Revolution

The magazine for Turbo's Hoet customers and suppliers
including news, views and technical updates

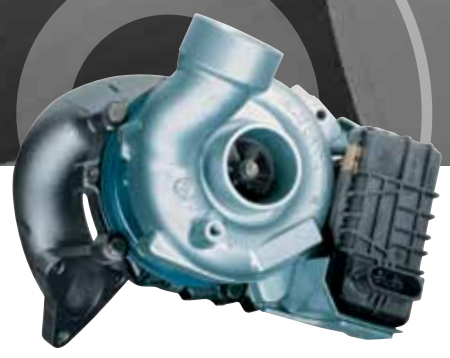
IN DEZE UITGAVE

ARE THE HYBRIDS REALLY GOING TO TAKE OVER?
Don't write off diesel.

FASTER CARS MEAN SLOWER DEPRECIATION

TURBOS BOOST THE GRAND PRIX OF THE SEA

THIS IS HOW A TURBO SPECIALIST TREATS
FAILED VARIABLE TURBINE TURBOS



Turbo's Hoet

Revolution 2

Ons magazine Revolution is aan zijn tweede editie toe. Het eerste nummer heeft op veel bijval kunnen rekenen bij de distributeurs en klanten van Turbo's Hoet, waar we heel blij om zijn.

Deze Revolution heeft het over de vooruitgang in milieuvriendelijke technieken, waar de turbo een grote bijdrage in levert. Voornamelijk op de dieselmotor speelt de turbo een grote rol bij het halen van de milieunormen, en als men weet dat om en bij de 75% van de nieuw ingeschreven wagens diesels zijn, dan kan dat tellen!
U leest over de nieuw opkomende trend van de hybride voertuigen, die steeds meer ingang vinden. Nemen deze het over van de dieselvoertuigen of blijft het een randfenomeen?

Zowel de kleine stadswagens als de snelle bolides zetten sterke prestaties neer, mede dank zij de turbo en hun elektronische sturing. We bekijken deze prestaties even van naderbij aan de hand van enkele toepassingen.
Ik wens u alvast veel leesplezier, en hoop dat U er wat van opsteekt.

Jeroen Velthuis
Sales director Turbo's Europe – Turbo's Hoet

Peugeot 308 HDi sets new records for economy

Peugeot's 308 has secured a place in the 2009 Guinness Book of Records. A husband and wife team, John and Helen Taylor, drove a completely standard 308 HDi 110 hatchback on a 25 day, 9,000 mile journey around the coast of Australia. During the record attempt, the pair broke two world records, achieving an unprecedented 1,192 miles on just 60 litres of diesel and recording an average fuel consumption of 90.75mpg.

The Peugeot 308 HDi 110 hatchback now holds the World Record for both the lowest average fuel consumption on a journey, a record previously held by the Peugeot 307 hatchback, and the record for the furthest distance travelled on a full tank of fuel. The attempt was scrutineered to make sure that all of the Guinness World Records' policies and procedures were complied with.

The car was standard, with nothing removed in order to save weight. In fact, Helen and John added weight by carrying two large suitcases containing clothes for the entire 25 day trip.

John Taylor said "We were very aware of the strong environmental credentials of the 308 before we set out. The Peugeot 308 is the perfect family car; it can comfortably seat five adults and the boot space proved itself too, swallowing up all our necessary luggage."

The Peugeot's powerplant features a variable turbine turbocharger with overboost, giving temporary extra power for swift acceleration, and a particulate emission filter, which means a driver can have funwhilst respecting the environment.

Turbo's Hoet remarks

Are the hybrids really going to take over? Don't write off diesel.

We've heard a lot about cars with hybrid petrol-electric power, such as the Toyota Prius. But is this the way that motoring is going to go for all of us? I think not. The turbocharger has dramatically improved the performance, economy and emissions of both diesel and petrol engines and I'd like to explain why a turbo-boosted diesel engine is still the best option – and could be even more so if our cousins across the pond would accept diesel as a viable fuel.

Let me start with an example of diesel's prowess. About 50 years ago, Formula 1 constructors started to extract 100bhp per litre from their engines; now there's a turbodiesel that will do the same – the BMW 123d coupé has a 2-litre engine producing 204bhp that will reach close to 150mph, and Autocar got one to 60mph in 6.7sec. Yet it uses less fuel than the cheapest petrolpowered Ford Fiesta, and produces less CO^2. So why aren't we all driving one?

It's down to price. Although the advantage of diesel over petrol in most types of car is now beyond serious dispute, the price of pioneering the technology has been high, and car manufacturers

have to pass the costs on to the customer. And remember that, while diesel is as common as petrol in Europe, in the US it is almost unheard of. For the diesel engine to gain the global audience it deserves, for volumes to increase and costs to come down, there needs to be a total change not just of attitude but of infrastructure on that side of the Atlantic.

Which brings me back to the Prius. In the virtual absence of diesel, it's typical of the cars that the environmentally-conscious American – including stars like Leonardo DiCaprio, Julia Roberts or Cameron Diaz – drives. While you're in the city it works brilliantly, often running on electricity alone, which is generated not by a coal-fired power station but recovered from the energy that would otherwise have been lost during braking.

The problem is that most of us don't do many miles in town – and away from urban areas, what you're left with is a 1.5-litre petrol engine lugging around a heavy battery pack.

Even so, a Prius is regarded as the most environmentally considerate car you can buy, and one of the most frugal. But let's compare it to a MINI Cooper D. The MINI will out-accelerate the Prius, has a higher top speed and is more fun to drive.

What might surprise you is that while the Prius manages a commendable 67.3mpg on the out of town cycle, the MINI posts an almost incredible 80.7mpg. It is also substantially more economical on the Prius's chosen urban turf. And it matches the Toyota's CO^2 emissions to the gram. It's more than three grand cheaper, too.

Volkswagen has pushed the boundaries further still with its Polo BlueMotion. By fitting a more aerodynamic nose, lengthening its gearing and re-engineering its 1-litre turbodiesel engine, it has produced a car with double-digit CO^2 emissions. And that means no Vehicle Excise Duty and no Congestion Charge.

It's the same with larger cars. Compare the Mercedes-Benz E320 Bluetec with the Lexus GS 450H: the diesel Merc will deliver 28mpg in town and 38mpg on the open road. The Lexus gives 23mpg and 26mpg respectively. You need to fill the Merc every 700 miles but the Lexus has to stop for fuel after 400. And as for drivability, the hybrid is only one second quicker from 0 – 60mph: the diesel manages a very respectable 6.6 seconds. So while there will be a market for hybrids, we shouldn't assume

they're going to take over the world. The turbocharger means there's a lot of life left in diesel (and if the Americans do finally accept it, the lower costs will make it a more popular fuel all over the world). It is also forecast that the use of turbos in petrol cars will increase from the current 5% to more than 30% by 2012. Speaking as the world's largest independent turbo distributor, I say long may it continue!

Faster cars mean slower depreciation

EurotaxGlass's, publisher of Glass's Guide to Used Car Values, has revealed which used cars are most, and least, susceptible to depreciation. It showed several factors that make cars hold their value better than their competitors, one of which is 'sportiness' – all but one of the cars in the list of the ten slowest depreciators are marketed as high performance or 'sporty' models.

The report also states that selecting a diesel variant will improve the residual value of many cars. Is it a coincidence that both of these groups are more likely to be turbocharged?

Assessing the value of more than 6,000 different models, assuming a 2004 '04' plate and 39,000 miles on the clock, the research indicates that used cars are more likely to retain a greater proportion of their value if they are a coupé or convertible, small or lower-medium sized, are produced by a prestige brand manufacturer, and powered by a diesel or low-capacity petrol engine.

Top of the list, with a retained value of 71%, was the MINI 1.4 diesel/1.6 petrol (hatchback and convertible) followed by Mercedes-Benz SLK200 Convertible, Volkswagen Golf 3.2 R32, Nissan 350Z

3.5 Coupé and Porsche Carrera 2/4 (997) Coupé and Cabriolet.

At the other end of the scale, after three years a Citroên C5 3.0 V6 Exclusive will be worth 17.5% of what you paid for it.

Turbos boost the Grand Prix of the sea

Powerboat P1 is one of the fastest growing motorsports in Europe. Racing takes place close to the shoreline in some of Europe's finest holiday seaside destinations, attracting large crowds to see the live events. It is also televised to more than 100 million homes worldwide.

So, what is Powerboat P1? Up to 20 open-top mono-hull craft compete side-by-side in each round, running in either the Evolution Class or the SuperSport Class. Evolution boats, also known as prototypes, are between 36 and 43ft long. They use inboard motors only, some of which put out 2000hp, with an enforced power to weight ratio of 1hp to 3.5kg. Evolution boats can reach speeds in excess of 100mph (equivalent to more than 200mph on land) and so, to ensure safe and competitive racing, they are limited to a maximum average speed of 87mph measured over the whole race distance.

SuperSport boats are built with standard production model hulls and engines. They measure between 33 and 42ft and have a maximum power to weight ratio of 1hp to 4.5kg. The engine capacity of diesel-powered craft must not exceed 6000cc with petrol engines restricted to 8300cc. Boats in SuperSport race to a maximum average speed of 75mph. All the boats must be monohull craft, homologated as cruising vessels. They are open top and are required to feature normal cruising-style side-by-side seating. Tandem-style seating arrangements in cockpits are specifically prohibited.

The 2007 season saw events held in Valletta, Malta; Napoli, Italy; Travemunde, Germany; Cowes, UK; Zeebrugge, Belgium; and Portimao, Portugal. Teams come from all over Europe (GB, Italy, Austria, Germany, Belgium and Malta) and there are entrants from as far afield as the USA and China. At the time of writing, with one meeting to go, both classes are led by British teams Each meeting comprises a practice session, a sprint race of at least 50 nautical miles and an endurance race of around 80 miles.

As with Formula 1, there is collaboration between manufacturers and the racing teams: this year, Team Sunseeker announced a strategic partnership with Fiat Powertrain Technologies who

supply twin 5.9-litre FPT NEF 400 turbo diesel engines, capable of a constant power of 480hp at 3000rpm. Other turbocharged engines come from manufacturers Seatek, Isotta Fraschini, Yanmar Marine, Mercruiser and Cummins – the latter supplying two 5.9-litre, 425hp engines to the Bullet Racing team for 'Buzzi Bullet III', which is currently in third place in the SuperSport Class.

While it might still be a specialist sport, albeit one with tremendous spectator appeal, it looks set to grow very quickly. So, if you have a coastal location, be prepared to supply replacement turbos for these exciting machines. You know where to come!

Fiat Grande Punto gets a sporty turbo boost

Fiat's T-Jet turbo petrol engine, which first appeared this year in the Bravo, is now available in the Grande Punto 1.4 T-Jet 120 Sporting. The new T-Jet petrol engine uses the latest turbocharging expertise to give outstanding power and torque but with notably low emissions and fuel consumption. Torque can also be increased at the touch of the 'Sport' button on the dash. Producing 120bhp and 152lb ft of torque, this responsive new engine gives the Grande Punto a 0-62mph time of just 8.9 seconds and a top speed of 121mph. Fuel consumption is modest, returning 42.8mpg on the combined cycle, while the engine emits just 155g/km CO^2.

Abarth reborn

You can expect to see sportier Fiats in the near future, too, with the relaunch of the Abarth company, one of the motor industry's legendary performance and sporting car brands. Abarth produced classic sporting versions of key Fiat models and ran racing teams that were dominant forces on both the race track and on rally stages in the fifties. Fiat's new Abarth division will run its own racing and rally teams, having won both the Italian and European Rally Championship titles with the Grande Punto Abarth S2000 in its debut season. It will also prepare racing and rally cars for customers in series and one-make championships.

The first road cars in the current range to wear the Scorpion badge will be the Grande Punto Abarth and a sports version of the new Fiat 500.

The most powerful Bentley production car ever

The Continental GT Speed is inspired by Bentley's legendary 'Speed' models that first appeared in 1923. The standard Bentley 3-litre had already established Bentley's engineering superiority in terms of roadholding, handling and braking, but W.O. Bentley, the company's founder, recognized the market potential for a more potent version aimed at the enthusiast driver who demanded superior performance. His response, the 3-litre 'Speed Model', complete with twin SU carburettors and a higher compression ratio engine, became one of the most coveted of all Bentleys.

Three litres now sounds small compared to the 6-litre W12 Continental GT's power plant. The Continental GT produces 552bhp and 479lb ft of torque at 1600rpm: twin, low-inertia turbochargers are a key factor in producing the flat torque curve, characteristic of every Bentley. The GT Speed, however, has been modified with lighter weight con rods to enhance engine response, and new pistons with anodized compression ring grooves to withstand increased cylinder pressures.

Together with a recalibrated version of the new engine management system, the GT Speed develops nine percent more power than the GT - 600bhp at 6000rpm. The maximum torque of 553lb ft at 1750rpm represents an increase of over 15% compared to the standard GT. As a result, the GT Speed becomes the first production Bentley to top 200mph and powers to 60mph in 4.3 seconds. Overtaking is effortless: it accelerates from 50 to 70mph in 2.3 seconds, the torque delivery being greatly enhanced by the twin turbos. It also delivers a harder-edged, more sporting driving experience through an enhanced chassis with a lowered ride height; uprated spring/damper settings; unique 9.5Jx20-inch alloy wheels with bespoke Pirelli P-Zero tyres; and uprated

anti-roll bars for improved agility and body control. At only £137,500, it's roughly equivalent to a week's work for John Terry.

225mph **BRABUS** twin turbo police car

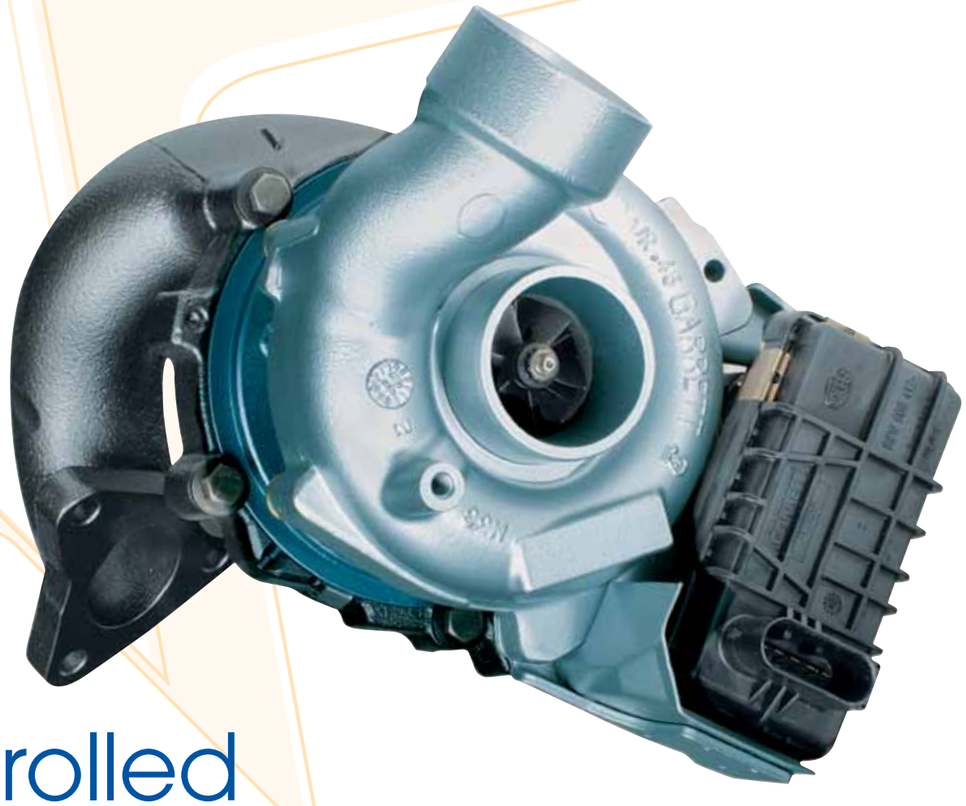
Next time you're cruising down the autobahn in Germany, keep an eye open for the Polizei BRABUS Rocket. With a top speed of 225mph, it is almost certainly the fastest police car in the world, surpassing even the Lamborghini Gallardo used by the Italian state police for emergencies.

To make the Rocket, tuning company BRABUS has squeezed a 6.3-litre twin turbo intercooled V12 under the bonnet of a Mercedes-Benz CLS. The power output is 730bhp and peak torque is 973lb ft: however, in the interests of not turning the five-speed automatic gearbox into shrapnel, this is limited to a paltry 811lb ft.

Actually, the German police Rocket isn't cruising the autobahn yet: it is used as a PR exercise at tuning shows to demonstrate that, whatever the teenagers do to their Opel Corsas, they're not going to outrun the long arm of the law.

When designing an engine, today's motor manufacturers have three principal criteria: the lowest possible emissions, the best possible fuel economy and the most possible power from a given engine size.

Emissions legislation has now become a big political and social issue and is the single biggest driving force of drivetrain development. All drivers are, of course, interested in fuel consumption and power output, but increasingly they are looking at how many g/km of CO2 (grams per kilometre of carbon dioxide) a vehicle produces. It is of particular interest to the company car driver, whose tax liability is determined by the level of emissions. The pace at which the motor manufacturers are moving is illustrated by comparing the new (2007) Ford Mondeo with its predecessor.



Electronically controlled VNT™ controlled turbos

The comparable new model has a higher power output, lower emissions, better fuel consumption and it will cost the company driver less in tax per month. The turbo is an essential part of the engine that helps the designer to achieve his objectives – but as engines become more complex, so does the turbo. The first electrically operated turbochargers appeared in 1999, when twin Garrett turbos controlled by the ECU were fitted to the BMW 740 V8 diesel. They were relatively simple by today's standards, but they proved their efficiency and now electric actuators have become much more prevalent – in fact, they're rapidly becoming the norm.

The reasons for their virtual domination are many: electric control of the vanes means they give faster response; more accurate control; constant response time; positional feedback to the ECU; and they permit on-board diagnostics, which is a requirement driven by legislation. Additionally, from the car manufacturers' point of view, they eliminate the need for the vacuum pump, modulation valve, pipework, check valve and damping reservoir needed for most pneumatic actuator systems, which provides a big potential cost saving and reduces complexity.

Looks can be deceiving

In the last issue of Revolution, we explained why it's not possible to repair a VNT™ turbo. With electronically controlled turbos, the reasons become even more apparent. They may look alike, but the electric actuators fitted to the earliest VNT™ applications are totally different to the electronic actuators

fitted to the latest cars. The hardware has evolved from a simple Rotary Electric Actuator (REA) to a Rotary Electronic Actuator, which provides feedback and fault code storing. In all, including high torque versions, there are at least six different types of turbo with electric or electronic control from Garrett alone.

There are also many different crank ratios (the length of the output crank from the actuator compared to the external crank for the VNT™ mechanism) and there have been numerous updates to the controlling software. Often, when turbo vehicles are serviced, the ECU is updated in much the same way as your computer regularly receives updates. Unfortunately, if you break an actuator or suspect that it is faulty, you can't just buy and fit a new one. First of all, there's the problem of making sure the replacement is the right one. Then the whole turbo needs to be set up on a flow bench, where a PC connects to the actuator, initialises it so that it recognises the commands that it receives, and runs an automated set up programme. This sets the 'soft stops' in the actuator's memory, to prevent contact of the vanes at the extremes of movement. It also ensures that the critical minimum vane open position is held in the memory and calibrates actual mass flow against actuator movement throughout the full range of operation. This cannot be done on the vehicle – it requires the factory flow bench.

We've talked before about the need to replace VNT™ turbos rather than remanufacture them. You can see from the above that the same goes for the electric or electronic actuator: if it is damaged or faulty it is necessary to replace the whole turbo with a new unit that has been properly set up by the factory.

It is unfortunate that the increasing complexity of so many vehicle components means that they cannot be serviced or repaired. However, it is the price we have to pay for the level of sophistication required to meet the strict criteria of power, economy and reduced emissions.

New engines for Audi

Audi has recently revamped the engines for many of its cars. Turbochargers are very much in evidence, in both the TFSI (Turbocharged Fuel Stratified Injection) petrol engines and the TDI (direct injection turbocharged) diesel range.

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The A3 is now available with a 1.4 TFSI engine, replacing the naturally aspirated 1.6 FSI engine in A3 and A3 Sportback models. It delivers a 10bhp power advantage over its predecessor with a 45Nm torque boost to 200Nm, 80 per cent of which is available from just 1,250rpm, and 100 per cent from 1,500rpm.

A new 1.9 TDI also joins the A3 stable. It benefits from a specially modified version of the already frugal 105 bhp diesel with new friction minimising components and redeveloped ancillary units and a manual gearbox with remapped, economy-biased ratios. Helped externally by tyres with reduced rolling resistance, and by additional modifications to further increase aerodynamic efficiency, the A3 1.9 TDI combines 62mpg-plus fuel economy with a CO2 output of just 119g/km, which will make it exempt from the congestion charge in London.

An all-new A4 Saloon was revealed at the Frankfurt Motor Show in September. Of the five engines that will be available when deliveries commence in early 2008, four benefit from a turbocharger. They are the 160bhp 1.8 Turbo FSI four-cylinder, the 265bhp 3.2-litre V6 FSI, the 143bhp 2.0-litre TDI, the 190bhp 2.7-litre TDI and the 240bhp 3.0-litre TDI.

The Audi A5 has added two engines to the range: a 3.2 FSI and 2.7 TDI. The diesel unit, with advanced common rail piezo injection and standard diesel particulate filter, enjoys a power hike from 180bhp in the A4 and A6 to 190bhp, and a 20Nm torque boost to 400Nm at 1,400rpm. It enables the A5 2.7 TDI to accelerate to 62mph in 7.6 seconds, to carry on to a top speed of 144mph and to return up to 42.2mpg. Finally, the new A8 2.8 FSI claims to be the UK's cleanest luxury saloon, with a CO2 output of just 199g/km.

This is how a turbo specialist treats failed variable turbine turbos

Many new vehicles are fitted with variable turbine turbochargers (VNT™), which work by adjusting the gas throat section at the inlet of the turbine wheel in order to optimize turbine power with the required flow velocity. This gives the benefits of higher power and torque, improved transient response, lower fuel consumption, reduced emissions and better braking power..

However, they are highly complex pieces of machinery and it's only possible to meet the exacting standards and demanding tolerances at the point of manufacture. Trying to repair one is like trying to repair a microchip with a soldering iron - it's practically impossible.

In the Garrett factory, each individual turbo has to be tested and adjusted after assembly, to ensure that it meets the engine manufacturer's specified flow setting. This requires a calibrated turbine flow bench which measures the actual airflow through the vanes of every single VNT™ that they make, and allows them to set and lock the minimum flow position to suit each application. Only then can they calibrate it to the specification set by the vehicle manufacturer.

Any disassembly of the VNT™ turbo will mean that the minimum vane open setting would have to be reset before the calibration process can be completed. Without the turbine flow bench, a remanufacturer can only guess that the airflow is correct: the turbo may operate, but it is highly unlikely that it will work to its optimum efficiency. An incorrectly set up turbo will affect performance and emissions, as well as potentially causing extensive engine damage.

Garrett does not sell spare parts for VNT™ 's for these reasons: it's just too big a risk. Even they don't remanufacture, so if someone tells you they can recondition a VNT™ unit, ask yourself where they are getting the parts from and how they propose setting the minimum vane open setting.

Don't risk your reputation or your business revenue by taking a chance. Fit a brand new VNT™ unit and have the peace of mind that it will work properly and not come back to haunt you!

Garrett®
by Honeywell

BMW's world beater

A diesel saloon that does 0 - 60 in under 6.5 seconds and is limited to 155 mph!

How diesels have changed! BMW's new 535d is setting new standards in performance and economy (around 30 mpg) thanks to the R2S™ regulated 2- stage turbocharging system developed by BorgWarner Turbo Systems. Using a small KP39 high-pressure turbocharger combined with a larger K26 low-pressure unit, it ensures smooth and progressive acceleration throughout the rev range, eliminating turbo lag completely. At low engine speeds the smaller unit provides 95% of the torque and, as the revs increase, the larger turbocharger kicks in to compress the induction air and even out the power delivery, taking over completely above 2,500 rpm. This is a first for BorgWarner and further manufacturers are set to introduce engines with R2S™ systems in the near future – both in the passenger car and commercial vehicle fields.

The Future's Green – or Blue

Volkswagen has released details of its new Golf BlueMotion, which will go on sale in the UK in early 2008. The car was revealed, along with five other new BlueMotion models, at this September's Frankfurt motor show.

Following the launch of the Polo BlueMotion earlier this year, the Golf has been given a similar treatment. It is driven by a 102bhp 1.9-litre turbodiesel, which averages 62.8mpg (4.5 litres per 100km) and will take the vehicle in excess of 1200km (745 miles) on one tank of fuel. A new particulate filter means that CO2 emissions have been reduced from 135g/km on the conventional 102bhp 1.9 TDI model to 119g/km on the BlueMotion model.

The car's efficiency is achieved through a combination of engine management software that reduces the engine idling speed; longer gear ratios in third, fourth and fifth gears mean that engine speed levels are also lower while driving; a lowered chassis and an aerodynamically designed underbody reduce the drag coefficient from 0.32 to 0.30; and special low-resistance tyres are optimised for rolling resistance. The Golf BlueMotion will be available in Germany by the end of this year.

The three golden rules to avoid turbo tragedy

The Fault Finding section of our web site helps you to diagnose problems relating to (or apparently associated with) your turbo. However, you can take steps to avoid problems by avoiding three common problems.

1. **Keep it lubricated:** change the oil according to the manufacturer's instructions and ensure that the oil filter and pressure control are correctly maintained.
2. **Keep the oil clean:** contaminated oil can wreak havoc with a turbo that is spinning at up to 200,000 rpm!
3. **Keep foreign bodies at bay:** take particular care when fitting a turbo, and ensure that the air filter is in good condition. The ingress of even a small object can have the same effect as jamming a stick in the spokes of a moving bicycle wheel.

Turbochargers are made to with-stand extreme operating conditions and should last the lifetime of your engine. Faults arise when they are not properly used or maintained: the three issues above account for around 90% of turbo failures.

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