Land Rover Perkins Prima Engine Conversion

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Abstract

The Perkins Prima powered Montego's reputation for being frugal combined with the low value of Montegos make it an excelent choice as a donor vehicle for a Land Rover engine conversion.

The Prima engine was one of the first high speed turbocharged direct injection diesel engine fitted to a passenger car. The engine has a similar power delivery to the Land Rover 2 1/4 petrol engine and unlike most other, usually van derived, diesel alternatives maximum rpm is in exesses of five thousand rpm making it work well with Land Rover gearing.

The modifications/fabrications for the conversion are fairly simple and no modification to chassis or bulkhead should be required.

A converted SWB should do somewhere between 30-40mpg[I average 36mpg]. It will be drivable at motorway speeds and will generally keep up with traffic that a 2.25 Land Rover diesel wouldn't.

Contents

1 Introduction

Montegos powered by Perkins Prima Tdi engines have fuel consumption figures up to 60mpg, this makes the engine a good choice if your aiming for better fuel economy, I get an average of 36mpg in my Lightweight[1] which is fitted with a Prima.

Cost of Conversion. The major cost will be the custom parts, adapter and mounts. I can only speculate on the total costs you will incur, but I would expect it to be less than £500 total. You will recover some of this cost by selling your old engine[2].

The expected return on your money can be seen in Figure1. This is based on current fuel prices and assumes 35mpg with a Prima engine and 20 mpg with petrol Land Rover power. The cost of conversion to LPG would probably be more than the Prima conversion cost[if not greater] and the running costs with LPG will be pretty similar to a Montego engine. We won't mention hassles with gas tanks and certificates, in fact I toyed with the idea of LPG but couldn't find anywhere unobtrusive to put the tanks supplied with a cheap setup.

The conversion is pretty much a matter of bolting bit's together, with some exceptions. A throttle cable is needed or modifications to the original rod throttle. Some wiring changes will be necessary. An exhaust system will need to be fabricated. No alterations to the chassis or bulkhead are required. I will try and outline the options for all the problems I think you might encounter. I don't know how much, or what, information or advice is needed, so bear with me.

There are several websites detailing this conversion, and a few magazine articles have been written on the subject. I would have a look at the websites and read this before you start. If your in any doubt about anything e-mail me. I think once you start its all fairly obvious and there shouldn't be any problems. I have listed the two references I found on Google, Wittsend's site[2] is probably the best site on the subject, I wouldn't grind all the crankshaft register off as he has done otherwise it's all pretty good. The material on the Dudleigh Engineering[3] site is pretty similar to the content on Wittsends site. Dudleigh's website comments on why their adapters are made from Cast Iron are possibly there because they get asked why my adapters are made from aluminium - my adapters are cast in LM25T6 and weigh around 6kg - don't ask me why they[Dudleigh] want heavy adapters. I didn't give there reasoning for heavy adapters any serious consideration but if you want more weight in the middle of your Landy eat a few more pies.

2 Engine.

2.1 Engine Source.

1. Turbo Charged[TDi]
   (a) Montego cars and estates
   (b) Maestro Clubman cars
   (c) Road sweeping machines
   (d) Stationary and marine engines
2. Normally Aspirated[N/A]
   (a) Montego vans
   (b) Maestro cars and vans

[1] Lightweights are actually slightly heavier than normal SWB?

[2] I had loads of offers on my old engine while it was in the vehicle and could be seen running, so it might be a good idea to arrange sale and conversion to coincide. As a last resort a reconditioner will buy your old engine as a core.

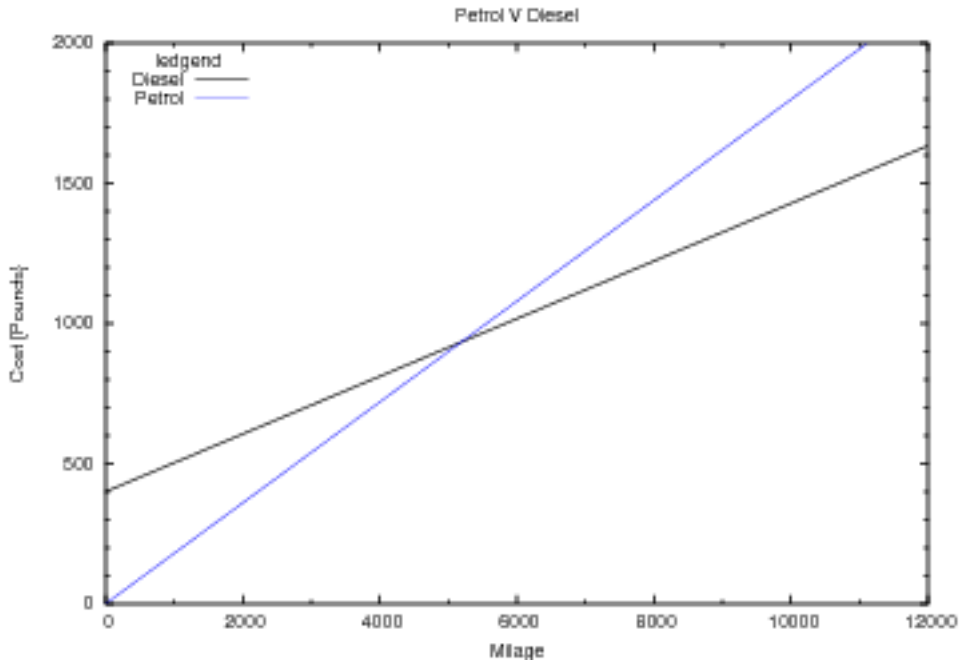

Figure 1: Graph comparing cost of running a Prima diesel and LR petrol, the break even point is the intersection of the two lines.

(c) Sherpa and LDV vans

(d) Stationary and marine engines

2.2 Engine Differences

TDi and N/A engines have some fundamental differences, mechanical as well as fueling. The major mechanical ones being compression ratio and piston cooling[?]. The injection pump is tuned to suit the type of engine and expected use, so I would expect an engine from a car to be set up with the flexibility required. There are ancillary differences between engines, the most obvious being different water and oil pumps on van engines. Sumps from cars have smaller capacity than vans. TDi engines have a different breather system with two hoses to the sump.

If you want a TDi get one rather than getting a N/A engine and retrofitting the turbo, which is most likely going to be more trouble than buying a turbo engine.

If you are using a N/A engine you will need to change some ancillaries to fit it, unless it's from a Maestro[the Maestro uses the Montego ancillaries].

Multistage and single stage injection[3]. In ˜1990 they changed the injectors to lower the noise and emissions. I have seen specifications claiming higher and some claiming lower power output's with the two stage injectors. I wouldn't worry which ones you get. There are other differences between the engines fitted with the multistage injectors.

EGR, exhaust gas recirculation, This is an emission control system that allows exhaust gas to be recirculated to lower combustion temperatures, reducing NO_X emissions. You can remove or disable the unit. Or even leave it as installed and working[what a novel idea]. If you remove the control gear the valve will stay shut. If you remove the EGR you will need to block the holes in the manifolds. The EGR control is located on the bracket with the glow plug relay. Stopping EGR function will not affect your engine[it should improve it].

2.3 Engine Problems Mileage and Stuff

The engine is said to have a service life in excess of 300,000 miles so don't shy away from hi-mile engines just because of the mileage. The most common problem with these engines is the head-gasket, but a new head-gasket usually cures it. the head gasket go around the end cylinders at the left hand side of the block, the gaskets corrode and then blow. Irt's not uncommon to see the head corroded so there isn't

[3]Two stage injectors have fuel pipes screwed to the top of the injector and the spill pipes bolted to the sides.

enough material around the water way to support the fire ring, this can be easily fixed by building the area up with weld and any shop that does heads should be able to do it.

Unless you have absolute proof of when the cambelt was changed assume it needs changing, I outline how to replace it in A.2. You will find the Haynes book of Lies about rover diesel engines in most public libraries, this book will have wiring diagrams and other stuff that will be handy to know.

3 Conversion and Land Rovers

Land Rover engines are - the petrol anyway - strong and durable units, designed a long time ago with low reving high torque needs in mind. The petrol engine is very inefficient when compared to a modern engine. Land Rover 2 1/4 diesels are slow and not very economical.

For more power the obvious choice is a Rover V8. In my experience the V8 used no more fuel than the 2.25 litre petrol[when carefully driven] and it's a nice little engine which suit's the Land Rover.

Ford V6. Why fit a V6 it's not as good as the V8, the engine parts cost more and they use just as much fuel.

The choice of diesel is quite wide, any truck with a 2-3 litre diesel is a potential donor. Jap diesels seem good, but spares can be frighteningly expensive.

3.1 Series One Land Rovers

I can't speak from first hand experience, I can only reiterate others comments. Some SI gearboxes accept the 4 cylinder bell-housing from a series II. which means you can use the adapter designed for SII gearboxes to bolt the Prima engine to bell-housing. I gather some of them use the small clutch housing, like 6 cyl Landies and don't accept a SII bellhousing so you can't bolt an adapter to them. Most people install a 2A/III box when they do the conversion. The only problem I have been told about that doing the conversion is the fact the axle and oil filter are closer than on a series 2A/III.

3.2 Series II and III Land Rovers

My adapter is designed for the series II, IIA and III 4 cylinder Land Rovers with a 9.5 inch Land Rover clutch. Series II and III gearboxes are essentially the same as far as the conversion goes. 6Cyl gearboxes can have a 4Cyl bellhousing installed on them.

3.3 90/110 Land Rovers

You can convert Defenders/90/110s by using bolt in bits.

The Sherpa van comes with an LT77 gearbox, which has a different input shaft and bell-housing to a Land Rover LT77. So you modify a Sherpa LT77 gearbox by rebuilding it with parts from a Land Rover LT77. The aim is a gearbox which both the prima engine and LT230 transfer box will bolt to. someone I have talked to said he used the Land Rover LT77 and Sherpa bell-housing bolted to a Land Rover LT77, without any modifications to the box.

This route can be taken to convert series Land Rovers, install the LT77, but you will have to change the box and transfer box and then either do the transfer box diff conversion or fit a Range Rover front axle. The people I have spoken to who have converted series vehicles like this say they would use an adapter and the stock gearbox if they did the conversion again.

My adapter will bolt a Prima directly to the 90/110 LT77 bell-housing. The engine mounts on 90/110 are different to series landies though.

3.4 Other Parts and Systems Upgrading

If you have manual brakes you will find a change to power brakes worth while. At one time I used to use Girling remote servos on Landy brakes to. The girling remote servos are easy to fit and used to be easily available in every scrapyard, they were fitted to numerous English cars[what's one of those] and came in several ratios between 2:1 up to 5:1. I seem to remember using an ATE servo off a BMW once? The best thing is probably to change to a Series III power brake setup, quite cheap and should all fit easily. an ionsurance company will probably take a better view of an update/retrofit rather than a home built system. Your series gear box will be fine.

3.5 Insurance and Modifications

You should tell your Insurance company about any modifications.

If you are updating something with original equipment parts it's unlikely any one can really question any changes, so a brake update is better if you retrofit a Land Rover system from the insurance point of view.

When you swap engines it's wise to inform them, if you were to make a claim and the vehicle was checked an alternative engine would be a good excuse to wriggle out of a claim. Saying that I have never seen an assessor look at an engine to see what it was. But best be safe. You will probably find the modification won't increase your premiums much if at all.

You should also change the engine details on the log book.

4 Parts Required for the Prima Conversion

1. Engine.
2. Adapter plate.
3. Engine mounts.
4. Crankshaft pilot bearing, or adapter bush.
5. Radiator hoses.
6. Wiring sundries.
7. Fuel lines.
8. Exhaust.
9. Electric fan.
10. Throttle cable.
11. A 975mm Fan belt, the part number will probably have 975 in it.
12. Fasteners, I will list individual Fasteners that I know you will need in A.4.

The above should be all the parts required.

4.1 Parts to Keep From the Montego

Assuming you had a Montego.

1. Oil cooler, very efficient laminar flow type oil-water cooler.
2. Radiator hoses, you won't necessarily use them but they might be useful.
3. The engine wiring harness and some of the main harness, including the connector blocks.
4. The rad fan, complete with shroud.
5. The exhaust system.
6. The throttle cable.
7. Fuel filter.

If you didn't save these parts you will need to obtain suitable alternative parts. A walk around a scrap yard should net all the parts required. A rad fan is pretty much useless without a shroud. A fiesta or Mondeo fan look like they would be OK. You will find There is room between the engine and radiator to mount a fan on the back of the rad. Of course the fan can be spun the opposite way and placed in front of the rad. The blades aren't always symmetrical so it might be more efficient spinning the right way.

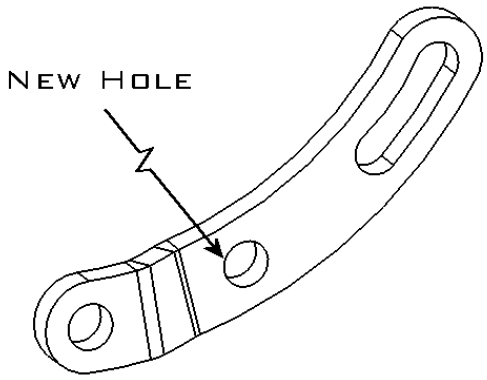

Figure 2: The alternator strap, the arrow shows the position of 'new' 10mm hole.

4.2 Other Parts Needed

1. Starter motor from a 1986-1994 Sherpa or LDV 2.0 Di van, these are 2.0 Di and 200D. If you look in some listings a 300 or 400series is also listed as having the 2.0 litre at one time. These are vans fitted with the normally aspirated Perkins Prima engine. New ones are exceedingly expensive.
2. A flywheel from the same source as the starter motor.
3. Fuel pipe to extend the fuel pipe to the filter and make a return.
4. Some wiring components to complete/alter your wiring.
5. A crankshaft oil seal is required, it goes in the adapter plate, it's a 4.125 x 3.5 x .375 oil seal and is available from all factors, for use on any of the applications with this engine[Sherpa Montego].
6. Some more radiator hoses and hose clamps, three SIII bottom hoses and a top hose combined with bits of Montego hose will do the job.

5 Before Installation

5.1 Engine

Clean the engine thoroughly and examine for water and oil leaks, this is the time to fix them. If you pressure wash the engine watch out for the engine numbers, I have blown several off when cleaning engines with a pressure washer.

As said elsewhere a new cam belt isn't a bad idea, unless the engine came with proof of when the belt was replaced assume it needs replacing, see appendix A.2 for belt change instruction.

How much you do in the way of servicing the engine is up to you, it's probably not a bad idea to check everything you can.

If you have the flat heater that's mounted centrally on the bulkhead the right hand heater hose might interfere with the vacuum hose to the brakes. Either shift the heater over or remove the hose fitting from the vacuum pump and bend it[cut it in half at an angle, rotate one part 180 degrees and weld back together] then push it back into the vacuum pump. The tube is a press fit, if you warm the pump up the steel tube will pull out quite easily, replace it in a similar manner. To move heater over cut an extra hole with a hole saw and shift heater over.

The pressure signal pipe, from the turbo to the fuel pump will interfere with the turbo inlet hose. The pipe is connected to the inlet side of the turbo by a fitting in the inlet side of the turbo directly above the air inlet. You will see there is a plug diametrically opposite, below the inlet, move the pipe and fitting to the lower tapping, block the upper one with the plug that was blocking the lower hole. Of course you could blank off the signal pipe and tap a hole in the inlet to take the pressure signal, it will make fitting stuff like a boost gauge easier.

Check all the threads in the block for the adapter and engine mounts are clean. I necessary borrow an M10 tap to clean them out.

Figure 3: Pilot bush adapter bush, the bronze bush has been fitted.

Check the adapter fit on the bell-housing, sometimes bell-housing nuts have distorted holes, if all the studs don't easily go through the holes take a small round file to the holes and tidy up where they are distorted.

I don't supply bolts to fit the adapter, see appendix 3. The bellhousing studs from your old engine will be required. SeeA.4.1 on how to remove studs.

Check all bolt holes are tapped deep enough to install the bolts, just wind the bolt in and check that it will grip whatever its going to be holding, unless it obvious that the thread is deep enough it's best to make sure. Generally I like to make thread depths 1.5 times the diameter.

Remove the alternator and the cast iron alternator bracket from the lower left hand side of the block, The LH engine mount goes where this was located. Don't bin the alternator adjustment strap[the bit of metal with a hole and a slot in it]. You can bolt the new alternator bracket to the engine now if you want, don't bolt the alternator on till the engine is in though.

The alternator Strap[the adjustable link] from the Montego fits when you have drilled an extra 10 mm hole in it, you need to drill the hole as far from the slot as you can get but on the same surface as the slot. See Figure 2 The RH engine mount has a lug threaded M10 to bolt the alternator strap to, don't put a bolt that is to long in this as the hole is blind.

This is a good time to paint the bulkhead, fit new footwells or any other repairs that the engine could conceivably get in the way of carrying out, I sprayed my bulkhead while the engine was out.

The engine mounts are made to shift the engine forwards 10 mm, lossen the gearbox mounts and it will move, you will possibly have to open the holes in the box mounts with a file to get the engine forwards 10 mm though.

5.2 Fit Adapter plate to engine.

The Prima is sealed to the adapter plate with a gasket, it needs to be oil-tight around the crankshaft oil seal. You can reuse, or replace, this gasket or just seal it on with silicon[RTV]. Before bolting the adapter in put the oil seal in the adapter, it's easier to make sure your installing the oil seal normal to the block face when the adapter is loose, it needs to go in square and should be below the level of the 'hub' face of the adapter, when the adapter is bolted on the oil seal lip should be riding on the crankshaft and the shell of the seal must be clear of the flywheel.

Fit the adapter with whatever sealant system you have decided on, snug all the bolts up and tighten them in a sequence. If you snug them up and leave it to settle/rtv to start curing then tighten fully after a few hours, it shouldn't leak. If it does leak you will have to remove the engine to seal it, whether you buy a gasket is up to you.

5.3 Crankshaft Pilot bush.

The input shaft requires a bush in the crankshaft to retain it concentric with the crankshaft there are two ways of accomplishing this.

5.3.1 Bearing

The way most people have do this is to fit a ball race in the 1.875[inch] bore in the flywheel. The depth of the 1.875[inch] bore is approx .32[inch] and the bearing is .5[inch] thick. The bearing should be installed almost .5[inch] into the flywheel and two washers installed under opposite flywheel bolts to prevent the bearing spinning in the flywheel. So you need to grind approx .150[inch] off the crankshaft register so the bearing goes further into the flywheel. Wind a tie wrap around the register so you have a guide to grind to, get your angle grinder and grind some of the register off. when you have done it get a file and dress

the burred edge so you can get the flywheel on. I would do this with the adapter off the engine, in fact if you still have the Montego adapter with oil seal, put it back on while you doing this. Other wise jam something in the gap around the mains and tape up the oil seal surface[if you have rag nearby make sure you don't 'grab' it with the grinder]. Be careful of the oil seal surface and try not to squirt iron filings into the mains.

5.3.2 Bush and Adapter.

I fitted an aluminium bush into crank on my Land Rover, the bush takes the original bronze pilot bush from a Land Rover crankshaft. See Figure 3.

Remove the bush from the Land Rover flywheel, I think you will find a socket that will work as a drift to do this[OD needs to be around 1inch]. Before you fit the bush in the bush[maybe I should call the aluminium bit an adapter] take any burrs off the bronze bush that it got when you hammered it out of the flywheel. You can press the bush into the adapter with a vice, or hammer it in, if you hammer it in check it still goes over the gearbox shaft before installing it in the crank. Before installing the Adapter in the crank find a suitable drift to hammer it in with, the drift should have an OD less than .875 inch so you will be hammering against the inside of the adapter; check the large diameter of the bush passes through the hole in the centre of the flywheel. Stick the adapter in your freezer for an hour or so. Check the end of the crankshaft is clean and bolt the flywheel in place.

When the bush is nice and cold get it out of the freezer[hold it with a bit of rag to prevent heating it] and knock it in to the end of the crank using a hammer and the drift you found earlier. I thread the bushes M12 so the bush can be extracted easily.

The flywheel is quite hard to wiggle off, put two clutch cover bolts in opposite holes and use them to hold the flywheel, you should be able to wiggle the flywheel and get it off over the bush[you did push the bush through the flywheel earlier didn't you]. This seems to work OK. Without a more complicated bush or pressing a steel bush into the flywheel I can't find a better alternative to one of the above methods.

5.4 Chassis Mounts.

You will find new rubber engine mounts have M10 studs and are sometimes a tight fit in the chassis slots, check this and run a file through the slots if they are tight. It's suggested you use Diesel mounts, I haven't tried petrol mounts to see what the differance. The diesel mounts are stiffer. You still need the right hand 'wedge' piece that was used with the Land Rover engine. When the mounts are all in place, make sure that the head of the bolt between the 'wedge' and the chassis, on the right hand mount, is not touching the isolated upper part of the mount. As mentioned elsewhere the gearbox will need sliding forwards.

5.5 Clutch Hose.

I installed a one piece clutch hose so I could route it differently and keep the bulkhead free of clutter, it doesn't use the bulkhead tab. This makes a bit more room where the throttle cable and air inlet hose is going. Not necessary but it makes things easier. I used Aeroquip it's the cheap easy way to make hydraulic lines.

5.6 Wiring.

I did the wiring prior to fitting the engine. I altered a Montego engine harness so the wires are all the right lengths and they run to the engine neatly near the starter motor, I bolted the entire Montego heater relay with it's mounting plate to the top of the passenger foot well, see Figure 4. I grafted the block connectors off the Montego main harness into the land rover harness so the engine harness can be unplugged.

I removed the starter solenoid from the bulkhead, you can use the Montego starter relay, yellow relay tie wrape to the bulkhead strut in Figure4. The old solenoid can be used to bolt the starter wires together, if you don't have new starter cable or can't splice the two original wires together. I replaced the starter cable with a single cable that goes around the front of the engine, attached to the cross member under the rad, along the left hand chassis leg and up the side of the block to the starter.

The wiring needed is:

A wire from the ignition 'on' position to the fuel pump solenoid[basically your old coil power wire].You will want to remove the ignition ballast if you had one. This ignition wire applies power to the fuel pump

Figure 4: The left foot well, showing the relays and the fuel filter, the red and yellow relay are fan and starter respectivly.

solenoid allowing the flow of fuel to the injectors, it also supplies power to the fuel advance temperature sender, the fast idle solenoid and power to the two relays[glow plug warning lamp and glow plug relay].

A wire from the ignition switch, on when the switch is in the starting position, supplies power to the starter relay. The wire from the ign' switch to the original solenoid is the one for this.

A wire from the warning lamp relay to a warning lamp on the dash, I use the cold start light which was connected to the choke knob for this.

The alternator can be wired directly to the battery lead on the starter.

The power from the battery lead to the glow plug relay should be fused, they use fusible links in Monty harness, I reused them.

The oil pressure wire is best left where it is, it's roughly in the right position for the Montego engine.

The original Monty temp sender works with my Mini temp gauge, take the temp sender out and stick it in boiling water and check your gauge to see what it's reading, you can alter the reading by changing the resistance with resistors.

Someones digram shows a 600Ohm resistor across the ignition light, it's there to ensure the glow plugs turn off even if the alternator isn't charging, not many people fit it.

6 Fitting the Engine

I found that it was almost impossible to fit the engine on my own with both engine mounts bolted to the block, I suggest you fit the engine to the gearbox before bolting the mounts to the engine. The engine should just slide in, no force should be required.

I leave two opposite studs out of the adapter and install a couple of longer 'guide studs' in their places to help in initial alignment. When the gap between bell-housing and adapter face is less than on inch the input shaft should be just entering the bush. If it doesn't slide in further, wiggle the motor and maybe rotate the engine a bit as you wiggle[to line the splines up] it should slide in. don't force it in. I find they go in very easily without the engine mounts on.

when the box/adapter are together fit the nuts and washers and do them up.

Bolt the right hand rubber mount to the 'wedge' and bolt that to the chassis. You can bolt the left hand rubber mount to the chassis now or after bolting the engine mounts on the block. There is room to bolt the mounts to the block when it's all dropped in place.

6.1 Throttle Cable

You can use the Land Rover throttle linkage and connect it in whatever way you find easiest, I have seen many variations.

If you want to use the Montego throttle cable I can suggest a way.

Remove all the original linkages.

Remove the crank clamped to the throttle cross-shaft.

Cut clearance for the crank in the bit of steel sheet that the throttle cross shaft passes through. turn the sheet and crank around so the crank points at the bulkhead.

So now you have the crank bolted on backwards and it will pull on a cable bolted to the bulkhead.

To mount the cable outer to the bulkhead you will need a short piece of angle with holes for mounting bolts and a hole for the cable to pass through. The angle needs bolting to the bulkhead a few inches above the end of the crank when it's pointing up at about 45 degrees.

You will have to find a cable holder to fit in the crank, my box of old carb bits always gives up these parts. When I have to make a cable inner retainer I tend to find a suitable nut and bolt to fit in the throttle shaft crank, drill a hole radially through the bolt head and saw a slot through the end of the head into the hole. The hole should be large enough for cable and one side of the bolt should have the hole enlarged so the cable nipple is retained.

Cable nipples can be bought if you have a cable shop near where you live or you can make them, old MIG welding contact tips make OK throttle cable nipples, or even the brass bits with screws in from 13A plugs. if you soldering the thing to do is pass the cable through the hole and then open it out so there is no way it will be pulled through once it is soldered on. Don't overheat the cable as it will break easily.

You need to decide how much travel you need, I usually weld a washer on the end of the crank so it's slightly longer and it works nicely with the original fuel pump fittings, you can off course reposition the ball on the fuel pump so the pedal doesn't require as much travel.

6.2 Radiator Hoses

You can plumb the coolant system with three Land Rover bottom hoses and one top hose.

You will need a branch from the bottom hose to the oil cooler, a section of the Montego bottom hose with it's branch can be used in the bottom hose. So put a Landy bottom hose on the bottom rad fitting and one on the water-pump then join them together with a section of Montego hose with the branch for the oil cooler in it. Or join them with a length of aluminium pipe that fit's between the two, it's about 14 [inch] long, and weld a branch into the tube for the cooler .

The top hose on mine is a Montego hose[slightly more than 90degrees] and a Land Rover top hose with a 4[inch] piece of aluminium tube between the two.

You will need to join your heater hoses to the oil cooler and engine, I have seen this done with copper plumbing fittings-13mm pipe to 19mm pipe?

6.3 Water Pipes

I get asked all the time where the water pipes go, in the absence of a diagram and the fact I lost all my photos, I shall describe the layout.

The radiator[Montego] has an inlet in the upper right-hand[4] corner and an outlet in the lower left hand corner.

The bottom radiator hose bottom hose goes to the lower left hand inlet on the water pump, it also has a branch which goes to the oil cooler. The oil cooler is then plumbed to the heater,

The upper radiator hose goes to the upper fitting on the left hand side of the water pump and has a branch to the expansion tank.

The second heater pipe is fed from the thermostat housing, the heater pipes are 3/4 [inch] on the Prima and 1/2 [inch] on the Land Rover.

6.4 Electrics

References

[1] http://www.integerspin.co.uk

[2] http://www.nhua.co.uk/conversion/perkins.htm

[3] http://www.dudleigh.com

[4] http://www.integerspin.co.uk/downloads/pilot_bush.pdf

A Appendix

A.1 Parts List

1. Radiator hoses

[4] Right hand being the right-hand side when your sitting in the drivers seat.

2. Fuel hoses
3. Wiring
4. Exhaust down-pipe from Montego, Ti pn:
5. Bolts, listed in A.4
6. Fan-belt, 975 mm long.

A.2 Timing Belt Change

Three pins are required to lock the timing, 6.75mm, 6.8mm or 13/64 inch drills will do.

- The crankshaft is locked with a pin through a hole in the adapter plate into a hole in the flywheel. The hole is located on the right hand side of the adapter. Once the pin is in place don't attempt to turn the crank as you might snap the pin.
- The cam-shaft is locked with a pin through the cam cover into the cam. The hole in the cam cover is found by removing an 8mm bolt located centraly above the cam and directly behind the cam-belt cover. Remove the bolt and rotate the engine and you will find a hole in the cam that lines up with the bolt hole. At TDC on cylinder one you can Fit a pin into this to positivly locate the camshaft.
- The injection pump has a 6.8mm hole in the pulley hub and a hole in the pump body. There is a slot at 11 o'clock on the injection pump pulley the hole in the pulley hub is in that slot, the holes accept a 6.8mm pin to time the pump.

The engine shouldn't be rotated with the belt removed unless you know what your doing. Remove the alternator belt. The crank-shaft pulley/damper should be removed, remove the crank-shaft bolt and pull the pulley off. Remove the cam-belt cover. Rotate the engine to clockwise to TDC, look in the hole in the cam cover and rotate engine till the hole in the cam lines up. Always rotate the engine clockwise. Look in the hole in the adapter and see if you can see the hole in the flywheel. Timing pins should freely slide into the relevant holes. The cam and pump pulleys are meant to be loosened on their hubs, so the timing can be corrected accuratly but I haven't needed to do this. When the engine is rotated so all three pins easily slide into the holes put the crank and cam pins in place, then slaken the belt tensioner and remove the old belt. The new belt should be held taught between the pulleys on the left-hand side of the engine, the belt tensioner is on the right. Put the belt half way on the crank-shaft pulley and pull it tight[without moving the crank-shaft] and slide it half way over the pump pulley and then get the belt teeth engaged on the cam pulley and push the belt back so it's riding on the pulleys as it should be. The belt on the tensioner side of belt run will be loose, but the belt on the other side should be tight. The fuel pump pin should slide into the pump and pulley.

When the belt is installed correctly it can be tensioned, make sure the belt is parallel to the pulley faces then tension so you can twist the belt about about 45^0 by hand, the best place to check is between the fuel pump and cam.

Remove the timing pins, replace the pulley and crankshaft bolt. Rotate the engine a few times and find TDC with the flywheel/adapter holes. check the cam and fuel pump timing. the cam and fuel pump can be be retimed by loosening the bolts that lock the pulley outer to the hubs and rotating the engine then relocking the pulley to hub. After rotating the engine recheck belt tension

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A.3 Fan[alternator] Belt Alignment

The fan belt will last longer and run smoother if it's in alignment. The easiest way to check it is to put the belt on tighten it and look along the belt run, it should be fairly obvious if the belt is leaving the pulley at an angle. A proper check can be made with a straight edge placed across the water pump pulley and the distance from the edge of the alternator pulley to measured, the gap between the straight edge and the pulley should be is equal to the differance in the thickness of the front of the water pump pulley and the alternator pulley.

to correct any misalignment put shims[washers] between the alternator mounts and alternator, alignment within a mm will be fine.

A.4 Fasteners

1. 8 off M10x25, these bolts fasten the adapter to the block. I use 30 mm bolts and washers.
2. 3 off M8x25, these are the small bolts that surround the oil seal and fasten the adapter to the block. I use 20 mm bolts and washers.
3. 7 off M10x25 to fasten the LH engine mount and alternator mount to the block. I use 25 mm bolts.
4. 4 off M10x30 to fasten the RH engine mount to the block.
5. 1 off M12x65 This fastens the block to the adapter and is located directly below the starter motor.
6. 2 off M10x25 or 30 to bolt the starter to the adapter, use socket heads or reduced head bolts from the Montego. I used socket heads as they are easy to access if you use an allen key in a 3/8 drive socket with an extension. But if you don't have these allen keys it might be easier to hexagon head bolts or studs.
7. 12 off 3/8 UNC to UNF studs and nuts to bolt the adapter to the bell-housing. you can reuse the old studs and nuts, don't reuse any damaged studs as they might damage the threads in the adapter. You can buy new studs from Land Rover dealers, they are about £4 a set.
8. 2 off M10x25 nuts and bolts to fasten the

If you had a Montego you should have all the above bolts left over after removing the engine, I would use the Montego wasted head, washer headed, bolts where possible. I can supply a set of bolts if needed.

My bike background means I am rather fond of loctite, it never hurt to loctite everything.

A.4.1 Removing Bellhousing Studs.

To remove studs either use a proprietry tool or use two nuts.

Using two nuts is the simplest way. Wind two nuts on to a stud, wind them on so the upper one is threaded onto the stud all the way. get two spanners that fit and try and undo the lower nut while tightening the upper nut. Put more force on the nut that your turning in the direction you want the stud to go. That was easy wasn't it. If any studs are damaged bin them.

A.5 Pilot Bush

The bearing is .875x1.875x.5 and should have two seals, one Part number is KLNJ7/8.

The Aluminum adapter is made from 2" H30 a drawing of the adapter is on the internet[4].

A.6 Exhaust

The Montego exhaust downpipe, see the Bosal online catalogue for the part number, has a flexible joint which should reduce vibration.

The front pipe can be cut and re-welded so it fits over the crossmember and goes between the handrake drum and chassis rail. I managed to fit the Montego flatish box up under the rear bed inthe place the original Land Rover box had been. I used the entire montego exhaust apart from the rotten round box.

Several conversions I have seen use flexible exhaust attached to the Montego downpipe and the exhaust is routed across and exits the Landrover under the nearside door.

If you have a welder it's easy to make any shape of pipe from straight, or bent, pipe. Make an angled cut, rotating one piece and re-weld, it's possible to form a bend like this.