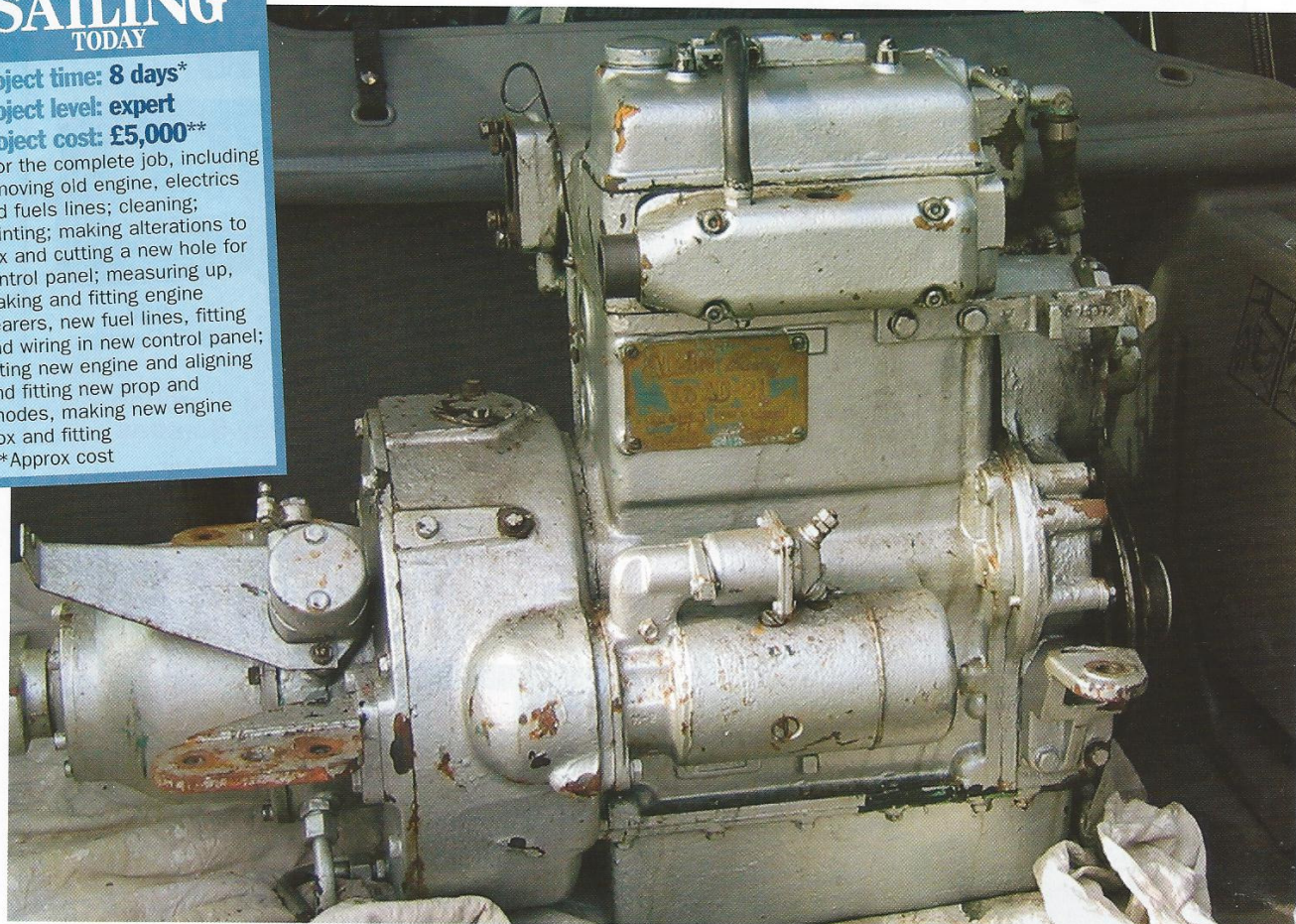


SAILING TODAY

Project time: 8 days*
Project level: expert
Project cost: £5,000**

*For the complete job, including removing old engine, electrics and fuels lines; cleaning; painting; making alterations to box and cutting a new hole for control panel; measuring up, making and fitting engine bearers, new fuel lines, fitting and wiring in new control panel; fitting new engine and aligning and fitting new prop and anodes, making new engine box and fitting
**Approx cost



How to replace... your engine



Rather than spend over £7,500 to have a new engine fitted, **Garth Cooper** tackled the job himself. Here he explains how he removed his old engine and prepared for the new...

Back in January 1999 I bought *Ngairé* and spent seven months completely refitting her. The previous owner assured me the pre-1970 Albin D21 diesel engine was in good working order, but when I launched I found there were major problems. Having spent a lot of time and money re-fitting the boat I couldn't run to a new engine, so settled for a £2,450 rebuild. In August 2000 *Ngairé* was struck by lightning and the engine took a hell of a belt. I didn't claim for a new engine at the time, although it gave me no end of trouble from then on. The Albin had done no more than 25 hours since being rebuilt, but she subsequently had so many new problems that I decided it wasn't worth

repairing. Instead, I spent the early winter months pouring over new engine brochures and hours on the telephone seeking the advice of all and sundry. Then, editor John Goode told me he'd fitted a Beta Marine 28hp unit into his Sadler 34 and was delighted with it.

I considered the 20hp model, but, after detailed calculations by Ted Spash at Beta Marine, we realised that the 28hp engine was really the one for the job. Modern, high-revving, lightweight diesels don't have the same low rpm torque as the old Albin – an ideal workboat thumper that weighed the best part of 358kg and was designed to throw an 18in diameter prop. The 28hp Beta weighs just 150kg and produces its maximum output at

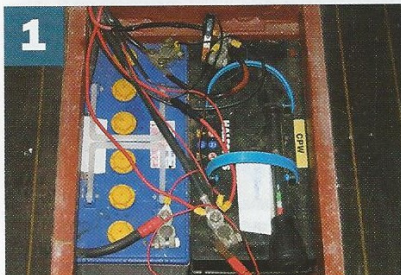
about 3,600rpm. I suspect I'll need to apply more throttle to get my 6.5 tonnes moving than I did with the Albin, but once moving I'll be able to coast along a lot more quietly.

Before placing the final order and deciding on a standard or shallow sump, the type of gearbox and control panel, the old engine had to come out, so that I could run a centre line through the prop shaft and take accurate measurements. I also had other jobs to do, including changing the water tank under the cockpit floor from a collapsible plastic thing, which I could never keep properly fresh, to a 45lt GRP tank with an inspection hatch, so that I could get in and clean it. I also needed to get the tanks out to clear the run for the exhaust system.

Step-by-step: Removing the old

Be safe

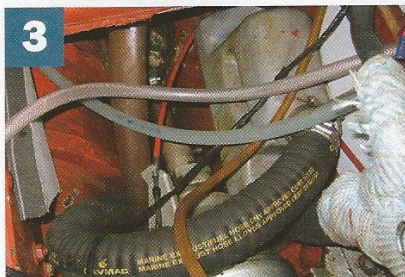
Taking an engine out isn't quite as straightforward as you might think. It's an expensive piece of equipment and needs to be treated with care. The first thing you must do is work out which bits have to be taken off and in what order, to give you easy access to such things as gearbox mountings and exhaust couplings. There are some simple safety precautions to take as well – especially if, like me, you are still afloat.



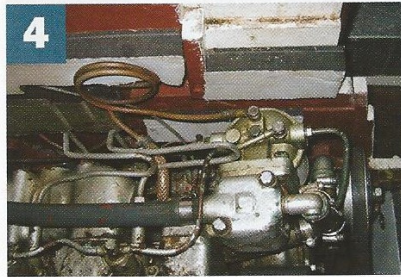
1 Start by disconnecting all the batteries (we took this opportunity to make up new wiring looms) and remove the engine wiring, control panel and manual engine shut off



2 The old Albin in all its glory – remove the engine box and local furniture to give you as much space around the engine as possible



3 Ensure the raw water-cooling inlet is shut (preferably tape it closed) and disconnect the raw water pipe to the engine. Shut the gate valve on the exhaust skin fitting. The first section of flexible exhaust pipe from the exhaust tail to the water lock box was a fiddle to get out – it went down into the bilge on one side of the prop shaft and up the other side to the water lock box



4 Disconnect the control cables and remove the mounting brackets. Ensure the fuel is shut off at the tank (you could take the opportunity to drain and flush the tank) and then disconnect the fuel lines. The old engine bears the scars of the lightning strike. The fuel filter connections are shot and the exhaust manifold face warped.



5 The underside. The exhaust manifold is warped, the Mirimax injector pump leaks oil from the feed pipe unions and way down below is the remains of both the mechanical fuel lift pump and the main oil filter – plus the engine controls

Tips

When lying across the engine, do use some padding as the projections on the top of a diesel engine can leave some pretty nasty bruises and weals if you don't



6 Remove the water pump, exhaust tail pipe, alternator and fuel filter to be able to get at the engine mounting bolts. With the alternator out the wood can be seen for the trees. One of the forward fixing studs can be got at, but before then the wiring needs sorting. Tag and name each wire before you disconnect as it saves hours of worry and testing afterwards. The engine intake heater (the plug and pipe in the air intake casing) also needs removing



7 Disconnect the prop shaft. You'll have to lie across the engine – this took a long time, made for some well-barked knuckles and a heck of a lot of patience was needed to split the coupling and then remove the machine screws. Although my prop shaft can't fall out, because the propeller is in a cutout in the rudder, I nevertheless have two Jubilee clips clamped on (with screws on opposite sides to keep a balance). The toughest bit was getting the recessed bolts out using a large Allen key



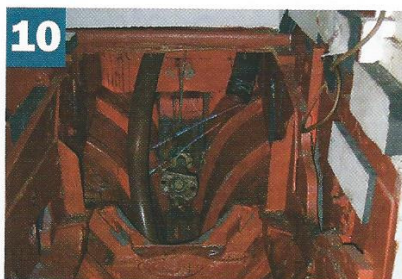
8 The final job was to undo and remove all six engine fixing bolts, or, in this case, 12mm s/s studding, which went right through the longitudinal bearers and the only way of getting at the nuts on the bottom was with some 'doctored' spanners (which thoughtfully came with the boat). Several nuts went into the muck in the bottom of the bilge to be retrieved at clean up



PRACTICAL Replacing your engine: part 1



9 Without a lift ring on this engine I had to wriggle rope and webbing slings through for the crane hook – the clearance in places was little more than $\frac{1}{4}$ in. I had intended to lift the engine out using a sheer legs and then swing it onto a pontoon trolley using the boom – but, at 358kg, I thought I might bend the boom. Instead, for £40 I arranged for it to be lifted out and ashore in one go, using the yard crane



10 With the engine out the space left behind looked huge. Now I faced the task of cleaning out and making ready for the new engine



11 The new engine control panel is twice as deep and half as wide again as the old one, so the aperture needed enlarging and a new external frame and perspex cover made. Fortunately, the set of drawings sent by Beta made the job easier



12 I removed the engine soundproofing with a sharp pallet knife – some I'll be able to re-use, but the rest will need replacing. Even with a much quieter, flexibly-mounted engine I think you can't have too much soundproofing



13 The normal method of setting up the all-important centre line, around which every other measurement must work, is through the dead centre of the stern tube. However, being afloat, the prop shaft was still in, so I used a light line tied onto the shaft about a foot back from the inboard end



14 The line was drawn forward along the top of the shaft to a cross beam on the front of the engine bearers. This was raised with shims until the line was drawn tight and true by eye. The shaft is $1\frac{1}{8}$ in diameter, so the centre line was $\frac{9}{16}$ in below this level. To check sideways I measured to the inner face of the hull planking. Subsequent measurements from the line had the difference added (below the line) or subtracted (above the line). It proved surprisingly accurate



15 With the engineering and woodwork complete, I got down to cleaning. First I had to remove the oil. I had intended to pump it through bilge filters, but diesel engineer, Royston Giddings, produced a 2m long sausage of absorbent material that retains oil and rejects water. Called a Pirtek Bund Sausage, it weighs less than $\frac{1}{2}$ lb dry and costs about £1.20. We weighed it after we'd filled it to capacity and lifted 6lbs of oil from the bilge. I've now installed a BilgeKleen bilge water filter and as my stern greaser has always ejected some grease, a small foil tray was wedged between the frames under the greaser to stop it going into the bilge



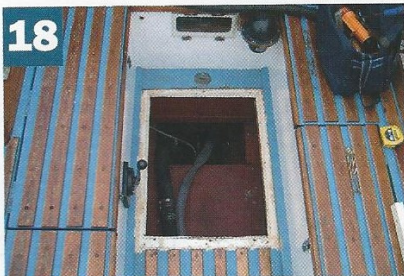
16 Getting the old steelwork out wasn't as straightforward as it looked. The old engine bearers were securely bolted to the vertical $\frac{1}{2}$ in ply side bulkheads running from just forward of the engine position, right back to the aft end of the cockpit. They are also bolted to a substantial support framework and to the galley side panels and the head of the quarter berth. These in turn are reinforced with beams bolted back to the frames. Some of the bolts attaching the metal cheeks and the steel caps on the floor frames had to be removed with a hacksaw. I left the frames bolted to the centre floor to give added support to the new engine bearer bases



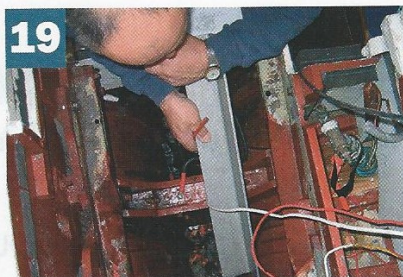
17 It was essential that the surface was free of all grease and dry enough to ensure the new bilge paint adhered properly. After removing the oil and crud I washed the bilges down with Jizer and a hand scrubber, rinsing off and washing again with liquid soap. I left it for a week to dry before painting

Tip

When working in a tight spot tie thin cord or even thread to the tool you're using so that when you drop it in the bilge you can get it out easily



18 The existing exhaust pipe was removed and a new one run down the port side under the locker. I originally chose a high-riser exhaust rather than follow the modern practice of a water lock in the bilge, but Beta advised me to go for an 8in high dry riser, dropping into a water-lock silencer mounted about 4in below outlet level. I could do this by mounting the box on the side of the engine compartment, although it would mean reinstating the anti-siphon device. A dry riser as tall as I was originally planning would have meant having a heavy metal pipe that could snap the exhaust manifold coupling as the engine moved, but the pipe work remained rigid



19 Every measurement was checked and rechecked; here my helper Royston sizes up the new engine bearer support caps. We elected in the end to retain much of the side panelling and the existing engine bearers and to cap these with new galvanised angle-iron cap plates as they were within the adjustable tolerance allowed for by the new engine feet



20 The fuel line filters and a new filter for the engine raw water intake were mounted on a board bolted to the side of the engine box. This may look like over filtering, but as the bottom of the tank is still 3in above the head of the engine, the mechanical lift pump will have little load to contend with. I then removed the old fuel lines and measured up for the new ones. The return will go directly from the injector pickups to the tank. Because the tank is not easily accessible I joined to the original hard copper lines



21 The new fuel line fixed in place using plastic screw-on cable ties. I'm using Silverflex flexible fuel lines to reduce leakage potential – as the old rigid copper lines had four connectors in each. The pipes, which have a rubber, fuel-grade interior covered with a steel mesh encased in a flexible plastic outer, were then connected and clipped back to bulkheads. They're also half-hour fire resistant



22 The heavy-duty wiring from the batteries, which ran in a loose loom under the floorboards, had always been a source of irritation. Now was a good opportunity to fit a conduit – with additional mousers, new circuit breakers and a central junction box to reduce the amount of wiring that went to the batteries. I also decided to move the filter unit for the electric bilge pump into a more readily accessible position in the engine bay, renewing the wiring and tacking it down



23 The new engine bearers bolted in place using 10-gauge s/s bolts. The bolts went down through the existing wooden bearers and through the side panels. The engine will be offered into place and lined up, then the holes for the feet marked and the engine lifted out again, so I can drill and tap the fixing holes with the bearers in place

Next month

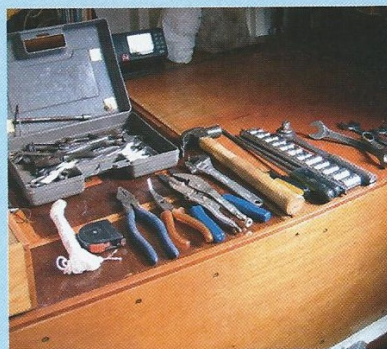
In Part 2 next month, Garth Cooper will explain the benefits of the new Beta BD1005 engine and how he overcame the problems of installing it into *Ngaire*.

Specifications

Beta Marine BD1005

Base unit	Kubota 3 cylinder, indirect injection four-stroke diesel Cast iron head and block
Capacity	1,001cc
Bore and stroke	76mmx73.6mm
Output at flywheel	28hp @ 3,600rpm 25hp @ 3,000rpm
Nett weight	150kg
Fuel	@3,000rpm 3.5lt per hour
Electrics	12-volt starter, 70 amp alternator

Tools & contacts



Ready to roll. A selection of the tools needed to remove the engine. As it turned out, the most used were the 13 and 14mm ring spanners, the wire cutters and long-handled screwdriver.

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