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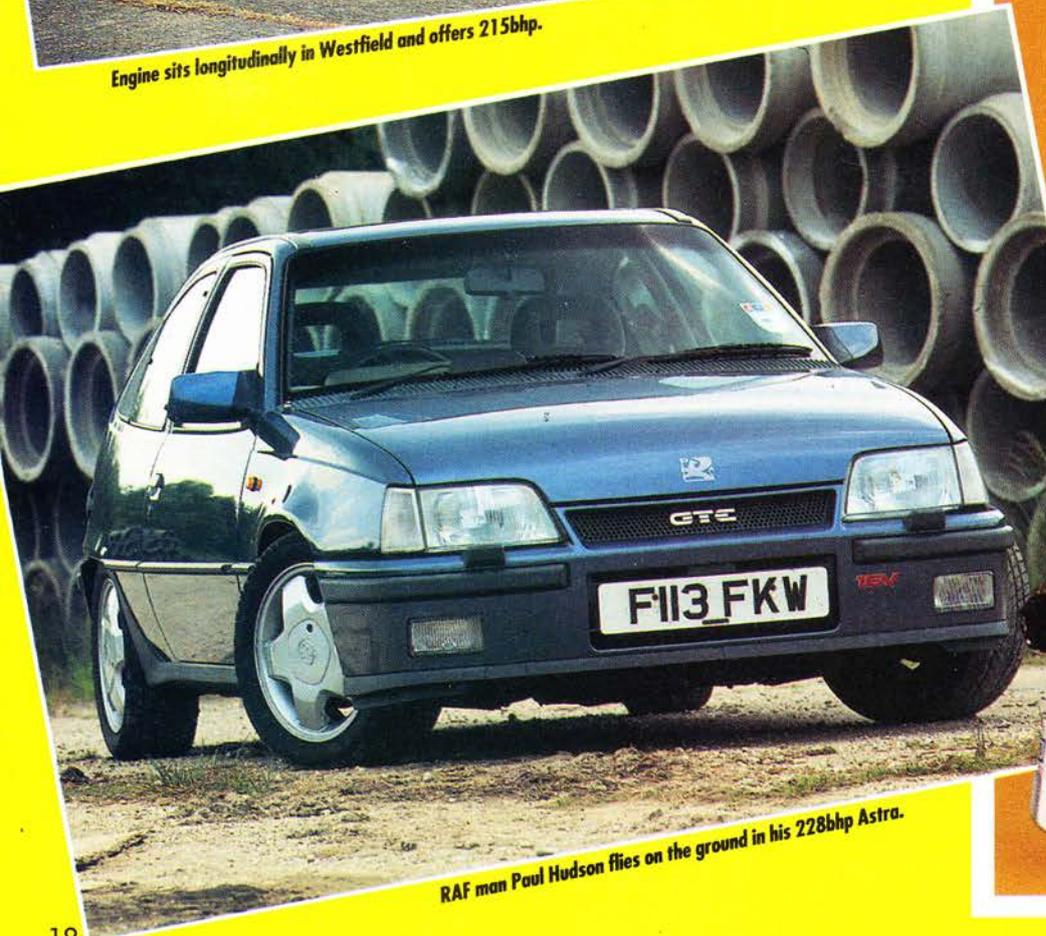
BRANDSTROM

Vauxhall This

*Ian Strachan compares the performance
with Vauxhall*



Engine sits longitudinally in Westfield and offers 215bhp.

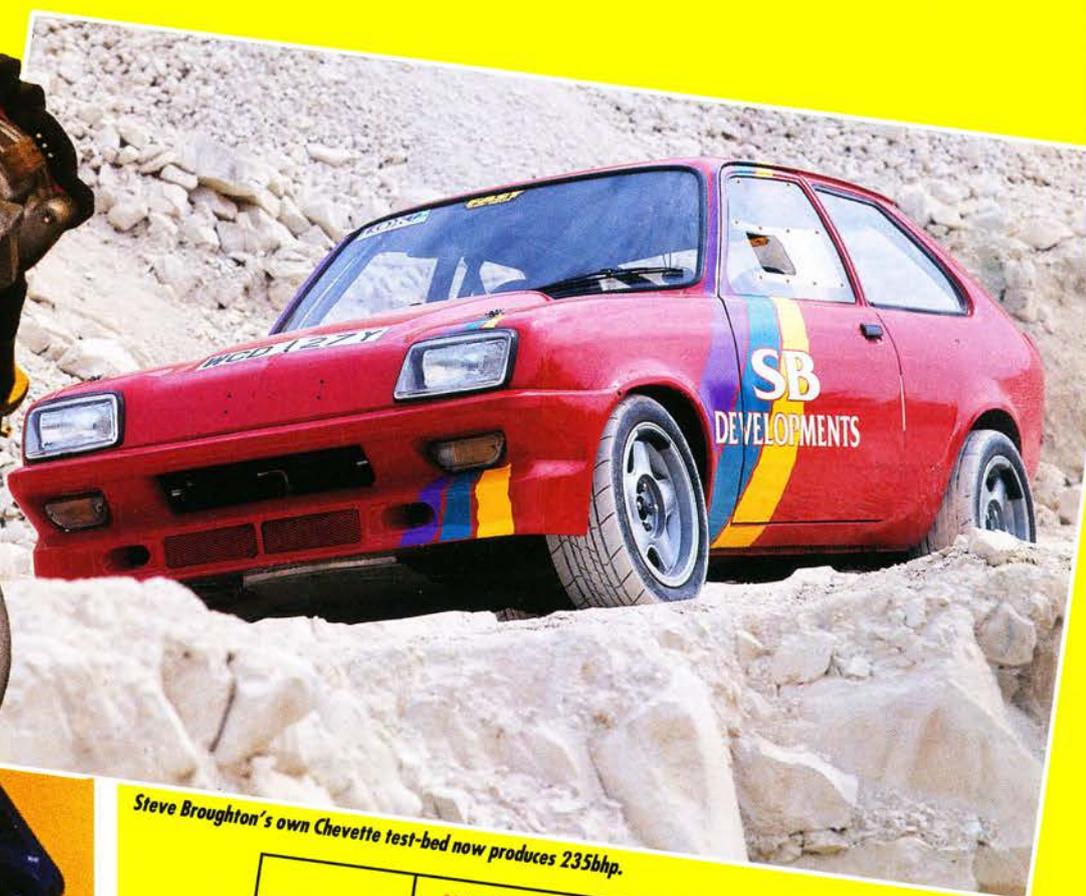


RAF man Paul Hudson flies on the ground in his 228bhp Astra.



is Variation?

of three very different chassis, all fitted
s 'little gem'.



Steve Broughton's own Chevette test-bed now produces 235bhp.

	WESTFIELD	ASTRA	CHEVETTE
0-10	0.7	1.0	0.9
0-30	1.8	2.9	2.4
0-50	3.7	5.2	4.1
0-60	4.7	6.5	5.1
0-70	5.7	8.3	6.3
0-80	7.7	10.8	7.9
0-90	9.5	13.1	9.4
0-100	11.9	15.9	11.9
0-110	15.9	19.9	14.8
0-120	22.4	24.4	-
0-130	-	32.1	-
0-140	-	44.6	-
1/4 mile at mph	13.3	15.0	13.6
V Max	102	97	106
	128	143	110

Vauxhall's 'little gem', the 2-litre 16V engine, forms the basis of all three conversions.

SB DEVELOPMENTS

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235bhp wide power band injection rally kit
Group A Astra Clubman Engine Kits
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Rod Bolt Set Specials
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Programmable Distributorless Ignition System
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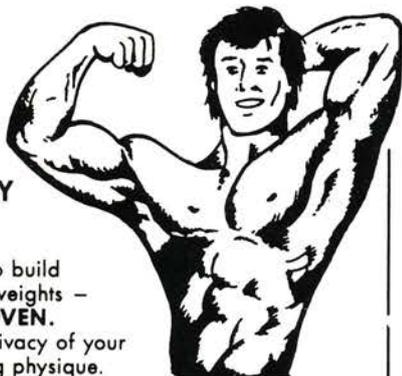
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Vauxhall This Varia

The Vauxhall 2-litre 16V powerplant has established an enviable reputation in the tuning industry, no doubt fuelled by its success on the track, powering the works touring cars. But for every factory car there's hundreds of privately owned vehicles, making full use of this engine's potential. Not surprising when you consider the 'little gem' responds well to even the mildest tweaking, being strong enough to cope with serious mods without spending mega bucks.

You'll find the silver and red cam cover isn't just fitted to Astras, Cavaliers and Calibras. It can be found under all manner of bonnets, from Novas to Mantas and even Escorts.

So what kind of performance can you expect from these readily available 16V units? With the help of Vauxhall tuners SB Developments (0372 278958) of Leatherhead, we attempted to answer this question. Three totally different chassis were sourced, all boasting the Vauxhall engine. Although all three are based around similar spec base motors, each has been tuned to match its intended use.

PAUL HUDSON VAUXHALL ASTRA

● Paul, an RAF navigator from Scotland, is used to travelling in machines with a much larger power output than his Astra. But 228bhp and a 0-60mph time of 6.5secs is more than enough to satisfy 'the need, the need for speed', once back on terra firma.

SBD's brief when receiving the car, was to build an engine which would be able to deliver the necessary power, yet still behave itself when driven around town. This was made possible by the MBE management system which reprograms itself every 250rpm, comparing information from various sensors measuring throttle angle, engine temperature etc, to determine the correct fuel/air mixture. In fact two days were spent on the dyno, mapping the system to suit. A stock air box houses a K&N filter, but with 4" trunking installed either side.

One of the characteristics of these engines is their strength. Many of the stock parts will handle the increased load

CHRISTIAN SILK WESTFIELD

● Christian is living every schoolboy's dream. He's the suspension mechanic for one of the top F1 racing teams. Obviously it's hard work and most of his time is spent living out of a suitcase and dashing from one country to another. So when he gets home, he relaxes...by hillclimbing a 215bhp Westfield.

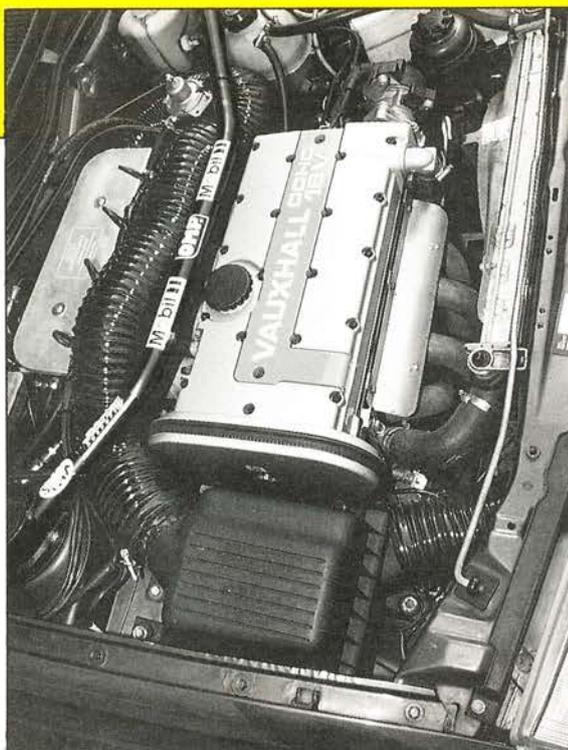
Space, or the lack of it, is an important factor in a Westfield. The long, slim design means the Vauxhall engine is installed longitudinally. Christian achieved this by fitting standard spec engine and gearbox mounts sourced from the Westfield Centre (0799 524380), as at the time it



Where to fit everything was the main consideration when Christian decided to drop the Vauxhall 16V engine into his Westfield hillclimb machine.



In its intended home, the 16V powerplant has been persuaded to offer Pcu! 228bhp.



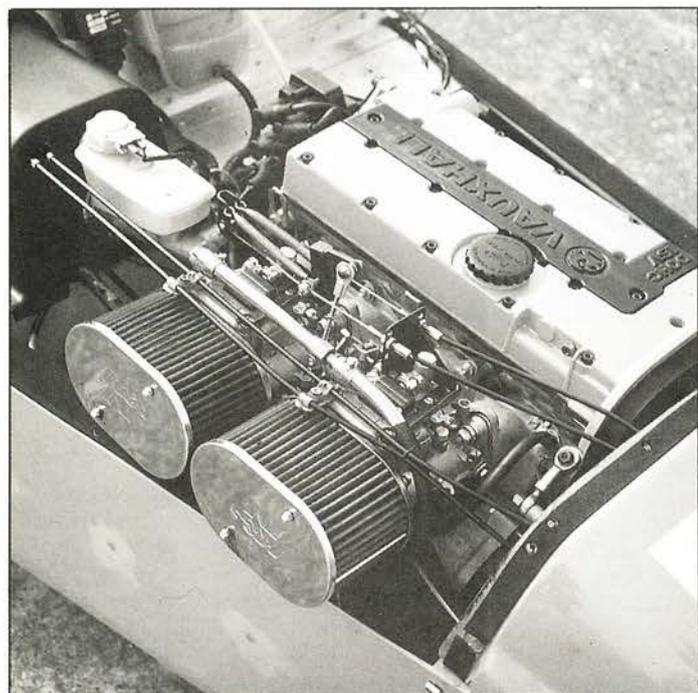
when boosting output, making such mods a whole lot cheaper. The factory flywheel was left unchanged, as was the stock wet sump system. The rods, however, were modified, connecting pocketed pistons, which raise compression to 10.9:1, to the stock crank. The head was flowed and matched to the inlet manifold, with SBD's own cams added.

Exhaust exits through an SBD fabricated 4-2-1 manifold which is larger than standard, though not enough to lose low down torque, and then matched to a Sebring system.

The brakes gained Tarox discs and Mintex 171 pads all round. Aeroquip hosing is employed throughout and supplies DoT 5 racing fluid. Suspension is by Spax and is fully adjustable.

Looks are basically standard, however 6x15" Calibra wheels are fitted and dressed in Dunlop D40 ZR195/50 rubber. Inside is similar, the only addition being an outside temperature gauge, following an incident with some unexpected ice.

The chassis copes with the upgrade very well. Power is transmitted smoothly and quickly, only being restricted by the stock transmission.



wasn't offered as a powerplant option by Westfield themselves. The ancillaries were fitted in wherever space allowed.

A Westfield wouldn't be a Westfield without induction roar, so the injection system was discarded in favour of twin 45 Dellortos, breathing through K&N filters. The inlet manifold is an SBD fabricated item, as is the exhaust which has been specially jiggered to fit the car. A dry sump system was also added to ensure ground clearance.

The cylinder head casting is stock, as substantial power increases are possible without even touching the head. An SBD high lift cam profile has been used, ground by Kent, which acts upon hydraulic tappets. The increased lift requires special double valve

springs. The stock pistons have been machined, enlarging the pockets to clear the valves. These sit upon lightened and balanced con'rods, strengthened by Cosworth rod bolts. The crank and flywheel have also been balanced.

Not surprisingly Christian tweaked the Westfield's suspension. Input is increased with the aid of a quickrack, while the independent front suspension is fully rose jointed. Stiffer springs are employed and the geometry has also been altered. A stock SEi system holds up the rear. Stopping power is supplied by a 2.8i Capri system at the front, while Sierra 4x4 items hold back the rear.

No improvement is needed in the looks department. The classic low, open, sports design attracts wide eyes and

Vauxhall This Variation

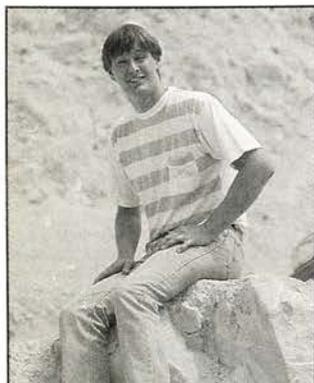
gaping jaws wherever it goes. However, the swept wings have been replaced with the smoother cycle options and the fuel filler cap flush fitted. Inside carbon fibre panels provide a hi-tech feel along with a Momo steering wheel.

When dry, the car weighs around 525 kilos yet produces 215bhp with 180lbft torque. The definite weight advantage propels it past 60mph in an amazing 4.7secs. Even with this supercar performance the chassis still has more to offer. Christian predictably describes the handling as excellent, perfect for hillclimb tracks.



STEVE BROUGHTON VAUXHALL CHEVETTE

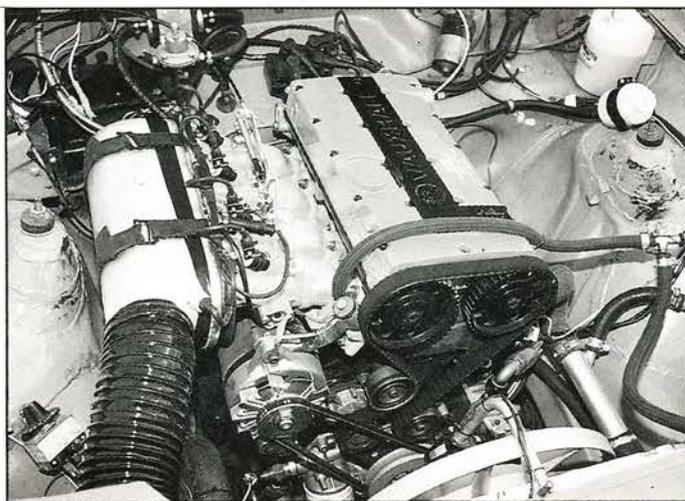
● Neither Steve, who runs SBD, or his rallying Chevette



are strangers to *Fast Car*, having been featured in October '92. Since our last meeting much engine and suspension development work has been completed.

The 16V block houses lightened and balanced crank and rods, while a lipped crank pulley prevents the alternator belt being thrown off. Omega racing pistons with enlarged valve pockets raise the compression ratio to 11.5:1. The ported and flowed head employs an SBD high lift cam and double valve springs.

On the fuelling side, the inlet manifold is matched to Lumenition injection bodies, 48mm in diameter. These are controlled by a 912 MBE management system, which also incorporates a



Chevette makes full use of 235 horses offered by SBD modified 16V motor.



distributorless ignition system. Like on the Astra the system reprograms every 250rpm. Dry sump lubrication is also employed. This lot produces a claimed 100bhp power hike, increasing output to 235bhp.

Installation had its problems. A pair of uprated Manta mounts positioned the engine as far back as possible, for better weight distribution, while SBD made a new

gearbox crossmember and a special oil filter to clear the front anti-roll bar. The engine is canted 7° towards the exhaust to maintain the oil level in the rocker boxes and stop the exhaust side overheating.

Power is fed through a lightened flywheel and single 9" spring-loaded clutch, to a Quaife (0732 353747) four-speed Pro 'box. An A-series Manta rear axle has had its

torque tube removed and been converted from three to five-link location. The ZF 70% slip diff' mates to stock halfshafts.

Much work has gone into curing handling problems. Spring rates have been dropped to 175lb at the rear and raised to 950lb up front, with Bilstein shox all round. The rose jointed front end features a 3" wider track, improving the centre of gravity and allowing 4 1/2° of camber adjustment. Rubber can change enormously according to the event, but always covers 7x15" Revolution RFX rims.

All interior trim has been removed. Seats of unknown origin are strangled by Willans harnesses. Extra protection comes from a Safety Devices (0353 624624) six point roll cage and Angus fire extinguishers. All gauges are by Smiths apart from the Elliot rev counter.

External lightening was achieved by perspex windows and glassfibre wings, bonnet and tailgate. A Chevette HS replica front spoiler was modified to fit, the rear version from an HSR. Bodycraft in Horsham sprayed the Vauxhall Carmine Red and Look 2 (0483 450324) of Guildford did the graphics.

The Chevette is obviously geared for bottom end speed and reaches 60mph in 5.1secs. Inevitably though the top speed was the lowest of our test day. The combination works well, as reflected by Steve's trophy cabinet. ■

Vauxhall this then?

While tuning packages for the Vauxhall 16V twin cam are numerous and varied, Jim Blackstock discovered a modular approach that won't break the bank.

In addition to being fitted to the performance variants in the Vauxhall range, their 16V twin cam is a popular transplant option for inexpensive and immediate power gains. It's finding its way into a huge variety of chassis, not just older models from the same manufacturer. We've seen it in Novas, Mantas and even a Mk2 Escort. One of the most impressive conversions we've seen, however, was in a Chevette, featured in October's *Fast Car* and built by Steve Broughton of SB Developments.

Steve went for the twin cam after numerous problems with the previously transplanted 8V Astra unit. In addition to reliability advantages, there are significant gains in performance. The engine in question was an essentially standard unit but Steve has now come up with a series of tuning upgrades which can be applied for both competition and road use.

His philosophy is simple; "We build an engine, test it on the rally stage or the road and if it works, either sell the motor itself or produce a package incorporating all the design points." Most of the tweaks outlined here give



greater mid-range output, essential for rallying and more useful for road applications, rather than out and out top end power. However, the latter is also possible, if the car is intended to be used on the circuit. Basically, it all depends on the customer spec and intended use.

Bottom end

All Steve's engines start with a secondhand block. As well as keeping the cost down, any inherent stresses present after the initial forming processes are removed during use. Block preparation is kept to a minimum, with only a light hone needed on engines up to 30,000 miles. In fact, they generally have the original

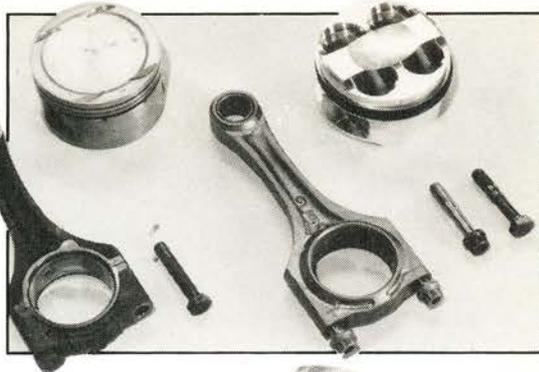
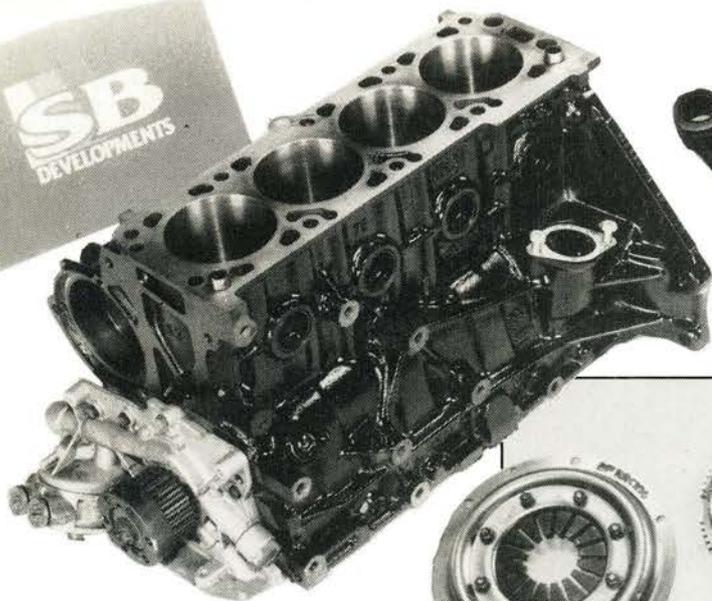
honing marks! The oil pump is normally replaced, however, as this is a particular weak point on this motor.

The centre gear is formed from compressed material and because the oil passes through the pump before it reaches the filter, any foreign bodies can cause this gear to shatter.

Special gears are available from GM Europe but these cost a massive £500 and are intended for group A motors. Therefore Steve uses new stock pumps. As long as the oil is looked after, the pump will be OK.

If a full rebuild is being carried out, the reciprocating components are balanced, firstly the crank, then with the flywheel fitted and then the pulleys. This is all done to a tolerance of 0.2

SB
DEVELOPMENTS



Stock rod, bolt and pistons (L) compared to lightened and balanced rod, Cosworth and GM bolts and modified piston.

Above: Standard blocks have little more than a hone and new oil pump.

grammes. Serious performance upgrades require re-machining of the flywheel to accept a Sachs or AP Racing clutch but Steve is having some uprated components made to mate with the standard flywheel. Apparently these will be safe up to 225bhp but any more will require a paddle item.

The cranks don't receive any lightening or heat treatment, Steve reporting bad experiences with cracked shafts following tufriding. He justifies the use of stock cranks by saying he's never seen one fail. Standard con' rods have a safe working limit of 7-7500rpm but for an extra margin of safety, Steve fits either GM Europe big end bolts, with a breaking strain of almost 13 tonnes or Cosworth 12 point items.

For more serious use, the rods are lightened by around 60g, being mounted in a lathe and having the big and little ends machined. They're balanced end over end, to within 0.2g, before being shot peened to remove any stresses and surface cracks which act as stress raisers. This all results in a safe limit of 8250rpm.

Steve favours Omega pistons, which come with cut-outs for the standard sized valves. However, with a big valve head these have to be enlarged to prevent contact while they are also cut back to promote gas flow. The pistons dictate the compression ratio, usually 11.3:1 for stage rallying or the road, since it's almost impossible to machine either the block or head and still avoid piston/valve contact, the two being so close as standard. Before assembly, the pistons are balanced as a set.

Top end

Standard secondhand heads are the basis for the breathing, since they also lose their stresses during use. Guides normally need replacing if there has been piston/valve contact, as the



Crank balanced and flywheel modified to accept paddle clutch.

bottom can chip off, producing a nasty bit of metal floating around in the motor. Stock guides are cast iron and wear slower than phosphor bronze items, so they're normally retained.

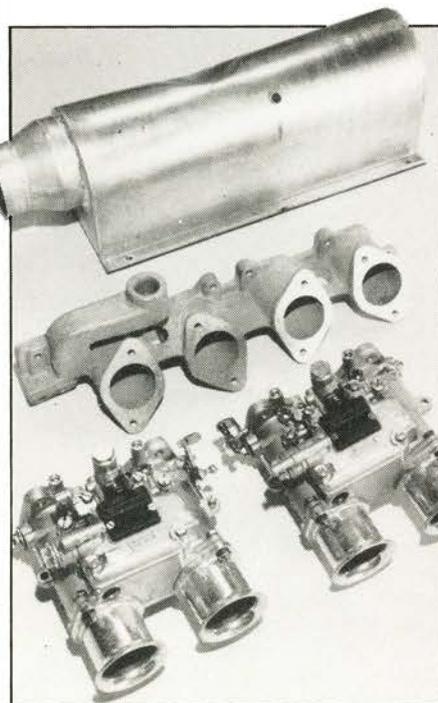
The combustion chamber volumes are equalised at around 42cc and the valve seats reduced in width to just 1mm before being blended into the chambers and ports. The latter receive extensive flow work but their overall size remains unchanged, to preserve port velocity for mid-range torque. The guides are cut

back flush with the port roof before the sharp edge on each port splitter gains a small radius.

Big valve heads use 1mm oversized items, on both the inlet and exhaust side. On the exhaust seat there's plenty of meat to cope with the larger diameter but not on the inlet. Therefore they are left to overlap the seat slightly. According to Steve this doesn't present any problems, since the overlap is only 10thou and because the valve is cooled by the incoming charge, there are no heat transfer complications. The reason this situation occurs is the price of replacing the seats. They cost £14 each and a further £25 each to fit - multiply that by 16 and you've got yourself a monster bill!

The valves themselves, as well as having a 1mm larger head, are also 1mm longer above the collet grooves. This allows tailoring of the shim sizes to suit the application, when solid tappets are used. Hydraulic items compensate automatically. The inlet stems are waisted and use a higher grade of steel than the stock items, leading to a thinner head. To keep them shut, two spring choices are available. The first comes from cam makers Kent and comprises double coils, allowing lifts of up to 13mm. The other comes from NM and is a single coil, supplied with a special cap. The disadvantage is the cost, however, with the NM items weighing in at £18 each, in contrast to the £110 per set for the Kent gear.

The only disadvantage with the double springs is the valve stem seals must be modified to sit inside the smaller diameter inner coils. Steve generally stays with hydraulic tappets to ▶



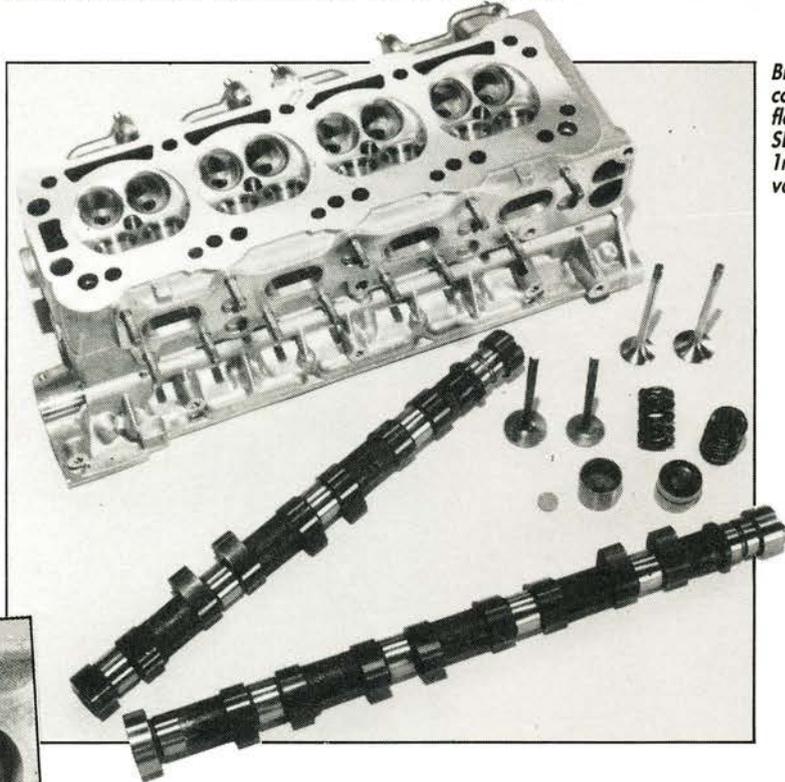
Dellorto 48mm carbs on an SBD manifold admit mixture, fed by a fabricated airbox.

Vauxhall this then?

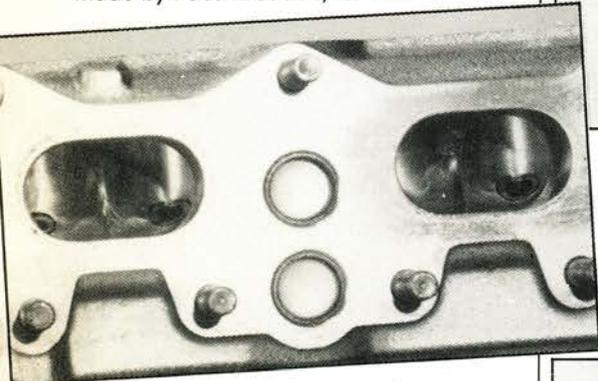
keep the cost down, saying these are safe up to 8250rpm. Above this speed they start to get a little 'fluffy' so lightweight steel items can be used.

Control is provided by SBD spec cams in various profiles, depending on the intended use. The specs are derived from drawbacks of existing shafts. For rallying, they use 305° duration and 11.5mm lift, ground for SBD externally. They are driven by alloy vernier pulleys from GM Europe.

SBD also modify the rocker cover breathing system, since the original baffle traps oil in the top end so it's replaced with a smaller version. For wet sump applications, a baffled big wing sump with a modified windage tray is used but for more arduous uses, dry sumping can be employed. The parts are made by Pace Products, for rwd

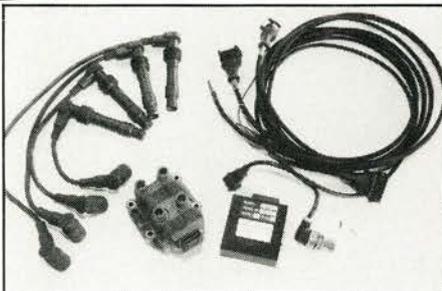


Breathing controlled by flowed head, SBD cams and 1mm oversize valves.



Left: Inlet port splitters receive slight radii while valve guides cut down flush with port roof.

Below: Ignition is by programmable MBE system, which will also control injection on stock motors.



installations where crossmember clearance can be a problem. All the engine breathers are blocked off on dry sump engines, breathing taking place through the lubrication system.

Fuelling is handled by a pair of 48mm Dellorto carbs with the choke size varying with the use. These would normally rest on an SBD cast inlet manifold, modified to allow water to continually circulate the head, preventing hot spots. Air comes from a remote filter, mounted ahead of the radiator to duct cool air to the fabricated air box. This means the

choke size can be kept low to maintain a high velocity through the carbs.

Two options are available for igniting the mixture. Firstly a Manta 1800 distributor can be mounted on an SBD bracket to the side of the block, driven by a step-off gear. The alternative is a distributorless system from MBE. Originally designed for the Vauxhall Lotus single seat series, this system can ultimately control fuelling, ignition and boost parameters on a turbo motor. In this case, however, for a motor on carbs, it looks after the ignition only.

The brain measures engine temperature and throttle position and adjusts the timing to suit. An added attraction is on transplanted road cars still on the original injection. The MBE system will control fuelling at any point in the engine's performance area, producing around 10bhp more peak power than is available on carbs. In addition, it means the expense and grief of splicing the 16V's brain to the new car's electrics can be dispensed with.

Exhaust systems differ depending on the installation but a rally or road spec motor would use a 4-2-1 tubular manifold for maximum mid-range performance, coupled to a system custom designed for the chassis. Something else which depends on the installation is a range of bellhousings which allow the engine to sit at 7° towards the exhaust side without canting any of the Ford gearboxes it was designed for. Obviously this is only for transplanted rwd applications. ■

PRICES

The following prices are without VAT but remember, a modular approach can be taken, ie some or all of the mods can be used, depending on the use and budget.

Modified cylinder head	£650
High compression pistons	£320
Machine pistons	£65
Con' rods, L&B	£150
High tensile B/E bolts	£59
SBD camshafts	£320
Kent springs	£110
Vernier pulleys	£105
MBE ignition system	£365
Carburettors, 2x48DCOE	£295
Inlet manifold, with fittings	£135
Sump, inc pick up pipe	£143
Airbox, inc filter & trunking	£150
Tubular exhaust manifold	£145

CONTACTS

SB Developments 0372 278958
MBE Systems 0285 641095

IN PRACTICE

Since his rallying Chevette was featured in September's *Fast Car*, Steve built and fitted a new engine, encompassing most of the modifications outlined here. However, the head retains standard size valves. Even slightly down on power, Steve's car finished seventh overall and fourth in class in a recent event. He finished behind three Metro 6R4s, a 400bhp Rover SD1, a works 2.6 Chevette and a Cosworth powered Escort. He hoped to be able to supply dyno figures from the engine before we went to press but this didn't happen. However, Steve predicts with the stage two head and 11.3:1 compression, the motor should make in the region of 230bhp. In a lightweight chassis like the Chevette, you can see it delivers the goods!