3CTE cylinder head swop (1996 model) update version 3 - Aug 06.

Most of the preparatory work is the same as changing the cambelt and there are several good tutorials on that. It is worth reading them first for another take on how to get that far. Colin Wilson's site gave me the confidence to change my first belt and has the best pics by far of the cambelt setup. http://www.cwwilson.dsl.pipex.com/

Preparation

1) There are possibly 70-80 nuts and bolts – so be organised and have jars or similar to mark which ones came from where. Believe me you won't remember in week's time when it comes to putting it back together. Take digital pics or refer to the ones in this tutorial for location of pipes/cables/bolts etc.
2) I would not want to do this job at the side of the road.
3) Jack the car up as far as you can get it, ramps are good.
4) Drain the radiator and engine water drain.
5) Cover the driver's door with a sheet and have a small piece of wood to jam the driver's door hinge open (it will try to close all the time due to being jacked up).
6) You do not have to drain the oil as the sump turbo oil return pipe is just above the oil level. The oil filter (if one of the large ones) can just get in the way and should be removed (it will then slowly drip oil forever). If the smaller one leave in place to stop drips.

Drivers seat out

Floor/seat/carpet removal is covered very well in this article with good pics.
http://homepage.ntlworld.com/mick.richardson535/toyota_lucida_vacuum_pump.htm
Take off the little plastic covers that cover the two bolts at the back of the drivers seat. Remove bolts, unplug the seat belt switch and lift away. Turn them over and place onto the next row of seats.

Remove carpet

Remove the trim along side the drivers door sill by removing the three screws and then prising the whole panel up. Catch the clips if they fall out. Any clips staying in place remove and put back in the panel.
Pull the carpet outwards to release the carpet clips from the sill edge.

You don't need to remove the footrest.

Remove the centre consol if you have one. Two Philips screws at the front hinge part. Lift away the top half and access the 4 screws below.

Remove Drivers seat side mounting.

Remove the two 14mm bolts securing the seat side mounting to the floor. Remove the petrol flap cable by undoing the small nut on the face. Lift away the whole assembly inc wires forward to rest by the brake pedal.

Remove/fold back carpet

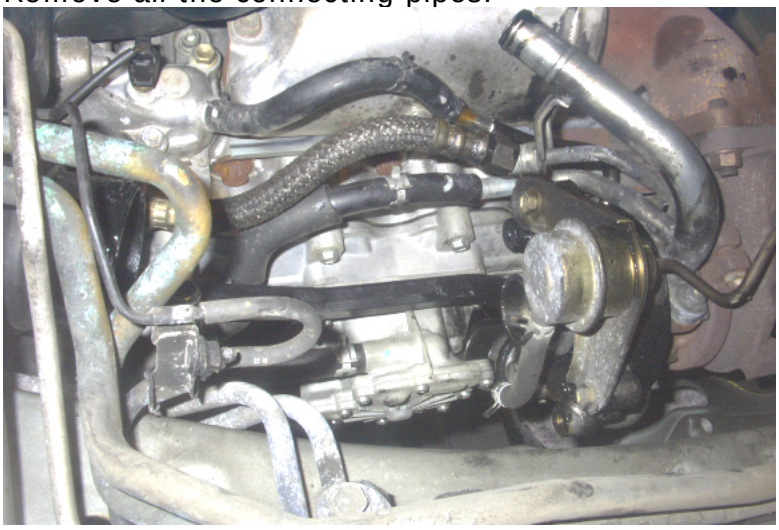
Pull the carpet away from the Velcro tabs by the drivers feet and peel the whole _carpet back towards the passenger side and push back up under the pedals (it remains clamped at the passenger side door sill).

Remove floor access panel

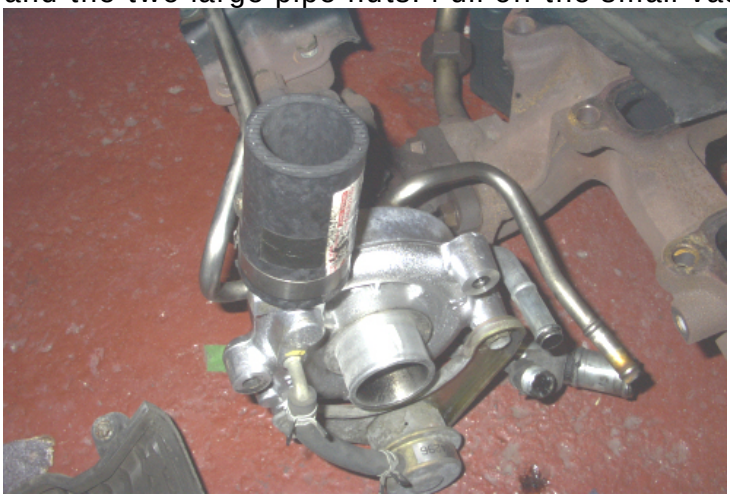
This should give room to remove the access/floor panel. Undo all the bolts and lift away – note the two longer ones and where they go.

Turbo removal complete with manifold

Drain the radiator and engine water drain.
Remove the turbo air outlet alloy housing by undoing the two bolts and the hose clips.
From underneath remove the access/cover panels beneath the turbo.
Remove all the connecting pipes.



Beware black oil will come out of one of the hoses, water out of other.
Remove the exhaust pipe three bolts, loosen the stay clamp and remove the two large bolts holding the bracket to the transmission.
From the rear end of the head/turbo remove the EGR valve (three bolts and the two large pipe nuts. Pull off the small vacuum hose.

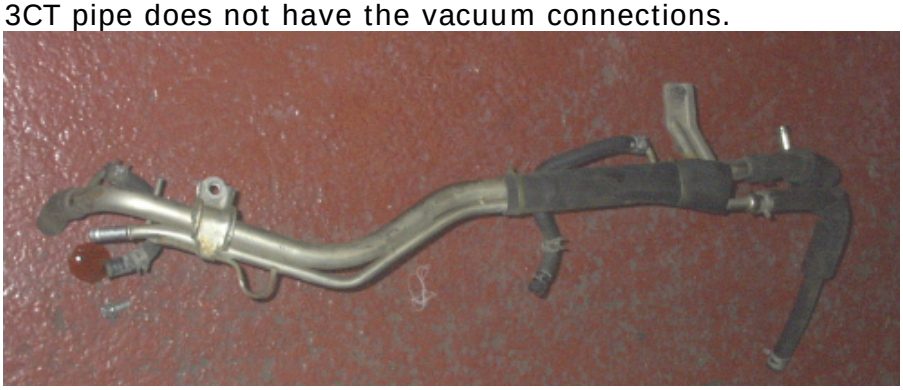


Remove the two bolts fixing the support plate to the head (can only be accessed once the valve is taken off).
Release the hose to pipe above that plate.

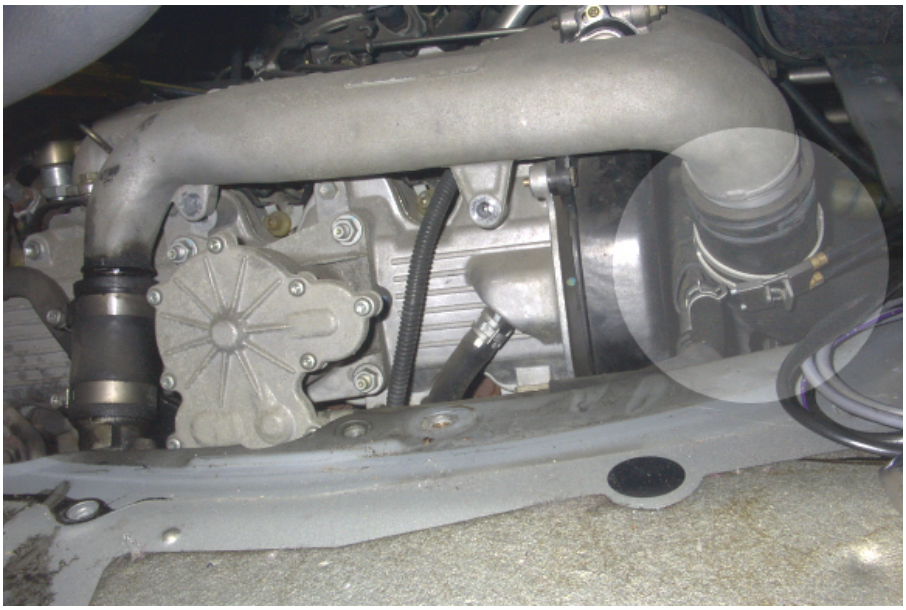
Remove the two bolts holding the heat shield over the exhaust manifold – lift off.
Remove all the bolts and nuts securing the exhaust manifold to the head.
Lie down and put both feet on the exhaust box. Push back hard to free the exhaust pipe from the turbo outlet.
Wiggle the whole assembly free and lift down and away.
Check no4 cylinder is wet or at least blacker than the other 3. – confirms the water in no 4 cylinder!

Removing inlet manifold
Straight forward unbolt, remove wiring plug and disconnect throttle link.
Remove turbo pipe. Lift away.

Remove cambelt.
Remove the set of pipes that go across the cam covers 3CT-E pictured.
3CT pipe does not have the vacuum connections.



There are two small bolts that hold it in place. Release the various pipes at each end.



Release the two large turbo pipes; to save removing them totally I put a tie-wrap around each one and then tie those really tight (crushing the hoses flat) to the brake pedal with a bit of string /rope – gives easier working area to the cambelt area.
You need to remove the front pulley – therefore you need to undo the front SAD.

Mark the pulley, SAD carrier and SAD itself with paint marks so all three components go back together in the same orientation. Undo the three bolts that hold the SAD to the carrier, not the ones that hold the SAD to the 'prop'.
On a 2wd there is enough clearance to pull the shaft to one side and wire it up to avoid strain on the front joint. On a 4wd I found that there was not enough clearance to move the pulley aside sufficiently to remove the pulley.
I dropped the front axle (very easy) by undoing the two large bolts that hold it in place.

This allows it to drop 3 inches, that helped but not enough. I marked the Front accessory carrier two nuts (17mm) and large washers with spray paint (essential as they have to go back exactly in the same place – there is loads of adjustment).

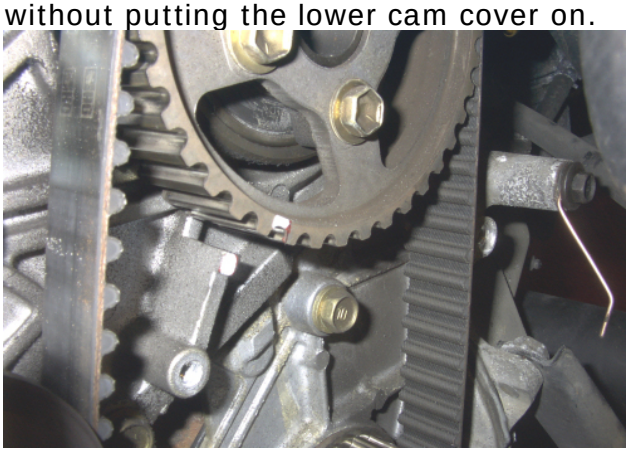
This allows the carrier to move forward and hence the whole shaft. They are like engine mounts made of rubber -this creates enough room to pull to one side.
Remove the front pulley bolt (19mm), there are three ways:-

1) lock the crank using a 14mm socket on the gearbox flex plate (plastic access panel under the starter motor) and undo with a

socket and large breaker bar. (see pic)

2) Using the same large breaker bar put the bar end on the ground and flick the starter (!) not tried it myself but apparently it works fine – stand clear…..
3) Use an air gun – worked for me.
4) If really stuck I've needed to use a ¾" drive breaker bar as the extension on a ½" bends (!) Hold on to the car and put your foot on the bar and push hard.

Use a large slide hammer or puller to pull off the pulley. There are three threaded holes in the pulley to use a small basic puller (lightly thread the bolt back in a few turns to give the puller something to pull against – not the thread hole which would be damaged).
Remove the cambelt covers which have a selection of clips and 10mm bolts.
Put the large bolt back in the crank with a large nut under it to make up for the space where the pulley was. Turn the crank until all the marks line up. Put a spanner on the nut under the bolt and undo the bolt again (holding the nut stops the crank from moving)
Temporarily replace the front pulley and mark all the pulleys with a paint mark. I put a wire marker as per pic so that the timing can be checked without putting the lower cam cover on.

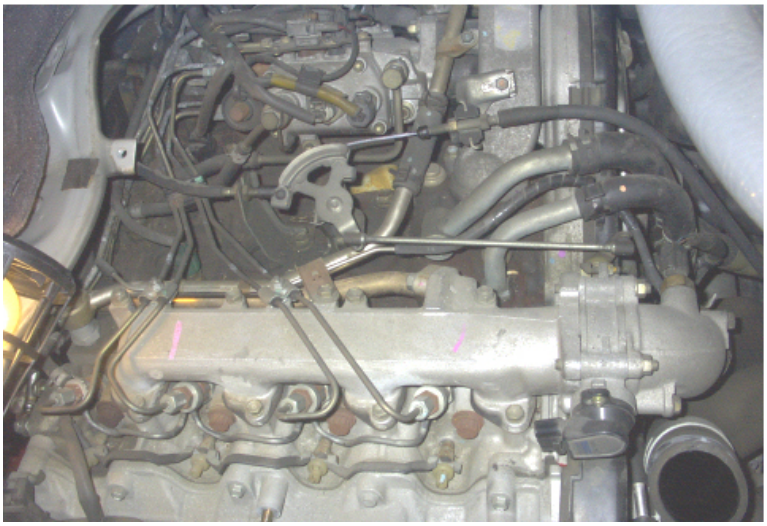


Put a 6mm allen (hex) key or star drive into the tensioner slot and release the tension to the max. The crank or pump may move. If the belt is virtually new mark the direction of rotation on it if you intend to reuse it.

Remove the belt and ensure that anything (fuel pump/camshaft) that moved is eased back so the marks continue to line up.

Pipes and more pipes.

Steadily remove all the pipes connecting to the cylinder head. I took loads of pics so that I could remember where they all go. I took off all the fuel pipes rather than bend them up out of the way. I marked each pipe on the fuel pump so it would go back in the same place. The other pipes are all different sizes and naturally line up so don't worry too much.

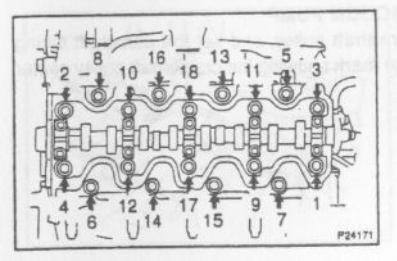


Remove head

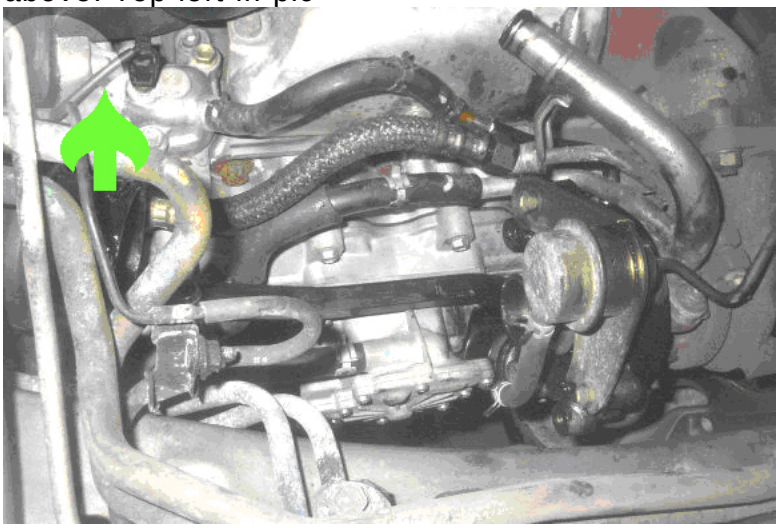
Remove the cam cover after releasing the wiring harness from the clips and number 4 glowplug.

I thought there would loads of thick oil draining out but as it had been a few days since I ran it it was fairly dry as it had drained down nicely. Cam was unmarked in as new condition.

Using a large bar and 14mm socket (needs to be the socket type with multiple serrations, not a simple six sided one) slowly undo the head bolts in several stages in a diagonal pattern as shown. They must be removed in order.



There is a 14mm bolt at the front of the head that is fairly well hidden that joins the alloy water housing to the engine support. Remove this bolt from above. Top left in pic



Remove the lead to the sensor on that housing.

Remove the EGR valve assembly on the back of the head.

Leave two head bolts lightly in place and break the seal by levering slightly with a screwdriver in the slot at the front of the head. The head will just stay in place as it has two short dowels of 10mm approx.

Double check all pipes and wires are now disconnected and the head is clear.

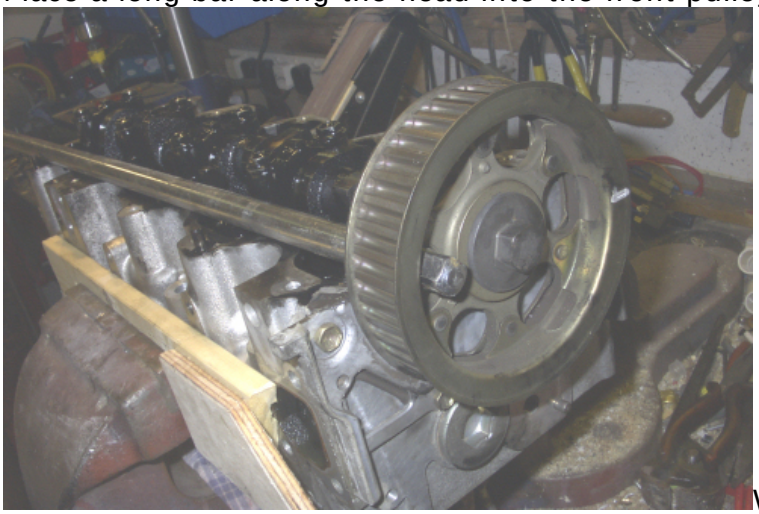
Remove the two bolts and pull outwards by the 10mm and lift away the head up and out.

It's not as heavy as it looks now all the components are removed.

Place on your bench (?) which you have cleaned up and admire the cracks between the valves.

Strip cylinder head

Place a long bar along the head into the front pulley to hold the pulley



While you undo the (tight) bolt. Use a puller on the inner webs of the pulley – not the outside edges as they are thinner pressed steel and will distort!

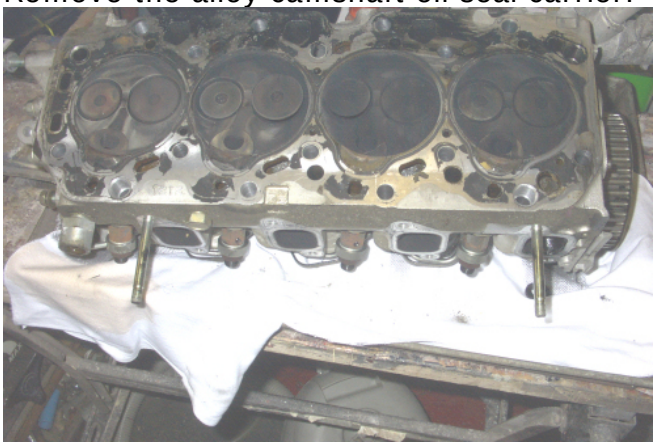
Remove the glow plugs wiring bar/strip. Put some easing oil or spray (I prefer Plusgas) around the base of the glow plugs and leave for a while. Undo the glow plugs one turn. Add easing oil and do back up. Undo a few turns, oil and do back up. If they are free take out.

The reason for this fuss is that the steel threads of the plug can weld themselves to the alloy and strip the threads as you forcefully undo them. Keep adding easing oil seems to stop any significant damage to the threads.

Remove the fuel injectors noting the washers and steel 'O' ring at the base of each. A large deep socket is required. If you do not have the head reconditioner will take them out for you.

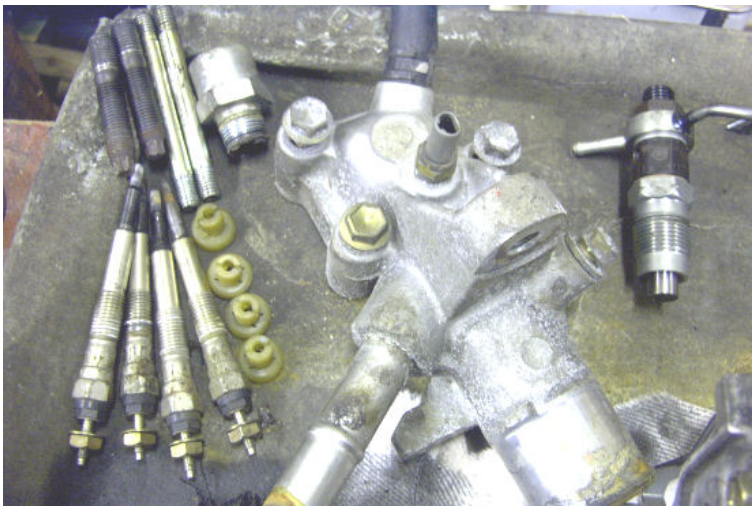
Remove the studs using a stud extractor or a pair of mole grips. Make a note of which holes they came from.

Remove the alloy camshaft oil seal carrier.

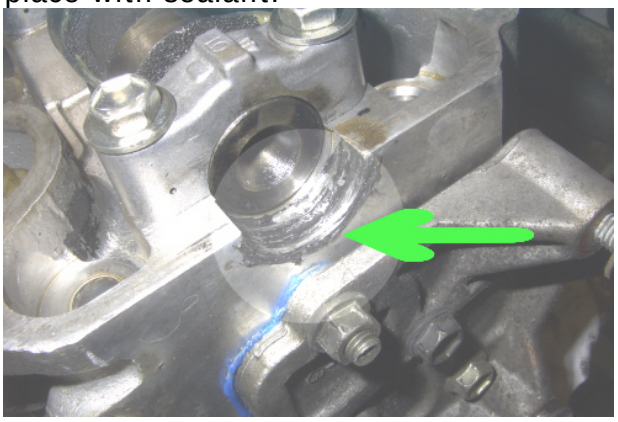


Remove the water outlet on the end of the head; remove the two studs that remain.

This needs doing as the head has to clamped to be skimmed. Remove the alloy mounting on the rear of the head for the same reason.



At the end of the camshaft there is an alloy half moon piece ‘glued’ into place with sealant.



Prise this out or else it will come out when the head is power washed in a hot cleaner tank, (guess how I know that!).

Remove inlet studs using:-

1) mole grips
2) A pair of nuts tightened together
3) A proper stud remover.

Remove the two exhaust studs using a star drive socket on the ends or worst a pair of mole grips.

Post off in a strong box to the repairer of your choice. I can recommend Mark as guy who knows these heads inside out. Cleaned and then pressure tested -Mark removes the valve seats grinds out the crack and welds up (he is a specialist alloy welder) New seats are then pressed into place and recut. Takes half a day per crack apparently.

Recon cylinder heads for 2.2td £345 inc postage and pickup.
RING **MARK** ON 01706 826260 0R 07971091617 ANYTIME
engine-express@hotmail.co.uk
ENGINE EXPRESS UNIT 11, BRIDGE MILLS, ROCHDALE ROAD, EDENFIELD, LANCS, BL0 0RE

Reassembly:-
Although the head will have been cleaned it may not be good enough (for me at least).
I could still see alloy swarf in the water passages As it was dry an airline cleared that.
The welded repaired crack on number 4 cylinder was a bit messy but there was welding slag relatively loose in the inlet port. I scraped that out with a long screwdriver and then a wire brush in a drill. Not perfect but better than a bit getting into the cylinder.

Lightly grease the cam lobes as they may be dry from cleaning. Oil may dry off during reassembly and initial start without oil pressure.
Replace the half moon alloy piece at the end of the camshaft, use a semi permanent engine sealant (silicone type is fine). Apply, leave ten mins then assemble.
As the original Toyota gaskets are virtually all metal with a rubber spray (very high quality) they leave little residue, but clean up what there is using a scraper (a large wallpaper removing Stanley knife type is good).
Stuff rags into the bores and clean the block surface. Blow out the bolt holes in the block (in case water has got in and will hydraulically lock the bolts and give a torque reading well before getting 'tight')
Check all oilway holes are clear. Use air line to be sure.
Check the water ways in the block for being clear and not rusted/crudded up. If crudded use in twist drill in the fingers or be careful with a low power drill.
Blow out the water that hangs at the bottom of the block.
Clean the face with thinner or brake cleaner.
Refit the two hollow tube dowels in the bottom holes at extreme right and left, tap in with a light hammer – do not distort.
Place the gasket (a 4 part steel gasket – use a Toyota one as the pattern ones are notorious for failing within minutes. There are genuine Toyota gaskets around that fit this engine [must be from another model where the engine is fitted in a different orientation]– but are not correct for the 3c or 3 CT-E in the waterway hole sizes, they block some large waterways around number 4 cylinder, just where the weakness is. ***You must get a gasket from the Toyota dealer!*** There is a thread on the forum explaining this in detail) – the holes only line up one way.

Replace the water housing and gasket
Press in a new camshaft oil seal. Grease the lip edges so that they do not run dry on start-up. Fit the end alloy plate. The pattern gaskets are just plain gasket material and I think they need a dressing of gasket non-setting compound – preferably the spray can type.

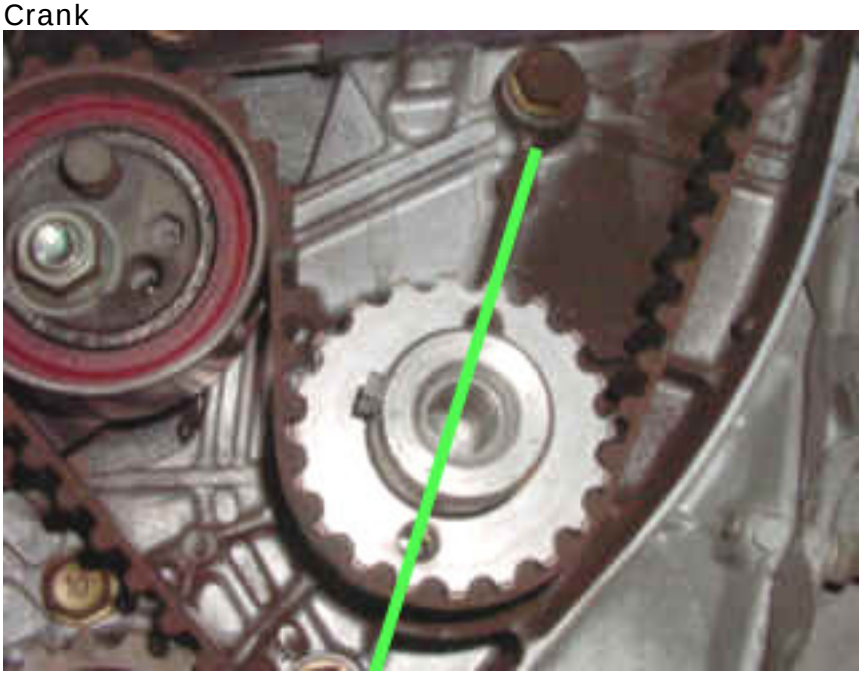
Refit the injectors remembering the washer right at the bottom of the hole and the larger one just above it. I reused the larger washers as the ones in the kit were too small. Tighten with a 24mm (I think) deep socket. Leave the glow plugs out at this stage.

The new head bolts I had contained a small packet of copper looking grease. It says give the threads and the underside of the bolt head a smear(between it and the washers you will reuse).

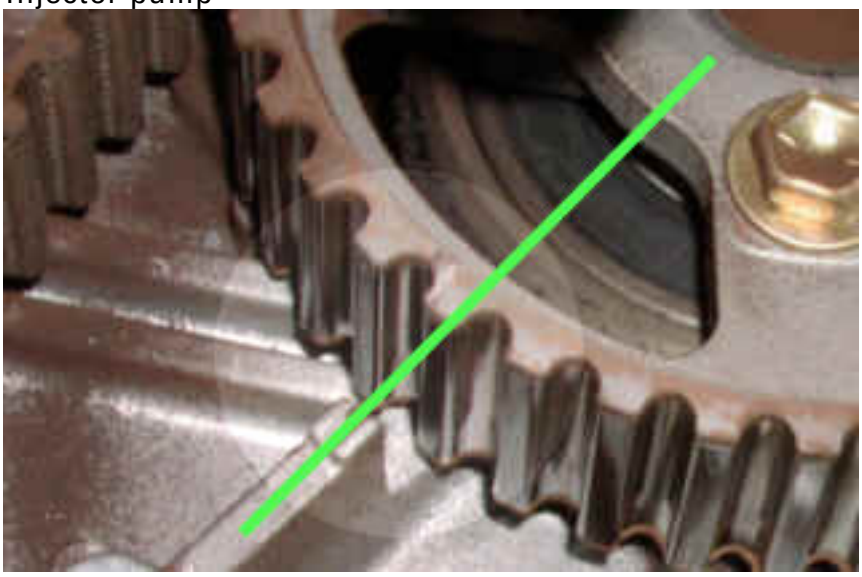
Ensure that the engine is set so that number 1 and 4 are at top of travel (as you left it when the belt was taken off and the marks were checked). Ensure that the cylinder head cam pulley is set to point to the timing mark (i.e. a double check is that the valves on 1 and 4 are closed). If you do not do this the pistons hit the valves and the head will not fit – or at least it will push the pistons down and mess up your timing.

Lift the head onto the dowels, they will hold it in place – but quickly fit a couple of bolts, short ones on the outside and longer ones next to the camshaft bearings.
Loosely wind them all in and then nip them up by a few lbs.
Using a diagonal sequence tighten them all in stages until 48 lbs/ft is reached. As per previous pic.
A good tip from Bob is to put a blob of paint or tippex at 12 o'clock on each bolt head at this point. Then tighten each bolt (diagonal sequence again by 90 degrees) so that each bolt dab of paint is now at 3 o'clock. When all done retighten again by 90 degrees so that all marks are at 6 o'clock. Job done.
Remember the 14mm bolt that clamps the head water housing to the engine mount? Refit it now.
Stuff rags into the inlet ports (drop a nut into one of those and you'll regret not following this advice!).
Fit a new cambelt and time it up as per the Colin Wilson tutorial and excellent pics.

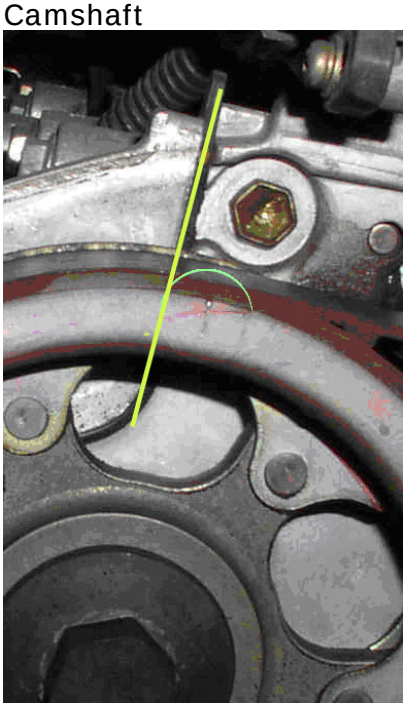
Crank



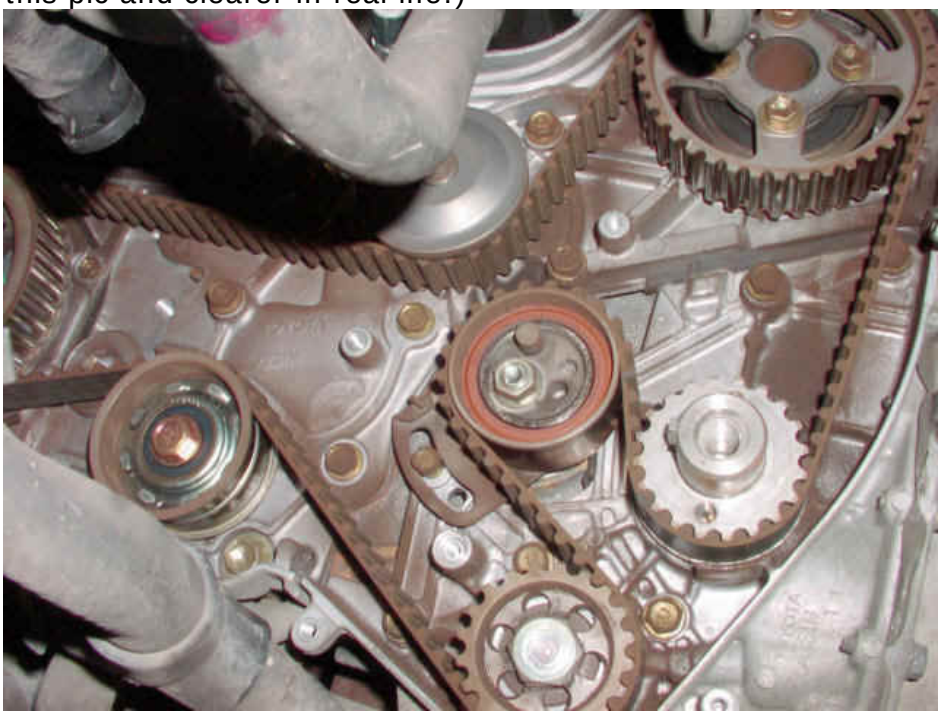
Injector pump



Camshaft



In this last pic (source Colin Wilson) the line goes across the joint between the cylinder head and the mark on the cam pulley (slightly out of line in this pic and clearer in real life!)



Refit the SAD coupling bolts into the right holes (marked with paint remember?)

Refit cam covers. Ensuring that the cam is still set to the timing marks (i.e. the cam lobe that the vac pump runs against, is pointing to the head not out towards the pump. Quite why you need to do this I can't figure as the vac pump will be compressed any way?).

Use new gasket, feed into the deep groove in the rocker/cam cover. Tap into place fully with a rubber headed hammer. Fit by pulling the bolts up progressively so that the cover does not distort (or break?)

Refit the steel chromed pipes that go along the front face of the cam belt covers. Ensure that each pipe is connected to a hose, particularly the small vacuum hose under the passenger seat access that is easy to miss. Refit the water hoses that go over the cam covers onto chrome pipe stubs.

Refit the exhaust manifold (in my case I kept it all together with turbo) by fitting two studs, one on the bottom row and one on the top. Ensure that the large pressed steel support from the turbo to head is in place on the turbo but that the bolts are loose.
Lift into place and quickly put the two nuts on. Put a smear of copper grease on the threads of the bolts. They are metric fine thread (m10 x 1.25) and go into soft alloy. Easily miss-threaded so start off by hand and if any resistance is felt do not go further without checking – do not think it's just tight and keep going……..
Bolt the support to the head and retighten the support to turbo bolts now it is all in the right position. All the turbo pipes are different sizes so reconnecting is easy and the pipes and hoses fall into place.

Refit inlet manifold with new gasket – I didn't use compound. The Toyota gasket is metal. The pattern gasket is a card like material. Having removed a pattern gasket at 6 months old it was rock hard and broke into pieces – use the genuine one.

Don't over tighten the jubilee type clips on the turbo outlet, they just crush and leak oil and pressure over time. If the short stub of pipe is soft and squished replace it (£12!).

Replace the copper coloured pipe onto the inlet manifold with a new gasket. If you wish to block off the EGR system this is where to put a blanking plate instead of the gasket. Read the benefits of this on the forum.
Next the chrome coolant pipe which has the vacuum pipe attached. I reused the washers where the hollow bolt goes onto the water stub as there were none in the kit of gaskets.

Replace the injection pipes, they all fall into place easily and are tightened up with an open end 14mm spanner.

Replace the three large turbo pipes and spring hose clips. A tip for easy fitting of the large hose clamps is to put them in a vice and use large nylon tie wraps to keep them fully open. Snip them off when in place. Or use a special tool - £28.

Refit the alloy turbo to hose casting and connect to the hoses.

Refit the exhaust pipe to turbo.

Refit the EGR vacuum operated device on the rear end of the cylinder head and the pipes that go onto the stubs. Don't miss the small vac pipe.

Refill with oil and a new filter.

If you have not previously flushed do so now. See forum for details. Ensure the coolant drains are closed and refill with coolant. There is a debate on what to use and the strength. Antifreeze is poor at conducting heat so I use 30% and water wetter. Fill with a large tight fitting funnel into the header tank and keep the coolant level as high as possible. Squeeze the top hose to assist in clearing air locks.

Charge the battery as you will have to turn the engine more than usual. Press the fuel filter rubber button on the top to pressurise the system. Crack open the fuel injector pipes. Turn engine a few times and repressurise the fuel filter. Keep going until fuel appears at the injector pipes.
This will give the turbo and cam some oil pressure before starting. Replace glow plugs and bus bar. Start!

Expect some smoke for up to 10 minutes. Quickly check for oil light going out.
Keep coolant filler cap off and keep topping up while running.
Allow to warm up and check all connections with a torch for leaks.
Feel pleased with yourself if it worked. If not, question whether you have the cam timing right.

Torques:-

Fuel injectors to head	47 lb/ft
Fuel injector leakage pipes (top of injector)	22 lb/ft
Vacuum pump	14 lb/ft
Cam rocker cover	10 lb/ft
Intake manifold	14 lb/ft
Exhaust manifold	34 lb/ft
Oil spray nozzle (on top of head)	65 in/lbs
Water outlet on head	13 lbs/ft
Cam oil seal carrier	65 in/lbs
Cam bearing cap bolts	13 lb/ft
Crank pulley	145 lb/ft
Cam pulley	65 lb/ft
Cam idler pulley	27 lb/ft
Injection pump pulley	65 lb/ft
Cam belt tensioner idler	27 lb/ft
Cylinder head bolts 48 lb/ft then 90 degrees	+ another 90 degrees
Glow plugs	9 lb/ft
Turbo to manifold	39 lb/ft