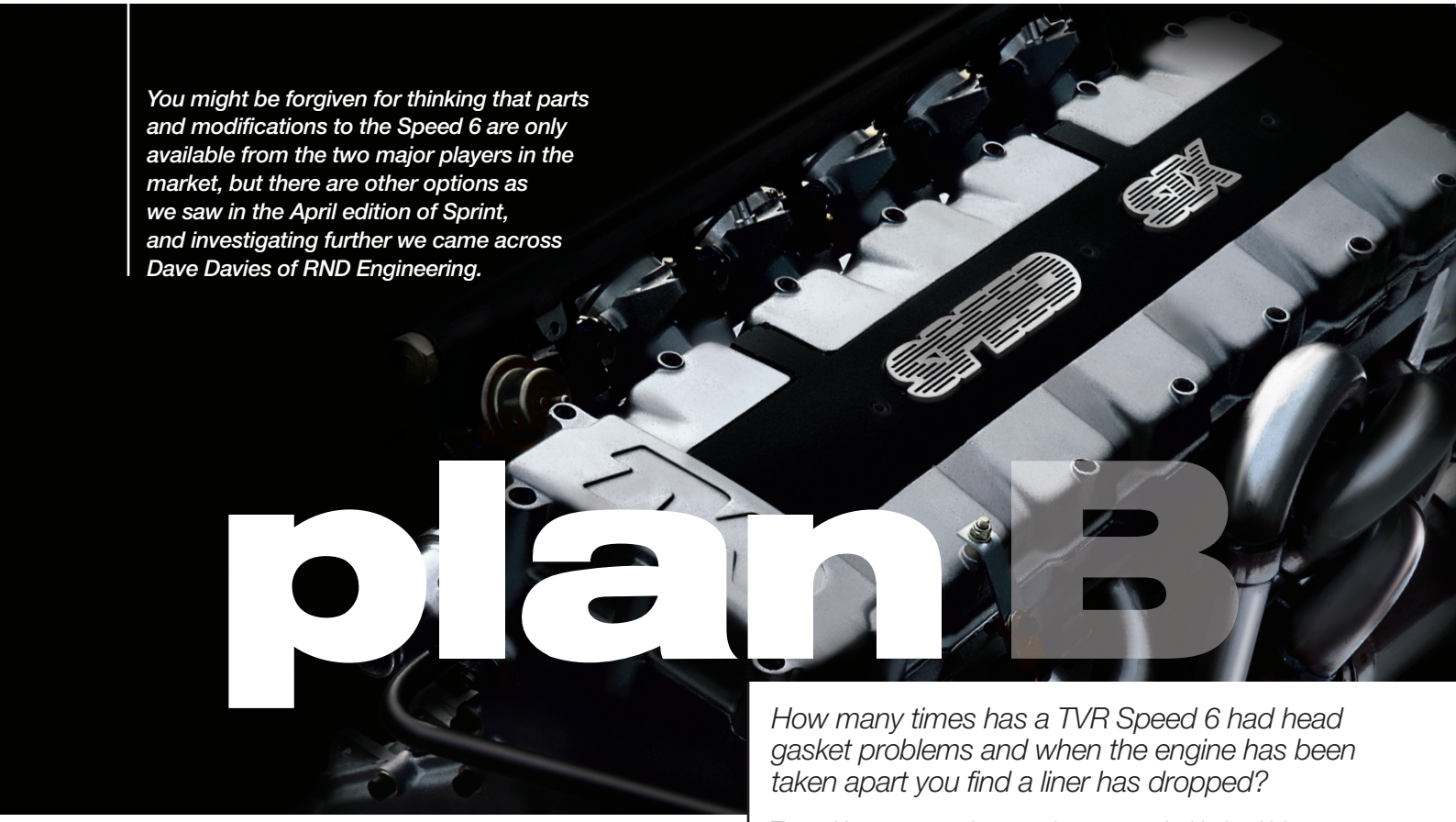


plan B

You might be forgiven for thinking that parts and modifications to the Speed 6 are only available from the two major players in the market, but there are other options as we saw in the April edition of Sprint, and investigating further we came across Dave Davies of RND Engineering.

With a good grounding in engineering, both hands-on and academic, Dave has worked with engines since his school days, moving on to become a trainee mechanic and then later to college to gain professional qualifications. The pursuit of power led to tuning, engine transplants and engineering developments covering a diverse range of vehicles that more recently has led to a diverse range of projects that include developments of ProCharger installations - a bolt-on device that combines the simplicity of a turbo, with the instant, on-demand power delivery of a supercharger - engine developments include a 2.5 V6 Vectra with 320 bhp, a 2.5 V6 Ford Cougar with 346 bhp, and a 3 litre Duratec conversion in a MK1 Mondeo converted to four-wheel drive and ProCharger.

Moving on to V8 engines, they've developed a 540ci supercharged monster-truck called 'Swamp Thing' with an engine producing over 1500 bhp, a Range Rover and a Ford Scorpio, both fitted with 4.6 Ford Modular V8's. ProCharger developments include an MGZT 260 SOHC Ford V8 engine upgrade to 5 litres, producing 600 bhp and 490 lb/ft, and a Chevy 305 trike modified to 383ci producing 600 bhp.

Obviously with an interest in engines producing high horsepower figures it was only a matter of time before they were approached by customers with TVRs, and they made their first venture into the TVR market with a supercharged 4.0 litre Speed 6, and an AJP 4.5 Cerbera. It was these projects that brought about a meeting with Al Melling, the originator of the AJP engines.

What transpired after is for another future article, and indeed Dave is now the owner of the design drawings and IP of the original range of AJP engines. The differences between the production Speed 6 and the AJP6 design will be the subject of an article here in Sprint later in the year.

What we're focussing on in this article are the solutions and parts that Dave has developed from experience, assisted by having had the benefit of access to the original designs.

I hand over to Dave to discuss the various common issues and his solutions to those problems...

How many times has a TVR Speed 6 had head gasket problems and when the engine has been taken apart you find a liner has dropped?

The problem appears to be excessive stress on the block at high revs, being caused by torsional and harmonic vibration through the crankshaft; there is a fluid damper on the engine which does help but it is not a cure as under high loads the block flexes a tiny amount and sometimes this causes the liner to move. There are a few things that can be done to combat this and the first is to correctly balance the crankshaft, rods and pistons. A point to note here, the 4.0 engine suffers more than the 3.6 because of the imbalanced conrods as the small end is heavier than the big end. As you can imagine with a longer stroke and the extra mass on the small end there is a balance problem which needs to be addressed. *(For more information on tortional vibration, the causes and consequences please vist http://www.rndengineering.co.uk/ and click on the link 'Speed 6 general information').*

I've listed the areas where we've addressed these and other commonly known Speed 6 issues.

Conrods

Our pro-stock lightweight I beam conrods are 60 grams lighter than stock rods, but most importantly are 180 grams lighter on the small end. These modified conrods are good for up to 600 bhp and 7500 + rpm.

From my experience I would not use the standard conrods (especially those fitted to the 4.0) above 7000 rpm and 380 bhp. Those fitted to the 3.6 are better but are too heavy.

Crankshaft

The standard crankshafts, in my opinion, are less than ideal from an engineering point of view with the 3.6 crankshaft design being even less desirable than 4.0 one. The castings are the same but the 3.6 is ground de-stroked and if you study one you will see the excessive material above the big end journal; they could have dressed this back and made it look and perform a lot better, and the same also applies to the 4.0. I addressed this and we've dressed and lightened both of the crankshafts and balanced them correctly. The 4.0 litre crankshaft is 2.0 kgs or 4.4 lbs lighter and the 3.6 crankshaft is 3.2 kgs or 7 lbs lighter, and rebalanced to race specification.

Block

As explained in the first paragraph what we've done here is strengthen the block in the crankshaft area by machining the block and fitting main cap supports on 2.3.4.5.6 main caps. This ties in the caps and the block in the vertical and horizontal planes, and this stops cap walk and thus stiffens the block to help it stop the flexing under heavy load.

Oil System

After revising the block assembly we are now looking at our revised oil system, the first thing we did was put an extra oil feed to the rear of the head on the exhaust side to compensate for the lack of oil on the rear exhaust side; as this is the hottest place on the engine this also aids cooling. To help this further we have our redesigned follower with 360 degree oiling; this gives a constant flow of oil to the camshaft lobes. Another upgrade is our all new redesigned billet high pressure/high volume oil pump which gives 30% more flow. To complement this is 360 degree main bearing oiling giving a constant feed to big end bearings to help lubrication and cooling.

Camshafts

Many of you have seen camshaft timing figures and to explain this in depth we have provided a link to a guide written by Peter Sleeman on how he refurbished his head and fitted new camshafts etc.

The most important setting when adjusting camshaft timing is CLA, Centre Line Angle; this is the valve at full lift in crankshaft degrees. Dulford Automotive have been using our camshafts and followers in their rebuilds for five years without any problems.

At this point there is an important thing to note about engine lubrication. One of the major problems we have found is people are using the incorrect grade of oils in their engines. One of the most important constituents is the amount of anti scuffing agent, zinkdialkyldithiophosphates or ZDDP. All flat tappet engines, which include TVRs, where the camshaft rubs against the follower require ZDDP to help protect these components. Modern semi synthetics and synthetics do not have enough ZDDP in them, so you need to check the amount of this additive. I recommend Millers 20/60 CSS semi synthetic as this has .120% ZDDP so if you want longevity this or an equivalent is the oil to use. For running in I would recommend a good mineral oil for the first 500 miles then use semi synthetic.

Because we manufacture our own camshafts there is enough material in the semi finished chilled iron blanks to put various profiles, higher lifts and longer durations on the lobes (the standard TVR castings are very limited).

All our camshafts are profiled by KENT CAMS and we offer four profiles:-

1. *Standard profile 268 duration and .320 inch at the lobe .81.3mm*
2. *GT profile 268 duration with higher lift and revised cam timing than standard*

   (Both of the above camshafts can be used with the standard TVR valve train)
3. *GTS profile 272 duration higher lift than GT to be used with our own valve train components.*
4. *GT-HO profile 280 duration higher lift than GTS used with our own valve train components*

We can also supply and design custom profiles to requirements.

Finally if you read Peter Sleeman's excellent booklet on how to time your camshafts the standard cam timing for S6 engine is:-

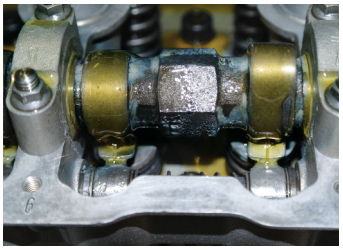
Inlet camshaft 107.5 CLA tappet clearance .007 + or – 1 thou

Exhaust camshaft 104.5 CLA tappet clearance .011 + or – 1 thou

Inlet camshaft Red Rose 113.5 CLA

Exhaust camshaft Red Rose 107.5 CLA

Performance Tip
If you wish to increase mid-range torque then use standard inlet timing but advance the exhaust cam; this can be done by B-Tech or Dulford Automotive.



Valve Springs

These are manufactured for us by a well known spring manufacturer as per the original recommendations by Al Melling in 2005. They are reduced pressure than standard to reduce loading on the valve train and made to our specification. These allow us to run lifts up to .600 inch or 15.25 mm and 8000 rpm.

Followers

These were designed for us by Al Melling from his original blue prints and manufactured to our drawings, and have 360 degree oiling giving a constant flow of oil to lubricate and aid cooling to the cylinder head. They are 6 grams lighter than the standard followers and allow the camshaft to follow the lobe correctly and because of their unique shape they accelerate the valve off the seat faster. These followers will work with a standard camshaft and will pull from 800 rpm in fifth gear if the engine is set up correctly.

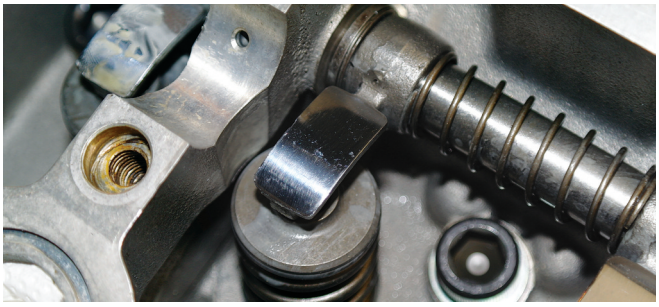
Cylinder Head

We've done a lot of development over the years and Dulford Automotive have been using our cylinder heads for five years. When we started our modifications the first thing we did was put the oil feed to the exhaust side of the cylinder head for better lubrication; this also feeds oil to the hottest part of the engine and with our followers will aid cooling. The other modification is to the valves, we have returned these to the original design with 8mm stems to give more support in the valve guide; an additional benefit here helps cooling of the valve. We also made the head diameter slightly bigger, by .5mm inlet and exhaust, to give a bit more seat area but these are also ideal if you want to port a cylinder head as you have a larger valve to work with.

We have two valves available, the standard 214n stainless, same specification as above, and also a severe duty pro-flow race valve made for us by Manley Performance Valves in the USA.

Re head modifications, as well as our standard reconditioned heads with all our upgrade components we can also do stage two ported heads and a full race specification using our Manley race valves.

"the question you need to ask yourself is, do I need to spend £1,000 on blueprinting? My answer to that would be - don't waste your money!"



Pistons

The standard TVR pistons are pressure cast and come in five types.

In addition we have developed an oversize piston which has a number of performance enhancing features; an offset piston pin or gudgeon pin for quieter running and more importantly less shock-loading on the piston on the power stroke. It has coated skirts for less friction, a high top ring for better cooling, more compression and power. These come with chrome-moly piston rings and are hypereutectic.

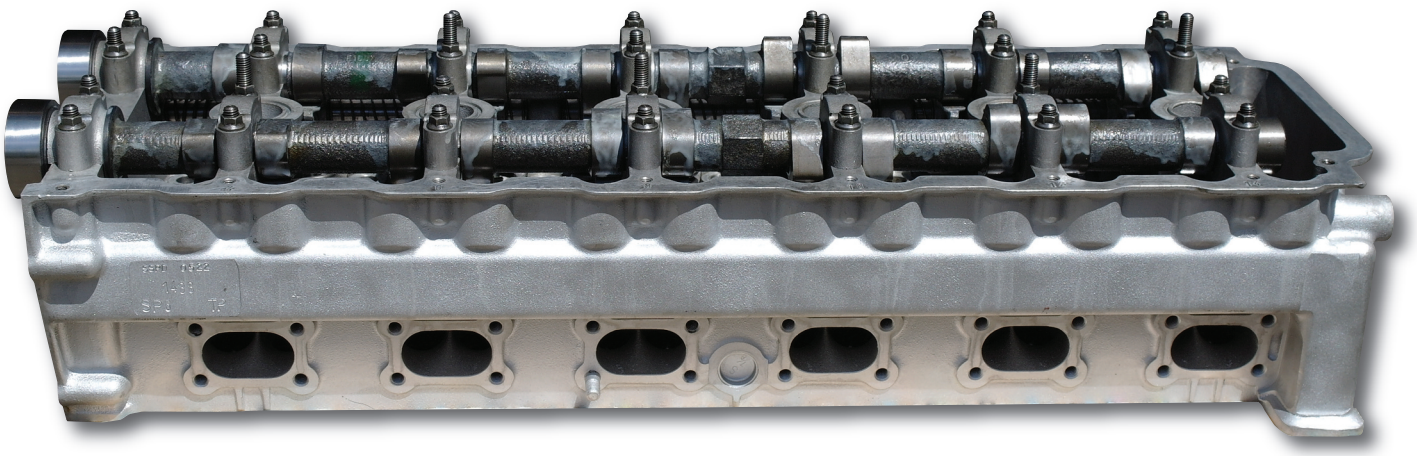
Blueprinting - Magic or Myth?

What is blueprinting? This is getting the original design drawings and looking at the measurements for all the components. Looking at blueprints for the AJP 6 show there is not only component specification but also an upper and lower tolerance limit; this is what you are working to, the idea is to build the engine loose so as to cut down on heat and friction and make more power. The question you need to ask yourself is, do I need to spend £1,000 on blueprinting? My answer to that would be - don't waste your money! Blueprinting is only beneficial if you are building an out and out race engine which will be rebuilt every few races where every bhp and lb/ft of torque counts by building your engine loose. If you do thousands of miles on your car there will be a certain amount of wear on the engine components, this in itself will loosen up the engine and make more power after about ten thousand miles.

Performance

Time and again I've seen people who have revved their engines to 7500 rpm +. There is no point in doing that as the 4.0 produces maximum power at 6500 rpm, and the Red Rose at 6800; after this torque and power are dropping and indeed the only thing that is going up is the torsional vibration and shock loading and wear. The 3.6 is a little higher with peak power at 7000 rpm. Even with our performance profile camshafts, peak power for the GT cam is still only 6500 rpm and 7000 rpm. With our GTS and GT-HO camshafts it is recommended that you fit our pro-stock conrods and rebalance the engine.

Dave Davies
in conversation with David Hothersall



Photographs courtesy of Dave Davies & Peter Sleeman

As a committed engineering DIY enthusiast, when Peter Sleeman purchased his 2002 Tuscan MK1 with 11,000 miles on the clock he bought it with the intention of doing all the maintenance on the car, and in the knowledge that he would be likely to be doing some more 'serious' work than just changing the oil and other general maintenance at some point.

That point arrived just 4000 miles into his ownership, his engine had always been a bit 'ticky' but just on one journey of 40 miles it went from 'ticky' to 'tappy'; it was quite obviously sick.

Peter takes over the story….

On removing the cam cover, it became clear that one lobe on inlet #5 was a mess and that the associated follower was seriously worn. There had always been evidence of an oil leak from around the cylinder head just above the coil pack (cylinder #5) but the scary thing was the valve clearances were OK just 2000 or so miles previously, so once the case hardening went it wore down in no time at all.

So, as the intro says, I enjoy the DIY of engineering and that's a good chunk of the reason I bought a TVR. If you're not sure whether to have a go yourself, you might be better off taking the safer option and entrusting this work to a reputable S6 specialist. That said, the S6 is an engine like any other. All the talk of "don't touch it, it's a highly toleranced and magical beast" is, in my opinion, laughable. Tolerances…pah! You'll see what I mean as you start to take it apart, however that doesn't mean you can afford to be slapdash. My normal approach is to put it back better than it came off (whatever that means) in fact, that's one of the great things about DIY…you can probably afford to do this where a garage can't. That said I did leave the head refurbishment to Dave Davies of RND Engineering who supplied new valves, reduced pressure springs, guides, followers, shims and cams. I also had the seats re-cut and the head re-faced. I also took the opportunity to have an extra oil feed put into the back of the head to supply HP oil directly to the exhaust follower shaft.

Dave contacted me when I posted for advice on PH and although I have no special allegiance to Dave I feel he deserves a special big "thank you" as his advice and patience with me were invaluable, as were the parts he supplied. The parts fitted to the head are now much closer to Melling's original design and just as importantly are made of decent material and hardened and finished properly by reputable firms like Kent Cams.

I wrote a document of my experiences about this and it can be downloaded from this link:- www.tvr-car-club.co.uk/tvrcc-sp6refurb.pdf

(Note: This is a very well put together and illustrated manual and is recommended even if you just have an interest in such things and have no intention of picking up a spanner - Deputy Ed)
The file is 108 pages and is 2.5Mb in size, you will also need Adobe Reader to view it.

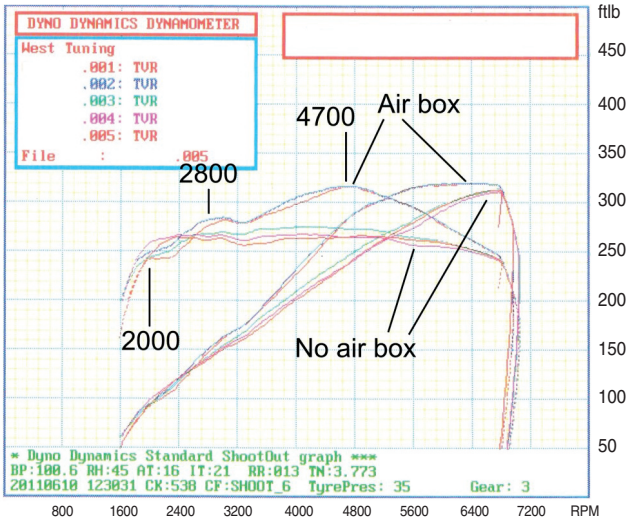
Hopefully it will encourage others to follow my lead and 'have a go'.

I also thought I'd share the results from a recent dyno run (dyno dynamics "heartbreaker"). (Standard 4 litre S6, 2002, with Cats and normal exhausts, non-mapped MBE)

At the time of the head refitting, some dialogue with B-Tech pointed to a possibility to adjust cam timings a little from the standard to try and make more mid-range torque at the expense of top-end power (I personally prefer my engines this way). They were basing this on some simulation results optimized for mid-range and based on their standard cams, incidentally they now supply all the parts I used on my rebuild.

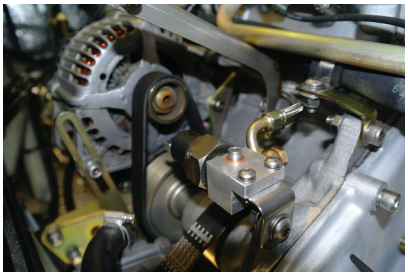
So I set the timings up as per their advice. The engine has now done over 2,200 miles and is running nicely. Popped the Cam cover the other day to take a peek and everything looks as fresh as daisies. The oil is nice and clean too.

The plots below show two runs with everything 'normal'. Peak power was around 322-ish and peak torque around 319, but it's where this happens that's interesting...4700 rpm and it's still making around 250 lbs/ft at 2000.



I'm very happy with that; I also chose to limit the revs to 6500ish, which turned out to be a good choice as the power graph is just flat out there.

The other 3 runs are with the air-box off...just for fun. OMG! Tuned length IS critical, so to those guys running their S6's with air filters pushed into the throttle bodies... get an air box back on!



Additional oilfeeds to increase oil flow and assist cooling on the exhaust side of the engine