

# Heavy breathing

In January's Low Flying Rob Walker wrote about upgrading his 1600 Rover k-series engine to gain a tad more power. Prior to Rob writing about his experience I spoke to him because I was attempting something similar. Well I am now seeing the benefit of my labours and I haven't stopped smiling yet!

In 1997 I bought the Caterham in kit form as the Supersport version, which delivers 138 bhp @ 7000 revs and 115 lbs/ft torque @ 5000 revs. In addition I fitted a Caterham competition exhaust and Superlite R throttle bodies. The Supersport upgrade costs around £1k more than the standard motor, so it appear quite good value at the time, but those of you with a standard k-series read on, because you could put that £1k to much more productive use.

I use the car for road use as well as for hillclimbs and sprints, last year finishing 6<sup>th</sup> overall in the Harewood championship and taking a number of class prizes. However it was clear that I had a big power disadvantage to some other competitors in class 4. For example Mike Bees made a guest appearance with a 1700 cc 250 bhp flyer, Andy Stokes is a regular with a 225 bhp 1600 Vauxhall and there are numerous other very quick seven type cars all slugging it out.

My target was to get around 180 bhp out of the unit without the need for a second mortgage. I spoke to a number of engine builders, many of whom talked a good story, but I thought they seemed to be more interested in taking my money! A couple of them wanted near to £6k to get 165-170 bhp, needless to say some fools and their money are soon parted, but not this one!

After various researching I came across a web site by a guy called Dave Andrews (<http://members.aol.com/dvandrews/>). Dave has helped a number of people develop their k-series engines, including Mike Bees and Rob Walker. After talking to some of Dave's proteges I decided to take the plunge and get my hands dirty and do it myself.

The k-series is an all aluminium engine and so its very light, but the problem is that it was designed originally as a 1400 cc unit and so its ability to breath is very restricted. The bottom end in standard form however, is good for 8000 rpm. So changes to the top end were called for.

Following Dave Andrew's advice, my aim

was to port the head and fit bigger valves, high lift cams, convert the hydraulic tappets to solid followers and fit a programmable ECU. Sounds easy! So in November the head, cams etc were removed, followed by two trips to Dave for advice and a demonstration on what to do.

Piper 740 cams, valve springs, steel valve spring caps, verniers and a new cam belt were ordered from Piper. A set of carbide cutters and mandrells/grit bands were bought for the head modification work. The other essential requirements were a variable speed electric drill and a bench grinder.

I made a wooden cradle to sit on top of my workbench, to support the head at a 45degree angle for ease of working. Oh, and I needed plenty of good light. I used one of those outdoor floodlights with 350 watts – it also acted as a heater in my cold garage to stop my fingers freezing!

Then it was a case of rolling up my sleeves and getting to work with the electric drill. The seat throats were opened up. The valve guides were also ground down to reduce the obstruction in the ports. The

head porting itself was fairly easy, being aluminium, but required a keen eye and careful work so as to open up the ports without visiting the water and oil ways by mistake! This is a case of carefully following Dave's instructions and photos on his web site and using some old valves to judge the size and shape of the port that is being working on. What you are trying to achieve here is a smooth shape from the inlet or exhaust to the valve seat and getting a straight shot at the cylinder. At the same time you need to reduce the metal where the two ports merge (beware there are waterways in this area). Each of the exhaust ports and each of the inlet ports need to have the same shape and curves. It is not necessary or desirable to create a mirror finish in the ports (unless you are trying to impress you mates), but a smooth finish is essential to create a clean flow. Your finger is the best tool here to check for imperfections and subtle changes in shapes. A good start is to work one exhaust and one inlet port, then use these as guides to compare each port as it is being done.





## by Dale Cordingley

Once the ports are done, the valve seats can then be recut to take 29.5mm and 26mm race valves and the head lightly skimmed. The combustion chambers only needed a little opening out for the bigger valves to create a smooth shape (these will have been opened partly by the valve seat recutting). The chamber only needs a light polish, but by putting an old valve in place you avoid any damage to the valve seats.

By New Year and after some 30 plus hours of work, it was all done without any mishaps. The capability to flow better was very apparent just by looking at the head, you could actually see more light through the ports and what's more it was really satisfying.

Next the race valves were carefully lapped in. The steel valve spring caps were then ground down a little to avoid the cam pressing on the cap rather than the valve stem (with obvious disastrous consequences). The valves, caps and stronger springs were then assembled in the head and fitted to the engine.

The next job was to convert the hydraulic tappets to solid followers. This was essential if the engine was to stay in one piece with the new cams and higher revs. Some of you may have heard my car after a run up Harewood sounding like an old sewing machine tapping away. For the more technical of you this is the result oil aeration, which allows the lifter to compress, rather than solidify on lift (so Dave tells me). This conversion involves

dismantling the tappets and chucking away various bits and then reassembling the remains with some custom made shims. Shimming is a bit of a tedious job of grinding the shims until the correct clearance to the cam is achieved. This can be achieved by putting the shim in the electric drill and carefully running it against the bench grinder. Then it's a case of rebuild the follower, put the cam in place and check the gap. If its too narrow take some more off the shim, if its too wide chuck the shim away and start again!

Once all sixteen followers have been converted, its plain sailing to reassemble the top end. Mind you, setting the cam timing is a bit nerve racking, hoping you have got it all in the right place to avoid a rather loud coming together between the valves and pistons on start up! Hand turning the engine a few times is strongly recommended.

By now it was February and all the work was done, so I connected the car to the old Rover MEMS ECU... It started first time with no big bang. What a relief! The car drove OK but it was running rich and was a bit lumpy.

Now I had to wait for the ECU, which arrived in late March. This was a newly developed 32-bit unit from Emerald Cams (Dave Walker, Technical Editor of Car and Car Conversion). It is a very advanced little box of tricks allowing specific settings for your engine including ignition, fueling, advance and retard, rev limits etc with

potential for other trickery at a later date such as launch control (see <http://members.aol.com/emeraldm3d/>). The unit was a straight swap for the standard MEMS unit, but being incompetent with a PC I couldn't get my computer to talk to the ECU, so I could not do the very simple task of setting the throttle pot before loading the car on the trailer!

I drove down to London the night before visiting Dave and his partner Karl Paton, at Emerald in Brixton, for a session on the rolling road. Now as those who have been there will know it is not the most up market venue, but these guys really know what they are doing - first priority was breakfast in the local greasy spoon with Dave!

Once our stomachs were recharged and after numerous cups of tea and various changes to the base map by Dave the Rave, we had the power runs on the rolling road. Dave told me to sit on the boot of a Caterham to give it traction on the rolling road, so like a fool I did. Registering 125 mph on a rolling road is rather interesting and not for the faint hearted! Also when you are hoping that everything was put together correctly you tend to have slight concerns that it will all hold together as 8000 revs approaches. The doors at Emerald don't look too forgiving either if the thing leaves the rollers!

The first run produced a rather disappointing 163 bhp. Some more tweeks and we saw 175 and smoother the power curve. After a bit of thought we adjusted the cam timing a little and there it was on the 6<sup>th</sup> run - 184 bhp @ 7664 revs and 136 lb/ft torque at 5840. A couple less bhp than Rob Walker's car, but more torque and lower down too.

The 250 mile round trip proved very worthwhile. A 33% improvement on the Supersport power and an 18% improvement in torque, all for around £1600 (I already had the throttle bodies). Now this improvement could be applied to the standard motor giving a staggering 60% increase in power.

Will I be able to catch the fast boys this year? We will have to wait and see! The first outing in April at Three Sisters near Wigan was positive and delivered a class win with a very comfortable margin. Am I pleased? Is the Pope a Catholic? My thanks go to the two Daves and Karl for their knowledge and help. I hope I won't disappoint them.

