

Our 'Get to know your Seven' series takes a break month while we consider a project for the slightly ambitious among us. **Steve Tourle** gives a detailed description of a popular, but for some rather daunting, major upgrade: converting to a dry sump system.

DRY SUMP CONVERSION

The procedure described here relates to a κ-series engine currently fitted with an anti-cavitation ('Apollo') tank; it describes the fitting of a Caterham-supplied dry sump kit consisting of a gold scavenge pump, auto-tensioner and an external Pace oil tank. Some parts will differ between an s3 and sv chassis, for example the offside engine mounting bracket. I have not covered the removal of the extended passenger footwell (if fitted) and replacement with a retrofit blanking panel (part no. 77548), but have covered relocation of the battery separately.

The numbers quoted in the text (eg, 79003) are the relevant part numbers—see the parts list and notes at the end of the article.

PREPARATION

Removing anti-cavitation tank, if fitted

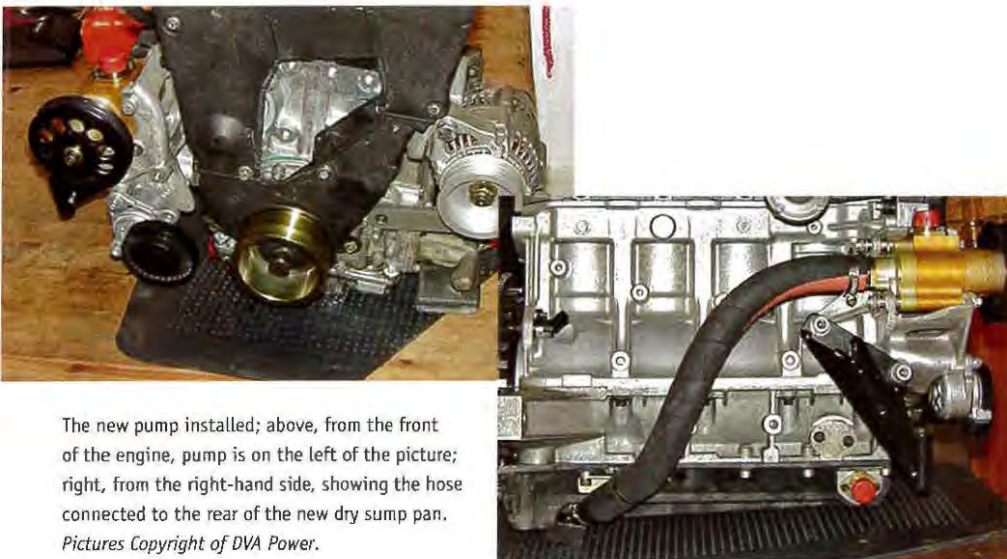
- Remove sump plug; drain oil from engine.
- Remove oil filter and discard; undo central sleeved nut that filter screws onto and separate oil take-off sandwich plate from engine.
- Remove the following: the connector from the temperature sender (if fitted to the tank), the fixings that secure tank in place and the braided breather hose from top of the tank.
- Remove anti-cavitation tank, complete with both hoses.
- Drill out the four rivets from the base plate that the tank was seated on; remove the plate. Spray *Dinitrol*, or similar, into rivet holes in chassis to reduce future corrosion; insert four black-headed pop rivets into the holes to seal them up.
- Remove camshaft cover and braided breather hose from casting; use an appropriate nut and bolt to seal the hole left in the camshaft cover—use Loctite on the thread to prevent it coming loose over time. Refit the camshaft cover to the camshaft carrier.

Preparing for installation of dry sump system to wet sumped engine

- Remove anti-cavitation tank if fitted (as described above).
- Drain cooling system; undo bottom radiator hose; at this point, removing the induction airbox or plenum can make access easier, but it's not essential.
- Remove bottom radiator hose and the metal 'submarine' pipe; removing the radiator allows more room to work, but it's not essential.
- Undo the cap-headed fixings from the wet sump pan; lower sump away from the engine. You might need a soft hammer-blow to release it from the gasket. Remove sump gasket.
- Undo the three fixing bolts and remove the aluminium sump baffle plate; remove foam baffle, if still fitted; remove oil pick-up pipe by undoing the fixing bolts and pulling down on it to release it from the feed hole in the engine block—make sure the rubber O-ring comes out.
- Remove the oil dipstick from the dipstick tube.
- Undo the three bolts securing the dipstick tube to the engine block, one half-way up the tube (which also holds thermostat housing) and the other two at the bottom; remove the tube from the engine.
- Ensure the gasket is intact, or replace with another and fit the dipstick cover plate (79003) with the two original bolts; tighten to a torque of 10Nm.



Three views of the oil scavenge pump, fitted with its pulleys and mounting bracket.



The new pump installed; above, from the front of the engine, pump is on the left of the picture; right, from the right-hand side, showing the hose connected to the rear of the new dry sump pan. Pictures Copyright of DVA Power.

INSTALLATION OF DRY SUMP SYSTEM

As mentioned above, the description here is for a system using the Pace 'Easiclean' external oil tank and consists of the following main tasks:

- assembly of dry sump pan components and fitting to engine
- assembly and installation of scavenge pump and cradle
- installation of the external oil tank and catch tank.

Assembly of sump pan components and fitting to engine block

- Take the pressed aluminium baffle plate (75680) and peel away any protective film coating. Fit baffle plate into the base of the sump pan (75683) using the eight M5x12mm mushroom-headed screws (HW/1174) provided. *The baffle will only fit one way.*
- Take the 5/8" flanged union (75669) and fit the thick rubber O-ring (27.5mm diam x 2.5mm) to the mating surface; fit the flanged union to the hole in the front of the sump using two M5x16mm cap head screws.
- Locate the oil sleeve (75682) – it's 31mm long with two grooves around its circumference. Fit to these grooves, two thick rubber O-rings (22mm diam x 2.5mm). Fit the sleeve in the front of the sump, into the counter-bored hole on the mating surface; this is simply pushed into place and completes the oil feed to the standard pressure pump when the sump is fitted to the block.
- Take the oil pick-up sleeve/gauze assembly (75722) and rubber ring (supplied with it). Locate another rubber O-ring (25.5mm diam x 1.75mm thick) and slide this over the body of the assembly. Insert assembly into the hole in the right-hand side of the sump, with the flat side of the flange towards the top of the sump – matching the flat on the sump casting.
- Press the rubber O-ring supplied with the gold-anodised sleeve into the groove on the outer mating surface.

- Locate the high line oil pipe and bracket assembly (75716) and the two aluminium alloy spacers (75718). Mate the oil pipe with the flange of the oil pickup sleeve/gauze assembly, ensuring the O-ring is in place, and secure with two black reduced-diameter M5x20mm cap head bolts (HW/1482). *Ensure the two aluminium spacers are located between the sump and the other end of the oil pipe.*
- Apply some Loctite 574 flange sealant to the mating surface of the sump, in a continuous line, and fix the sump to the block using eight of the original ten M8x20mm cap head screws, one M8x70mm, one M8x80mm, and two M8x25mm screws – instead of two of the originals – where the high line oil pipe is fixed. Tighten in the correct sequence to a torque of 25Nm, and 30Nm for the two longer bolts. **Warning:** don't over tighten as this may damage to the threads in the engine casting.
- Insert the sump drain plug (6118746) into the sump drain hole.

Assembly and installation of the scavenge pump and cradle

- Remove original nylon pulley from the tensioner (75697) by cutting into it towards the bearing with a hacksaw in two or three places around the pulley – *without damaging the bearing*. Once you've made the cuts the pieces of the pulley can be pulled away from the bearing.

- Now fit the replacement aluminium-flanged pulley (75664) onto the bearing using some Loctite 'bearing fit' to ensure the pulley is retained. Fit the large circlip (1300-40MM) against the bearing to prevent float between pulley and bearing; it is quite a tight fit – make sure it tucks in nicely under the rim of the pulley. *The circlip goes on the side of the pulley facing the radiator.*
- The tensioner can then be fitted to the front of the pump bracket (75697) by the two shouldered M8 screws provided (75697S); Loctite these into place. *You'll need to pull back the tensioner against the spring to gain access for one of the bolts.*
- The offside engine mounting bracket needs to be removed from the engine; this will be replaced by a new one which provides clearance to fit the pump cradle.
- The pump bracket can now be secured to the right-hand side of the engine block using three bolts, the two M10x100mm unplated ones supplied and one of the original M10x50mm ones removed from the top engine mounting. The two 100mm bolts are fixed through the replacement engine mounting bracket and the pump bracket into the engine block; the 50mm bolt is fitted in the centre of the bracket to the engine block. These should be tightened to a torque of 25Nm.
- The bolt holding the engine mounting bracket to the engine mounting can now be secured. **Note:** Ensure that the earth cable is replaced as it was before removing the old bracket.
- The pump (75663) can now be secured to its bracket – with the 5/8" threaded union facing upwards – by two M8x25mm cap head bolts at the front and two M8x45mm at the rear. These should be fitted with spring washers and Loctite. As the rear bolts are tightened up, the two spacers or bushes pressed into the rear of the bracket will drift inwards through the bracket and fill the small gap between the bracket and the pump.
- The length of 1" inside-diameter scavenge hose (75709) is now fitted between the oil scavenge pipe fitted to the sump and the rear of the pump using two jubilee clips. *Remember to remove the red plastic cover, if fitted, from the pump inlet before securing the hose.*
- Fit the oil pump belt (75715 – which is a 3pk 765 polyvee belt) around the crankshaft and oil pump pulleys. To aid fitting of the belt, you can rotate the crank pulley clockwise using a socket on the nut as you press the belt against it – the belt will then drift onto the pulley. The tensioner pulley should be outside of the belt. Remove the locking pin from the tensioner to allow it to take up the slack and press against the outer edge of the belt. No further adjustment is required. ➤

A few words about dry sumps

This is, perhaps, an appropriate point to reprise our brief beginners' guide to the subject...

For those who are not familiar with the 'dry sump' concept, this is simply an arrangement where the main reservoir for engine oil is a tank, remote from the engine itself, rather than the pan at the bottom of the engine, below the crankshaft; the pan is the low-point of the engine which drivers, particularly in low-slung vehicles like Sevens are wary of grounding for fear of damage and the consequent loss of engine oil.

So, in a dry sump system the sump is not, strictly speaking, 'dry' but the oil is 'passing through' the sump pan rather using it as its reservoir – the place it goes back to when the engine is not running.

This requires slightly more complicated pumping and plumbing, but it can bring a number of advantages: oil distribution, pressure and surge can be more effectively managed so that lubrication can be more consistent under extreme conditions and g-forces (cornering, acceleration, braking); also the turning crankshaft does not encounter the drag of all the oil in the wet-sump pan – and, since the pan itself can be shallower, the car can (if the sump is lowest point) be run lower for the same minimum ground-clearance.

In the context of racing cars, you might hear mention of 'dry sump gearboxes' and, whilst we don't normally think of the transmission having a sump, the principle is the same – the oil is stored elsewhere and pumped through it.

For both 2-litre Vauxhall engines and the K-series, Caterham introduced a racing car style 'dry sump bellhousing' set-up, where the oil tank is inside the bellhousing (the casting that joins the engine and gearbox). While costly, it's a neat solution suited to the Seven's confined engine-bay.

But the external tank method is just as popular, offering some advantages in ease of servicing, installation without removing the engine and the possibility to tailor a system to a particular modified engine, such as using a larger capacity tank.

Ed.

INSTALLATION OF DRY SUMP SYSTEM, continued

Installation of the external oil tank and catch tank

Before the installation, I had Pace weld a triangular fixing plate to the base of the oil tank to simplify fixing. I also had a boss fitted to allow the standard temperature sender unit to be fitted to record oil temperature.

- Drill fixing holes in the base plate of the oil tank (6mm if using M6 bolts) to fix to the mounting plate. Drill matching holes in the mounting plate and secure to the chassis cross members using 4mm rivets or similar.
- Secure bottom half of tank to mounting plate with M6 bolts and nyloc nuts and three rubber spacers to give some vibration resistance.
- Fix two flat fixing plates (77547) to the top chassis rails using two rivets in each at the points where the tank is closest to the chassis side rails, flush with the upper edge and protruding downwards. If you bend the lower part of the plates out at 30 degrees (away from the tank) before fixing this helps retain the large jubilee clip in place while you tighten it up.
- Fit upper half of tank to lower half using the supplied connector in the correct rotational orientation. Fit the large (150-170mm) jubilee clip (SGT150-170) around the upper half of the tank and engage it behind the fixing plates; tighten enough to prevent the tank from moving. *I used a couple of small squares of silicon hose material, sandwiched between tank and plates, to soften the contact points.*
- Fix the two 5/8" to JIC-12 male-to-male oil unions into the two inlet/outlet bosses in the tank; use *Loctite* on the threads to help make them oil tight.
- Fit the temperature sender unit into the sender boss fitted to the lower part of the tank (*assuming you had this modified*). Re-route the wire from where it fitted to the old anti-cavitation tank sender to the new location; extend and secure as required to fit.

Fitting the breather catch tank

I fitted this to the passenger footwell plate in a suitable location to allow access for emptying when required.

- Connect one input to the catch tank with a length of oil-proof hose to the 5/8" centre outlet on top of oil tank and secure it with jubilee clips.
- Connect a further piece of hose between the other 5/8" inlet on the top of the oil tank (near the edge) and the front breather outlet in the side of the cam cover. You can use the original 90-degree angled rubber hose and a 13-to-16mm adapter to join the two different sizes; secure with jubilee clips as appropriate. If the rear breather in the cam cover is open, this should be sealed. This breather may have been connected by a hose to the backplate of the throttle bodies or the plenum (whichever is fitted); this hose should be removed and the hole sealed-up in the backplate or plenum.
- **Note:** the two breather outlets on the cam cover are not identical – the rear one has a much smaller orifice and does not provide adequate breathing in this application.
- Remaining outlet on the catch tank can be vented downwards to underside of car with a length of oil-proof hose or fitted with a small breather filter.
- Fit the two braided (or otherwise of choice) 5/8" oil pipes. One is fitted between the outlet on the top of the pump (90-degree female fitting) and the inlet at the top of the oil tank (straight female fitting) and is routed under the throttle bodies and over the bellhousing. *Remember to remove red plastic cap from pump outlet first.* The other is fitted between the outlet at the bottom of the tank (straight female fitting) to the 5/8" flanged union on the front right of the sump (90-degree female fitting) and is routed around the front of the engine bay. Ensure the hoses are secured appropriately to prevent them from being damaged or damaging other components – this is especially important if stainless-steel braided hoses are used as they can be abrasive. I used some aluminium- and-rubber P-clips riveted to the chassis rails.



Above:
The oil tank fitted into the chassis, ahead of the passenger footwell, showing the various hose connections (see text). This particular tank, the Pace *Easiclean*, is jointed around the middle so that it can be split in half for – as its name suggests – easy cleaning or inspection of the inside.



Right, from top: engine bay viewed from above exhaust (left-hand side of car) showing pipe from lower front of oil tank.



New sump pan seen from beneath right-hand side of car.

View from above bellhousing, showing plumbing to the new oil tank.



View from above, standing over front of car – showing pipe routed around bottom of engine bay and secured to chassis with rubber-lined P-clips. White circular item at bottom of picture is the coolant reservoir.



BATTERY RELOCATION

IN ORDER TO be able to remove the long passenger footwell – necessary for the new external Pace *Easiclean* oil tank installation, it was necessary to first relocate my car's battery.

I recently upgraded to a Powervamp Racing Battery (model PVR25) which comes with a nice aluminium bracket made specially to hold it in place. I found that the battery and bracket fitted neatly in a vertical position in front of the car's heater on the horizontal bulkhead.

I secured the battery bracket to the heater using two nuts and screws with some heater casing and two further nuts and screws through the base of the bracket into the bulkhead, using countersunk heads so as not to protrude into the battery when fitted.

I used a strip of thin high-density foam under the base of the battery to avoid any potential stress points caused by the screw heads.

I also took the opportunity to replace the battery cables with new ones – one of the old ones was no longer long enough. I used 25mm 170A battery cable obtained from *PoleVolt Ltd* (part no. PVC25/170) with appropriate tube terminals. Incidentally, the originals were 16mm cables so this might assist with starting performance.



Steve's battery was previously sited in the typical spot, on top of the extended passenger footwell; with that gone, it had to be moved and his very compact Powervamp fitted on the scuttle ahead of the heater.

8454 Washer bottle bracket for Lucas bottle £1.66	75697S 2 required Screw-tensioner Rover dry sump bracket BRKT-FS 108251 £0.19 ea	77548 Retro-fit panel footwell dry sump kit £25.00
1300-40MM Circlip-40mm R500 drysump idler flanged pulley -02> £0.85	75697T Tensioner Rover dry sump bracket PQG 100180 £50.00	77700 Braided hose oil tank to internal oil pump £15.00
6118746 Filler plug, diff. and drain plug 6-speed £5.75	75709 Scavenge hose - 1" ID Rover d/s pump-sump 100S4-16 £27.50	77701 Braided hose scavenge pump to top of oil tank £17.25
73154 Rad hose-Rover dry sump, blue silicon variant (bottom) to radiator 594-8 (blue section) £45.00	75712VVC*** D/Sump eng. mount brkt R/H Rover- NOT VV/X-POWER 1.8 £45.00	79003 Dip-stick cover plate D/S Rover £3.00
73155 Cooling submarine 1 outlet - Rover dry sump £16.00	75713 4 required M8X25 caphead setscrew Rover d/sump pump/cradle £0.40 ea	BMCH10X100 2 required Bolt-Metric caphead Rover drysump cradle - unplated £0.86 ea
75663 Scavenge oil pump (Gold) Rover DS-Gear/VHPD + Race £390.00	75714 2 required M8X45 Caphead bolt Rover d/sump pump/cradle £0.40 ea	FB 110101 Bolt manifold strut/alt.adj/ D.S. pump bracket £0.52
75664 Flanged idler pulley R500 oil pump drive £45.00	75715 Polyvee belt Rover d/sump oil pump (Gold)-3PK763 £11.50	HW/1174 8 required Bolt - M5x12 (5PK) allen key dome head Rov/VX D/S baffle -1993> £1.75 ea
75669 5/8 BSP Flange union Rover dry sump £22.50	75716 Hi-line pipe/bracket adapter Dry sump Rover £42.50	HW/1482 2 required Reduced diam caphead bolt M5X20 High line bracket £1.40 ea
75675 O Ring 5/8 union to sump (front) Rover £0.60	75718 2 required Alloy spacer - Hi-line pipe Rover d/sump scavenge adapt £3.00 ea	OR/6035 4 required Dry sump O-ring to suit adapter - R/VX £0.80 ea
75680 Sump baffle d/sump, Rover £40.00	75722 Hi-line scavenge filter assembly (Gold)-dry sump £34.30	P1290A Expansion bottle cap - no hole NK/bottle - no hole (WSB180) £0.50
75682 Sleeve oil supply, Rover d/sump £8.00	77511 Dry sump oil tank Pace 'Easiclean' £225.00	SGT150-170 Hose clip - 150mm-170mm (DS Tank) tank retaining £2.40
75683 Sump pan, Rover d/sump £250.00	77512 Dry sump mounting plate RHD £7.52	SGT25-40 4 required Hose clip - 25mm-40mm £3.00 ea
75685 M8X70 socket cap screw Rover d/sump £1.40	77545U 2 required Oil union M/M-5/8X-12 Pace DS oil tank -2003> £4.00 ea	WSB125 Catch tank - oil 2-litre with cap & bracket - 7517 £16.85
75686 M8X80 socket cap screw Rover d/sump £2.10	77546 3 required Angle bracket-D.S. tank fixing £1.06 ea	WSH5/16 4 required Washer - 5/16" heavy duty, spring £0.50 ea
75687 O ring sump to filter housing, Rover £0.60	77547 2 required Flat plate-D.S. tank fixing £0.90 ea	

PARTS LIST

Steve has gathered together details of all the parts he used for his dry sump project, which we've listed here.

All of the components listed on the left are normally obtainable from Caterham Cars' parts department or online. Listed for each are the part number, an indication of how you would find the part described on the website and an idea of the price.

One of each item is required unless stated otherwise (*but see also the notes below*). The prices indicated here were believed correct when Steve assembled his parts last year, and should give some idea of the costs involved if you're interested in the same upgrade. Most of the components are pictured on Caterham's website too, if you want to get a 'feel' for what all of this kit actually looks like whilst you contemplate such a project.

Notes on specific part numbers:

8454, WSB125 & P1290
only required if not sourcing 3rd party catch tank.

75697S
only 1 is normally supplied, you will need 2 of these; tell CC when ordering.

75712VVC
will be different for an SV or S3.

75713
you'll need 4 of these; 2 are normally supplied.

77511
can be supplied by Pace direct if you wish them to modify the base with a fixing plate and temp. sender boss, or you can send them the CC one and they will modify it for you for about £80.

77546
will not be required if you mount the tank using M6 bolts assuming you have the base of the tank modified.

77700/77701
oil hoses can be supplied by *Think Automotive* to exact length if you wish to decide your own route, in which case delete them from the CC order.

FB110101
only required if you have the manifold strut fitted; not needed with throttle bodies.