Know this

1-Litre EcoBoost

When it comes to modern Ford engines, there are some great alternatives for your classic Ford coming through — like this turbocharged three-cylinder engineering marvel with frankly-ridiculous horsepower potential.

Words and Photos Jon Hill

If we told you that a 1-litre engine had more power and torque than a well-tuned Pinto and that a car with an engine sporting just 995cc had lapped the Nürburgring in 7 minutes 22 seconds, and had the potential to reach 350 bhp, you may well think we're talking out of the proverbial.

Question it you may, but it's true — the 1-litre EcoBoost is a completely new breed of Ford engine that'll blow your mind. And note that one word we used — FORD. Yes, it's not a Volvo, Yamaha or a Mazda design, but a Ford one. And what's more it has a Ford bellhousing pattern — sort of.

Plentiful and relatively cheap, it all sounds like fantasy land and quite rightly, we needed to find out more. So we took a trip to see a specialist — David Wedge at DTM Power, someone who has spent plenty of time in research and development, developing the engine for a private client to get over 300 bhp while keeping one of the flattest torque curves you'll ever see.

To show us, David has a complete engine plus several in bits, so he was able to guide us through what makes the EcoBoost special, plus reveal its downsides too — and there are a few.

Mostly though, this could be the future — a light torquey engine that should fit anywhere.

Where to find one

Introduced in April 2012, initially there were two turbocharged versions of the 1-litre EcoBoost with 99 bhp and 123 bhp. Since then, there's been an update — the power output in the special-edition Fiesta Red and Black versions has been pushed to 148 bhp, while there are also normally-aspirated versions with 65 and 80 bhp.

You may think their small size makes them only suitable for the likes of the Fiesta — all revs and no grunt — but the truth is they have masses of torque where you want it; enough to find them in everything from the B-Max, C-Max, Focus, even the Mondeo and Transit Courier van.

You won't believe how they drive — those torque figures reach 125, 148 and 155 lb.ft respectively and with a flat curve. Close your eyes (perhaps not while driving) and it behaves like a much bigger-engined car. And they do it with economy, too — although that torque does make you want to boot it all the time.

"THE ECOBOOST HAS MORE POWER AND TORQUE THAN A WELL-TUNED PINTO — AND 350 BHP POTENTIAL"

How does it work?

Forced-induction helps, along with modern engine design — the oil-return channels cast into the side of the block that direct it away from the crank and therefore preventing it from slowing down as the oil splashes back into the sump, for example. But there are many more details and the only way to see them is by examining the engine in detail. The following pages will help to give you some idea of its potential. →

Info

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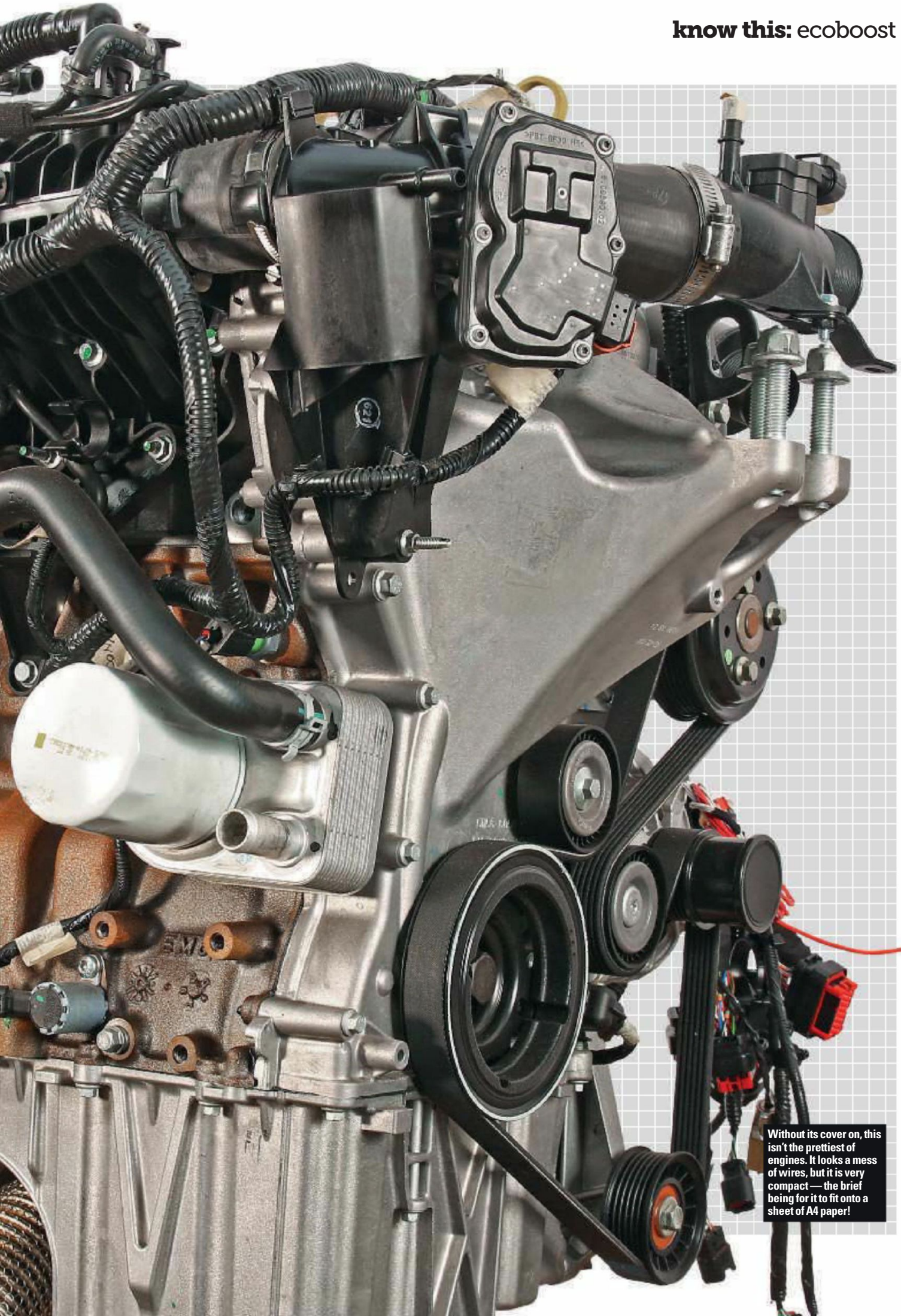


Without its cover on, this isn't the prettiest of engines. It looks a mess of wires, but it is very compact — the brief being for it to fit onto a sheet of A4 paper!

THE BLOCK

The complete engine is light – weighing just 96 kg — although for its size that is actually a fair amount. Most of that's due to the block's cast-iron construction.

This is one of DTM's development blocks that's been stripped of components, and it shows off its major features well – on this side you can see the oil redirection channels cast into the block, while below it is the cast-in knock sensor.

Dimensions of the block are a 71.9 mm bore with a stroke of 82 mm, which is nice and long and can only accentuate the torque figures the engine produces.

The bottom end is well supported – the crank runs in four main bearings, which are braced into the bottom end of the block with buttresses built up the sides into the sump area adding strength, but reducing weight at the same time.

CON-RODS

Con-rods are of superior I-beam construction

The rods follow late Ford engine design of being of chunky I-beam construction. They are 139 mm rod length with 15.5 mm wide shells and a 40 mm journal designed to take a 20 mm floating gudgeon pin.

The big ends are laser scored and then control broken, which eliminates machining as the caps can only fit the rod they were broken from.

The big ends are control-broken to eliminate machining.

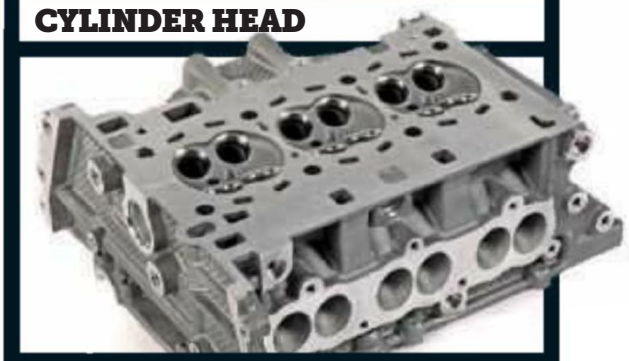
THE CRANK

The crank is cast but fully counter-weighted, opposing the pins — although it's externally balanced.

The oil pump is a variable displacement unit, which is electronically-controlled via the ECU.

On the nose of the crank are two toothed pulleys – one's the drive for the cambelt, the other the oil pump – both sit behind the front cover and run in oil, which also serves to lengthen belt life – although belt changing probably means taking the engine out!

CYLINDER HEAD



The cylinder head is the classic twin-cam format using four-valves per cylinder — therefore, it's a 12-valve! Naturally, it uses the latest technology to accurately reproduce an extremely efficient head design with a fair amount of potential — although there are more emissions-based features built in, which need to be removed in the name of performance.

This may look like a classic multi-valve combustion chamber but note the extra hole next to that for the spark plug — this is for the direct injector, which sits upright in the chamber and squirts straight into it. Although this efficient, it creates more problems.

The ports are large but they are dry ports — fuel is not injected into them. To create power beyond 200 bhp, porting work is needed although it's a delicate affair; especially in the exhaust tract — there isn't much meat between it and the water jacket.

The exhaust manifold is built into the head, which also provides the mount for the turbo.

"LIKE THE ST170, THE ECOBOOST FEATURES VARIABLE CAM TIMING, BUT ON BOTH CAMS"

The 1-litre EcoBoost is one of the new-breed of Ford petrol engines — compact, efficient but still very tuneable.

CAMSHAFTS

These are both the same and typical turbo cams — they have short duration and high lift, which minimises overlap.

Like the ST170 and Duratec, the EcoBoost features variable cam timing, but on both cams. This is controlled by oil via a central actuator, which works in a system of curved channels with sliding pistons allowing the cam to rotate and vary the timing by around 15 degrees of movement.

The actuator is controlled by the ECU, which means the timing can swing about as necessary to optimise the timing and therefore performance.

PISTONS

These are cast alloy and of classic slipper piston design with low bodies - they feature domed crowns producing a compression ratio of 10.0:1 — high for a turbo engine. This area also features tumble and swirl pockets to help with efficient burn.

The limit of the pistons is around 200 bhp, after which cracking problems occur. Further power is available but it would mean a switch to forged pistons.

Piston cooling squirters are fitted into the base of the cylinder bores, so that they squirt the underside of the piston with oil.

The sump is of alloy construction, and front-bowl configuration. The cut-out is meant for the exhaust to pass through although it may clear a front-wheel-drive crossmember — further investigation is needed!

The oil filter and cooler unit fits on the side of the block, and is fed with coolant.

THE TURBO

This is Borg-Warner unit is very small and is meant to complement the normally-aspirated side of the engine — hence the 10.0:1 CR, which helps off-boost performance, and reduces lag. It then boosts at 20 PSI, which is enough to produce 150 bhp. It will create more but the turbo is virtually at its limit at this point as it's already spinning at around 190,000 rpm — it is one of the fastest spinning turbos ever in a production car.

FUEL-INJECTION

This is direct to the combustion chamber via a common rail and is very similar to common diesel practise.

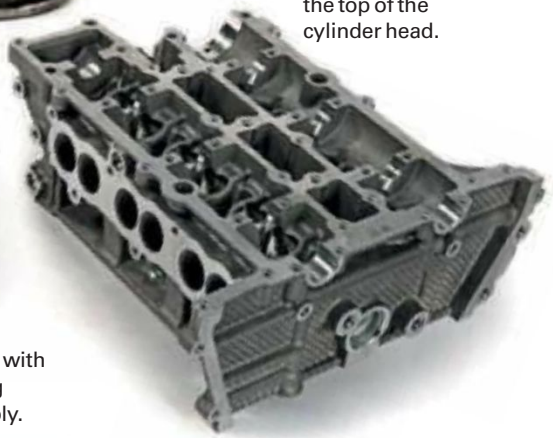
Injectors are super-precision pieces and need careful handling — it's a no-no to touch the end of them, for example. The reason for the precision is emissions — the actual window for injecting fuel into the combustion chamber is very small since both valves need to be shut, which of course is a very short duration.

Cost of replacement is a limiting factor — they cost a fortune — although to raise performance the traditional trick of upping fuel pressure simply won't work as they already act at a very high pressure. The only way of improving flow is to fit a different injector, which chances are will have to be bespoke but are available from DTM Power.

THE VALVES

These are normal multi-valve Ford pattern with sizes of 27 mm inlet and 23 mm exhaust that flow very well.

The cams and valves mount into the top of the cylinder head.



The followers are mechanical with adjustment carried out during computer–controlled assembly.

ANCILLARIES

The front cover carries a serpentine belt system, which is driven via the crank to the externally driven water pump, located at the top, then fed via an idler to the alternator below it.

Behind the front cover lives the cambelt, which runs in oil. Note the dipstick tube too, while you can also see the water pump cassette-style system.

The thermostat is a twin/split system housed beneath a plastic cover.

Although there is a problem — due to the direct fuel injection into the combustion chamber, there is no fuel passing the backs of the valves to keep them clean. Therefore, they gum up with deposits, which can build up after just 15,000 miles. We thought de-cokes were a thing of the past but it looks like this engine needs one around the 50-60,000-mile mark, otherwise flow can be severely restricted.

IGNITION

The whole engine is controlled by a Bosch MED 17 unit with CAN BUS and individual cylinder knock control. Spark is provided with coil-on plug units via crank trigger system.

There is also fly-by-wire throttle incorporated into the system.

GETTING MORE POWER

Other than dropping in a Fiesta Red or Black engine, you can raise the performance of the standard turbo engines. DTM can reprogramme the ECU to achieve those 150 bhp figures with no mechanical changes. However, this is the limit of the standard components — after this point, the pistons and rods need replacing, although the crank can be retained — this is a turbo engine where revs are unlikely to go beyond 8000 rpm — but the head requires porting and the cam reprofiling therefore, a full engine re-build is required.

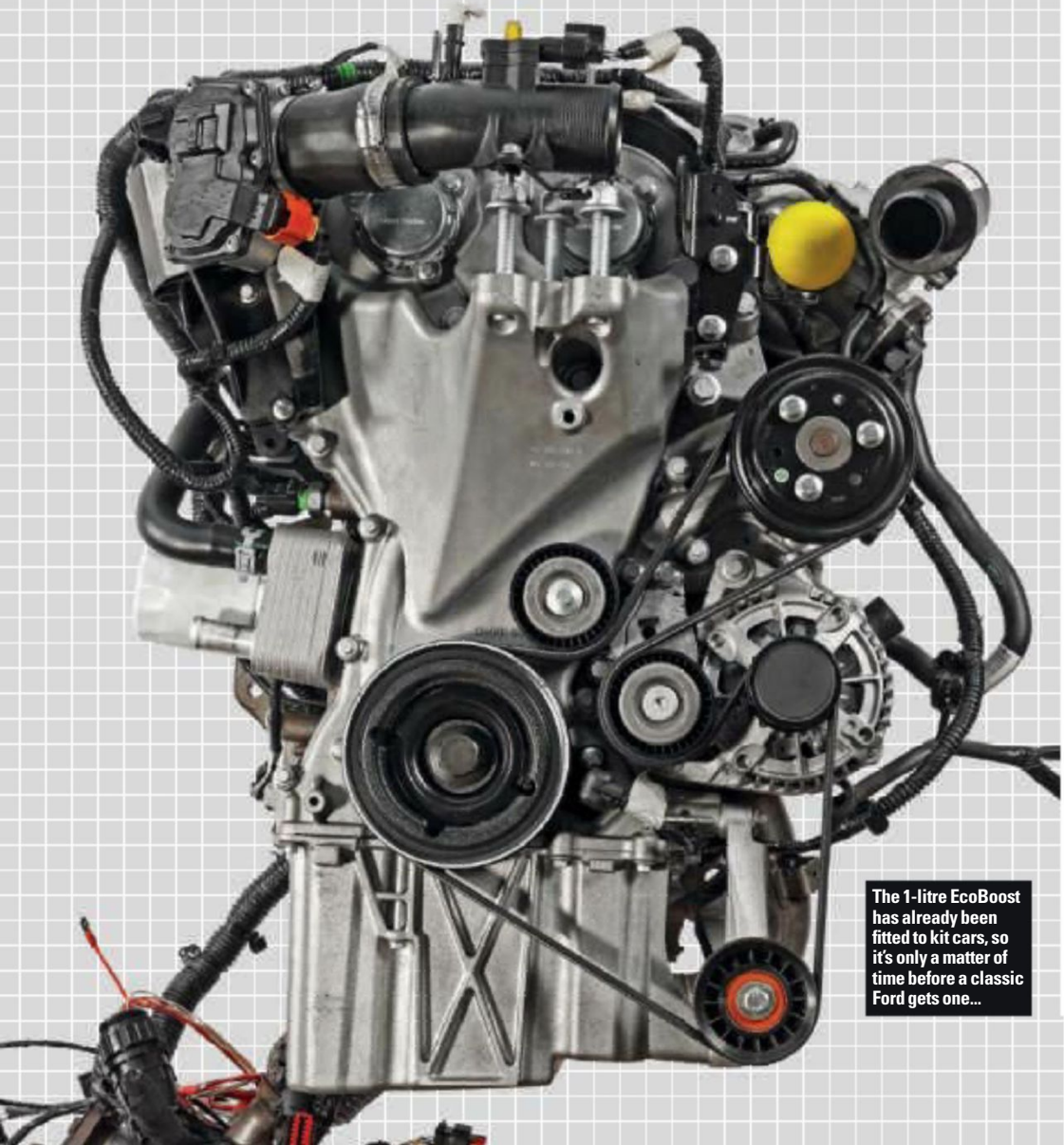
DTM have already gone to this stage although the fuel system ran out of capacity dictating the larger injectors. This configuration achieved 200 bhp at 6500 rpm with 157 lb.ft of torque at 2500 rpm.

They've gone further — fuel restriction was the issue so they added a further set of port injectors, controlled via a Hurricane ECU system. David stressed this wasn't that user-friendly so further upgrades would need a standalone ECU system, such as a Life or Link ECU. To the mix, they added a larger turbo, a new intake manifold/plenum with port injector mounts and a bigger throttle body, achieving 302 bhp at 6500 rpm — again with a flat torque curve peaking at just 2500 rpm.

With unlimited fuelling now on-tap, the aim is to hit 350 bhp, which apparently is achievable. We'll see!

The standard ECU can't really control the fuelling needed for 200 bhp and upwards so it's time to go aftermarket.

"THIS IS A FRONT-WHEEL-DRIVE ENGINE, SO IT'S IDEAL FOR DROPPING IN A MK1 FIESTA"



The 1-litre EcoBoost has already been fitted to kit cars, so it's only a matter of time before a classic Ford gets one...

FITTING ONE INTO A CLASSIC FORD

This is a front-wheel-drive engine, so it's ideal for dropping in a Mk1 Fiesta or even a Mk3/4 Escort, while it uses what Ford calls a Durashift five-speed, which is actually an IB5 gearbox (itself a variation of the old 'BC box). Plus there's a Durashift six-speed option, too...

The bellhousing bolt pattern looks remarkably similar to the standard Ford layout. Indeed, we took a rubbing and offered it up to some classic bellhousings we had in stock and it's not a million miles away — we're not saying it definitely fits as no-one's tried it yet, but we reckon with a bit of adaption, it looks like it could! As is usual, the kit car world's already done it with Caterham fitting one in their Seven, so it can be done!

The standard flywheel is 285 mm in diameter, with a clutch face of 225 mm, while there are a few bosses on the side of the block that could be used for side-mounts. Remember, you can do it with a Zetec or Duratec — two engines that you could now almost forget they were never offered in rear-wheel-drive format.