

FORD TDCi TUNING

No longer seen as smoky motorway-munchers, modern diesels have loads of tuning potential and here's how to extract the most from them...

A diesel modifying guide? Yup, that's right. Although diesel cars are still seen as rough-running, smoky, noisy, rep-mobiles here in Blighty, the rest of Europe is one step ahead and has started to make good use of the huge tuning potential of modern diesels.

We'll be talking about the latest generation of 'common rail' diesel engines. While it is possible to squeeze a few extra horses from the older TDi units, the real gains are

found with the newer TDCi range.

Whether you want just a little more poke under your right foot to make the daily commute a bit more amusing, or raise a few eyebrows by blowing the doors off the latest Japanese imports, diesel-power can do it.

Finding someone to carry out these mods can prove tricky, but luckily for you we've done all the digging. Read on and get the spanners at the ready.

Words: Jamie



GO FROM
70BHP
TO OVER
350BHP

The TDCi injects minute quantities of fuel into the engine before the main injectors when sensors detect unnecessary vibration. This makes for a very smooth engine

REMAPPING

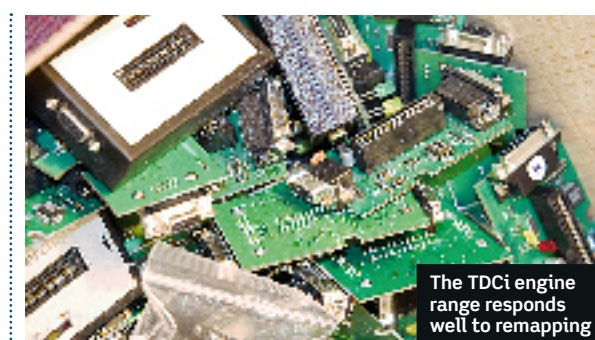
The first step to release more power is a simple remap. Alterations to some of the ECU's parameters can see a 20-30 per cent increase in bhp and a 15-20 per cent increase in torque on an otherwise factory motor.

There are a number of ways to remap the ECU. The actual files that contain all the info (or map) are similar, but the methods of installing them differ. The most popular way to remap the ECU is to use the car's OBD (On Board Diagnostics) port, and upload a revised map. Units such as the Bluefin, Code:Red, and forthcoming DreamScience and Powerchips ProFlash hand-held devices use this function to allow the user to upload a modified map, and cost around £500.

An advantage of this type of tuning is that the user can, if they wish, put the standard map back onto the car. This can come in handy with new cars which are still serviced by main dealers, as it's quite common for Ford to release updates for the ECU which overwrite the existing map, whether that map be a standard or revised one. With one of the hand-held devices the user can then reload the tuned map, or put the standard map back on the car before it goes to the main dealer in the first place.

CUSTOM MAP

Although the units come with pre-loaded generic maps, it's possible to upload a bespoke map. This isn't something that's needed at the first level of tune, and they all work fine with mild mods such



The TDCi engine range responds well to remapping

as exhaust and air filter upgrades. However, if you're planning on serious power a custom map will be needed later.

DreamScience units tend to be more popular for this as any DS dealer with the Advantage III software can write a custom map. Paul Hills at Engine Advantages will write a bespoke map for around £350, whereas a Bluefin will need to go back to the Superchips HQ for the required map to be written. Bear in mind that the Bluefin unit is already available

As Martin Collins of Collins Performance explains: "This is the way Ford put the information on the ECU at the factory, so is often seen as the safest way to remap an ECU."

TEST AND DEVELOP

Custom maps are also available using this method, but the car will need to go to someone like Collins Performance for it to test, develop and write the map.

The third way to remap the ECU doesn't actually remove the existing map. Instead, units

"Another way to remap is to 'flash' a revised map onto the ECU."

for most of Ford's diesel range, whereas DreamScience units are still under development, and the company's focusing on the 2.2-litre Mondeo ST TDCi before releasing units for other models.

Another way to remap is to 'flash' a revised map onto the ECU. Collins Performance offers this, and it involves overwriting the existing info on the standard ECU with new settings. Power gains will be similar to those seen with one of the hand-held devices, but as the information is uploaded using a laptop and Ford-specific software you don't need the hand-held unit itself, so prices tend to be a little cheaper at around £350, depending on the model.

such as the Rapid and P-Box modules alter the signals from the ECU to the injection system to increase power and torque levels. Gains and price are similar to the other methods, ranging from £300-£500 depending on the model. The simple 'plug-and-play' method of installation is probably the easiest to remove, but because of how they work, tuners tend to shy away from this method and only use it as a last resort when uploading a revised map isn't possible.

If we look at the Mondeo ST TDCi 2.2-litre as an example, you can see how all the methods of remapping produce similar results. The claimed gains of the Bluefin take the power from 155bhp to 185bhp, the DreamScience and ProFlash units are expected to produce around 185-190bhp, a Powerchip re-flash will also see 185bhp, while a Rapid module gives about the same gains with 183bhp. There are ample to choose from, and it's down to preference and what you intend to do with the car.





The TDCi engines aren't much to look at, but a spot of colour coding can help

INTERCOOLERS

Another area that needs attention is the intercooler. On any turbocharged car, diesel or petrol, reducing the air charge temps plays a critical part in the pursuit of power. Also, contrary to popular belief, a well designed and better flowing intercooler can reduce turbo lag as well as massively dropping inlet temps.

As the diesel-tuning scene is so new in the UK finding off-the-shelf replacement intercooler upgrades is practically impossible. However, there are a number of companies who will make a custom intercooler and all the necessary pipework to make it fit. Performance 3000 offers this service for around £700, and Pro Alloy is also keen to get involved with development work for diesel intercoolers.

However, if you own a Mondeo ST TDCi there are a few off-the-shelf intercoolers, although they are not branded as diesel intercoolers. The new Focus ST uses the same intercooler as found in the ST TDCi, so the upgrades available for the Focus will also fit the Mondeo. With the capability of over 400bhp they should be more than up to the job. A Pro Alloy uprated Focus ST intercooler costs around £550, so are slightly cheaper than custom jobbies and have already been proven in the Focus ST market.

Larger intercoolers will allow you to safely run more boost, so another remap will be required to make the most from the intercooler upgrade.

EXHAUST AND AIR FILTER

The next step after a remap is to get the engine breathing better. An uprated panel filter from the likes of K&N is the cheapest and easiest way to unleash a few more bhp. Depending on the model, prices will vary between £30-50. With no other mods, except the previous remap, you will see a couple of extra bhp, but don't expect massive gains as you simply won't get them with a panel filter on its own.

An induction kit may free up a bit more power and vary in price from £80-100. A lot of modern cars have extremely cramped engine bays which mean induction kits can often suck in hot air and some believe they can actually lose power over the standard set-up. Cold air feeds and heat shields are available to combat this problem, but the best advice is to speak to a tuner and see what they suggest for your particular car.

However, combine an uprated air filter with a decent exhaust system and you can look forward to an improvement of around 10-15bhp. Again, because diesels are so new to the UK tuning market many of the big names in performance exhausts don't yet produce off-the-shelf upgrades. One of the few is Piper, with its products for the Mk2 Focus, including all the diesel range. Prices start from £150 for a stainless rear section up to £450 for an ST replica twin-exit system.

Other than this you will be looking at custom exhaust systems to get rid of the unwanted gases. This is no bad thing as you get an exhaust that fits your car perfectly, and you can have any combination of single or twin exit, bore size and tailpipe design you want.

With a custom exhaust you have the option of a cat-back

or a full turbo-back system including a de-cat pipe. Performance 3000 offers a custom exhaust service, and while actual costs depend on the model in question, typical prices for a cat-back system range from £300-350 and from £400-450 for a full system including de-cat pipe.

On the subject of de-cat pipes, unlike petrol-engined cars, there is only one emissions test for diesels as part of the MoT, and most modern diesels will pass this without the use of a catalytic converter. Performance 3000's Mike Randino explains how a de-cat can actually improve the emissions test results: "With a cat fitted, when people drive around town or in traffic the cat can actually gather carbon deposits and start to block up (which hinders performance anyway), and then when it comes to the MoT, the tester will hold the engine at high revs to get

a reading and all the carbon deposits get blown out the back as black smoke. With a de-cat pipe fitted this doesn't happen, and it helps performance too."

Looking once again at our Mondeo ST TDCi example, with an uprated air filter and free-flowing de-cat exhaust system you should be expecting to see another 15-20bhp, which when combined with the remap will see you with around the 200bhp figure.



TURBOS



Although not many people in the UK have dabbled with fitting bigger turbos to diesels yet, thankfully our European cousins have. One example is David Daniels who owns Belgian tuning company Street Performance. He has successfully fitted what he calls a 'Stage 1'

which has a standard exhaust housing (as the exhaust housing actually forms part of the exhaust manifold on the ST TDCi) but uses a larger compressor wheel on the inlet side. It is similar in size to the Garrett T35 as found on the big-turbo Escort Cosworth, and allows more airflow at the standard boost pressure.

"It makes more power and torque than before with less strain on the engine."

BUY IT NOW

David can sell you one of his 'Stage 1' turbos for just £300, but you will need to add shipping costs to the UK. Although David is currently focusing on the 2.2-litre

a diesel engine means making a bigger bang. The more air you get in, the more power you will have, but also the more fuel you will need to stop things melting. The fuel pump on the Mondeo ST TDCi is capable of supplying fuel at the injectors at 2000bar, and the standard system only runs at 1600bar, so there is plenty of scope to run more boost."

A bigger turbo will require a different exhaust manifold, and probably a different exhaust system to mate with the increased size of the exhaust housing. Initially you will be able to get away with standard injectors, but if you plan to run huge amounts of boost either modified or higher-flowing items will be needed. At present this remains uncharted territory, but David hopes to have

a 250-300bhp package available for the ST TDCi by the summer. He has even got a 400bhp upgrade on the cards.

It is possible to produce even more power from a diesel engine by running two turbos together. This is well and truly into competition and motorsport grounds, so has the price tag to match, and is called 'compound turbocharging'. This basically involves running two turbos in series, so that the raised pressure output of the first turbo is fed into the second, which increases the pressure again. With this method it has been known for racing diesels to produce up to 9bar of boost pressure – that's a mammoth 130psi.

"Getting power from a diesel engine means making a bigger bang."

turbo upgrade to his own Mondeo ST TDCi.

Most turbos fitted to the Ford TDCi range are VNT turbos (Variable Nozzle Turbine), which differ from conventional ones. VNTs feature a series of movable secondary vanes in the turbo housing, which alter the angle and speed at which the exhaust gases hit the turbine. These are so accurate that most VNTs don't even require a wastegate, as the movement of the secondary vanes can keep the boost pressures at a safe level.

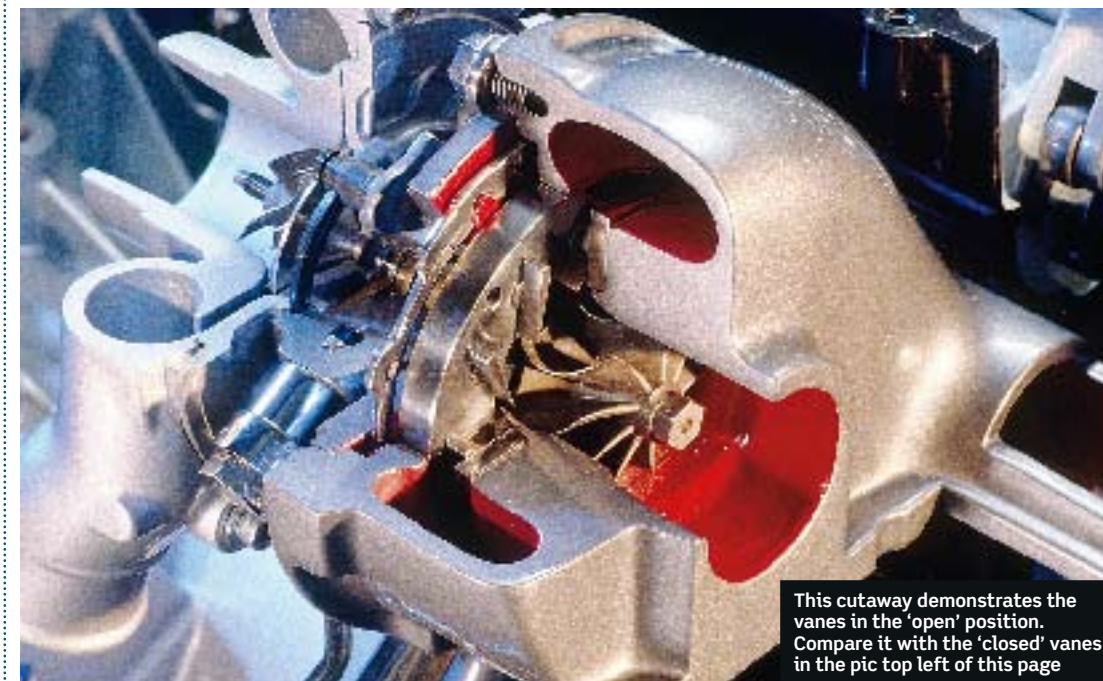
The way VNTs work also allows the use of an 'overboost' function, which means you can temporarily run extra boost at low engine speeds when it is safe to do so, and then back off the boost as the engine revs increase. Ford makes use of this function on many standard TDCi models, and tuners can exploit this for big results.

The first stage of turbo upgrade is a hybrid unit. On the ST TDCi David uses a Garrett GT17/21V

This turbo combined with an intercooler upgrade and a custom-mapped DreamScience has seen David's car produce 230bhp and 370lb/ft at a reduced boost level of 1.5bar from the previous 1.7bar. He explains:

Mondeo ST TDCi engine, the same principals will apply to all diesel engines, so drop him an e-mail to discuss what options are available for you.

The next step requires an even bigger turbo. According to David: "Getting power from



This cutaway demonstrates the vanes in the 'open' position. Compare it with the 'closed' vanes in the pic top left of this page

1.4 LITRE



1.6 LITRE



2.0 LITRE



2.2 LITRE



CUSTOM ENGINE BUILDS

Running bigger turbos and increased boost will often mean the need for serious internal engine modifications, which come with a seriously hefty price tag. In principal the same modifications can be made to a diesel engine as a petrol one, but the limiting factor is the availability of performance parts meaning expensive, bespoke components often have to be used.

As with petrol engines, porting and polishing the head will free up a few more bhp, as will fitting different profile camshafts and bigger valves. The only problem is that no-one currently produces performance parts like these for the diesel range, so you would either need to have them custom made, or see what other existing items are available and modify them to suit.

The same is true of the bottom end. H-beam con rods and forged pistons will aid reliability and will probably be needed when the standard power output has been increased by 50 per cent or more. However, these will set you back around £2000 alone, without all the other necessary parts, machining work, and bespoke mapping needed for a custom engine build.

Even the 1.4 TDCi can be made into an impressive performer

TRANSMISSION

If you're planning a custom engine build, or to run a remarkable increase in power and torque then the standard transmission will need looking at.

It's not the bhp that will cause transmission problems but torque, and modified diesels have bucket loads of it, especially if the torque limiter has been removed or tampered with at the remapping stage.

Thankfully most of the gearboxes fitted to the TDCi range, including the MTX75 and six-speed MMT 'boxes, have quite strong gear teeth and are not prone to breaking easily.

According to gearbox experts Competition Transmission Services: "Unless you are running super sticky slicks you have one very useful safety valve - wheelspin. With the amount of torque diesels produce you are inevitably going to lose traction on the front wheels, which from the gearbox's point of view is a good thing as it instantly relieves the amount of stress it has to deal with. One thing which is well worth doing though is fitting an ATB diff, otherwise you'll struggle to get any of the power down."

An ATB for the MTX75 'box as found in the Focus models will cost £600, and one for the six-speed Mondeo ST TDCi is £650, but will help get the power down and reduce torque-steer.

If you are running big power and use the car on track or at the drag strip it may be worth getting the gears shot-peened and super-finished to ease the likelihood of stress-related fractures. CTS can take care of this for around £400-450.



FAST FACT

The 'TD' in TDCi stands for 'Turbo Diesel', the 'C' refers to the engine being 'Common Rail'.

HOW MUCH?

The following table gives an indication of what power levels you can expect to see at each of the different stages of tune. The figures are based on accumulative modifications, and are estimates only. The actual power output of your car may vary, and will depend on the modifications made.

	Re-map (bhp)	Exhaust and air filter (bhp)	Intercooler (bhp)	Turbo (bhp)
FIESTA 1.4 TDCi (70BHP)	80-90	90-95	100-110	110-150
FIESTA 1.6 TDCi (90BHP)	115-120	120-125	125-135	135-180
FOCUS 1.8 TDCi (100BHP)	125-130	130-135	135-145	145-180
FOCUS 1.8 TDCi (115BHP)	135-140	140-145	145-155	155-190
FOCUS 2.0 TDCi (134BHP)	155-160	160-170	170-180	180-220
MONDEO 2.0 TDCi (130BHP)	155-160	160-170	170-180	180-230
MONDEO 2.2 TDCi (155BHP)	185-190	190-200	200-220	220-350

TDCi

SPECIALISTS

Code:Red
(Profile Automotive)
0161 4069797
www.codered-chiptuning.de

CTS
01582 840008
www.gearboxman.co.uk

DreamScience
01482 224433
www.dreamscience.co.uk

Performance 3000
01935 427554
www.performance3000.com

Piper Exhausts
01300 245300
www.pipercams.co.uk

Powerchips
(Collins Performance)
01260 279604
www.powerchips.co.uk

Pro Alloy
0845 226 7561
www.proalloy.co.uk

Street Performance
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Superchips
01280 816781
www.superchips.co.uk

TYPICAL PRICES

(based on 2.2-litre Mondeo ST TDCi)

Bluefin£500
K&N 57i£100
Custom exhaust.....£400-450
Up-rated intercooler£550
Stage 1 turbo£300
Quaife ATB.....£650

NEXT MONTH
ZVH TUNING