### 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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Turbo'r Hoek

# Revolution

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

#### **INSIDE THIS ISSUE** GARRETT VNT™ TURBOCHARGERS To repair or not to repair?

**OIL MATTERSD** on't make any mistakes with yours

**PORSCHE & BORGWARNER** Develop the first VTG<sup>™</sup> for a petrol engine

**TURBO'S HOET OFFICIAL DEALER** FOR HOLSET IN FRANCE



# Revolution

From now on, this is an edition of Turbo's Hoet which you will be receiving for free. Filled with news, opinions and technical updates on turbochargers.

In this issue, you will find an article on Garrett VNT TM tools for problem solving and ordering turbochargers Turbochargers: when do they need replacing? Further online. Enjoy your reading! on, we find a piece on the importance of oil for the lifetime of a turbocharger. Did you know that 90% of turbo failure is oil-related? On page 6 you will read everything on the subject.

On page 8 we find an document on Porsche & Borgwarner, who developed the first VTG TM for a petrol engine. The latest Porsche 911 contains materials which- up till now- we only to be found in aerospace

You have in your hands a new magazine: Revolution. applications, and represent a unique step forward to larger efficiency and higher performances.

> Finally, I draw your attention to our new website on page 10. We recently added a large number of interesting



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

### Turbo's Hoet remarks

### How drivers destroy their turbos

Looking at the Spin Doctor article on oil in this issue of Revolution, we were struck by the fact that many drivers don't know how to treat a turbo.

The businessman, for example, sets off in the morning in his brand new turbocharaed car. Short on time, he has his foot to the floor before the oil has warmed and circulated properly. Then, after a couple of hours, he dives into the motorway services, turns off the engine without letting it idle and goes for a 'comfort break'. Little does he realise how much damage he is inflicting on his turbocharger. As the oil stops circulating and the fan comes to a halt the turbo, which seconds ago was spinning at up to 200,000 rpm, reaches a phenomenal temperature and things start to cook! The oil begins to 'coke', producing particles that will grind their way through the turbo bearings tomorrow morning when he starts the cold engine again. We suppose that we in the aftermarket should be grateful - it means more

# VW 1.4 litre engine has a turbocharger and supercharger for personal cars

The innovative TSI engine from Volkswagen provides maximum power with minimum fuel consumption, by using a turbocharger and a supercharger. Dubbed the 'Twincharger', it is a 1.4 litre petrol engine that gives excellent power delivery throughout the speed range with no turbo lag; fuel economy of over 38mpg in a Golf GT; and an output of 168bhp. The manufacturer claims that it has all the benefits of a petrol engine in that it

is quieter than a diesel and has a wider rev range, but it delivers comparable fuel efficiency and torque (177 lb ft).

The thinking is quite simple. In order to combine the power characteristics of a large engine with the lightness and economy of a small engine, a turbocharger is the obvious answer when the engine is running at high revs. However, low exhaust pressure at low revs is an inherent problem and can cause turbo lag. This is overcome by the use of a high speed, mechanically-driven compressor, or supercharger, controlled by an automatic charge pressure control system. It kicks in during initial acceleration and supplies additional boost by working alongside the turbo when additional power, such as when overtaking, is required.

FSI direct fuel injection allows a high compression ration of 10:1 and the ability to pass 7000rpm without risk: in the Golf, that means a top speed of 137mph, 0-60 in 7.7 seconds and more than 38.2mpg, with a CO2 output of just 175g/km. The TSI power plant, which won the Best New Engine Award in the International Engine of The Year Awards, is available in the Golf GT and Sport, and the Touran SE and Sport.

Saab gave green motoring a performance boost at the 2007 Geneva Motor Show when it unveiled its latest BioPower technology - the first production-based engine to be optimised for pure bioethanol (E100) fuel.

Bioethanol fuel is produced commercially from agricultural crops such as wheat, corn, grain, sugar beet and sugar cane.

Unlike petrol, its consumption does not significantly raise atmospheric levels of CO<sup>2</sup>, which some scientific research suggests is a major contributor to global warming. This is because emissions released during driving are balanced by the amount of CO<sup>2</sup> that is removed from the atmosphere when crops for conversion are grown.

### The turbocharged Saab that doesn't need petrol or diesel

Saab launched its BioPower flex-fuel technology 18 months ago and its entire range is now available with engines that can run on the eco-friendly yet potent fuel source bioethanol E85, standard unleaded petrol, or any mix of the two fuels.

They enjoy substantially reduced fossil carbon dioxide (CO2) emissions, whilst delivering significant increases in power, when running on bioethanol E85 compared to when running on petrol. BioPower 100 is an exciting evolution as it requires no fossil fuel at all, and it demonstrates the great performance potential of



business for us supplying and fitting the replacements. You can be sure that, when he is off the road, that businessman wants his car back quickly, which is why we hold massive stocks and can get you the replacement turbo you need by next day delivery.



bioethanol. Combining Saab's turbocharging expertise with the use of high-octane E100 fuel, the 2.0 litre 9-5 engine produces an incredible 300bhp. This has been possible through modifications to the engine management system and internal components, allowing the use of greater boost pressure with a raised

compression ratio. This exceptionally high specific power output of 150bhp per litre demonstrates scope for future 'rightsizing' using small, high output engines that also deliver energy savings. Peak power is complemented by a substantial 400Nm of torque, giving the engine similar power to a naturally-aspirated 4.0 litre unit. The Saab 9-5 BioPower 100 Concept accelerates from 0 - 62 mph in just 6.6 seconds and from 50 - 70 mph (in fifth gear) in an even more impressive 8.2 seconds.



By Trevor Cass, Garrett IAM Product Support Engineer (Europe, Middle East & Africa)

The turbocharger aftermarket has traditionally been a place where a customer had the choice of buying a brand new or a remanufactured turbo. However, the rapid development of the turbo, alongside developments in engines, fuel injection systems and engine management, has meant that this must change.

# **Garrett VNT<sup>™</sup> Turbochargers** To repair or not to repair -



Open vanes: full drive



In order to comply with strict emission controls, our turbos have become much more technologically advanced - which, in turn, means they are more difficult to repair. Because the VNTM is far more complex than a conventional turbo, repair and remanufacture can't be done correctly without specialist equipment and information. Indeed, even with the equipment in our factory, we ourselves don't remanufacture. We know that new units are the risk-free option.

When we build new turbos we calibrate them to three decimal places, with a number of checkpoints used to ensure correct operation. A remanufactured turbo would also need to be calibrated to the same degree of accuracy. But calibration of a VN™ turbo on its own is completely worthless without the critical first stage being completed: setting the 'minimum vane open' position.

The Garrett VN™ components are manufactured to extremely tight tolerances but, due to the large number of parts and the clearances needed for the safe and efficient operation of a VNT<sup>TM</sup>, each individual turbo has to be tested and adjusted after assembly, to ensure that it meets the engine manufacturer's specified flow setting. Any disassembly of the VN™ turbo will mean that the minimum vane open setting must be reset before the calibration process can be completed.

We set the minimum flow vane position by using a calibrated turbine flow bench which measures the actual airflow through the vanes of every single VN™ that we make, and allows us to set and lock the minimum flow position to suit each application. It is not possible to set the calibration of the actuator to OE specification until the minimum vane open position is set. Without a 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.



# is it worth the risk?

#### The consequences

The outcome of not being able to set the minimum vane open position accurately may be:

- Conflict with the engine management system, leading to error messages or running in `limp home' mode.
- Low flow/pressure, which can cause poor response, poor overall performance and increased emissions - and possibly an MoT failure for your customer.
- Over-rich diesel fuel/air mix, which can cause excessive temperature, damaging the turbo and engine.
- High flow/pressure, which can lead to overspeeding of the turbo, wheels bursting and consequential damage to turbo and enaine.
- Excessive boost pressure, which may cause blown gaskets and physical engine damage.



Setting the minimum flow vane position

Closed vanes : partial drive

#### The 'real' cost of fitting an incorrectly remanufactured turbo

You should also consider the real cost of replacing a turbo if the remanufactured one that you have fitted fails. Your supplier may replace the turbo free of charge, but who pays for the time to fit the second replacement? And if the failed remanufactured unit damages other parts of the engine, who would be liable for the repair? Garrett will not sell spare parts for VNTs for these reasons: it's just too big a risk. Your official Garrett distributor will sell genuine new turbos, to exactly the same specification and quality as supplied to the original equipment manufacturer, with a valid guarantee. They back this up with many years of specialist turbo knowledge to help you.

Why risk a remanufactured VNT<sup>™</sup>? Use a new unit, for safety's sake and for the sake of your business.

### TecDoc - Turbo's Hoet

The information source for the vehicle repair market with the original data of the parts manufacturers.

Founded in 1994 by companies of the automotive aftermarket industry and the German Association for Spare parts (GVA), TecDoc Informations System GmbH has established itself as the leading supplier of electronic spare parts information on the European market.

TecDoc furnishes the free vehicle spare parts market with current and comprehensive data for identifying and ordering parts – for both, PC as well as CV – directly from the databases of the cooperating automotive aftermarket manufacturers in a standardized catalogue form.

TecDoc is needed on every level in the market, especially when accurate information is needed, in order to minimize faulty data in the communication between the customer and the selling party.

The core tasks of TecDoc are still the standardizing, gathering and distributing of data as well as the development of the necessary data technique.

Nevertheless, TecDoc intensively works on new projects in order to offer more efficient solutions to industry, trade and garages.

Counting from May 2008, Turbo's Hoet is an official data supplier of TecDoc, which means that our customers can look up their turbochargers on the CD Rom of TecDoc. The 'contacts' sheet enables them to directly order them at Turbo's Hoet. The big advantage is that the TecDoc data is renowned throughout Europe to be the most complete, which brings together the largest amount of PC and CV. Our own webshop is also fed by the same data.

Many wholesalers have computer systems which use an identical data search system, as their systems use the same TecDoc data. Hence the fact that those wholesalers expect Turbo's Hoet to be in this up-to-date database, if we want to receive orders from them.

# TecDoc

# Oil matters

# don't make any mistakes with yours



Two other oil-related problems can occur through driver misuse. Prolonged engine idling can cause the turbo to rotate without producing boost. Consequently, a vacuum within the turbine tries to pull oil past the turbine-side oil seal and into the turbine housing, which can lead to failure of the oil seal. Hot engine shutdown may cause the oil to coke up inside the oil drain, forcing the oil out through the turbine and compressor seals.

#### Handle with care

When fitting a replacement turbo, take care to ensure that the seals are properly seated and the inlet and outlet hoses are of the correct bore and kink-free. Refill the engine with the correct volume of oil (flush the engine first, if necessary) and test the turbo for operation and leaks thoroughly. Selecting the right oil for the engine is important. Mineral or synthetic? Mineral oil (i.e. that which comes out of the ground and is refined) used to be the only option. It offers good basic protection for a wide range of engine types but it does require changing frequently. Synthetic oils (i.e. those that come from a laboratory, albeit with a mineral oil base) are especially designed to circulate quickly from cold, reduce wear and last longer, but there is a price premium. The middle ground is semi-synthetic oil, i.e. a blend of mineral and synthetic oils, which falls between mineral and synthetic both in performance and price.

Be very careful about mixing oils in an engine. Not all lubricants are compatible and if you top up with the wrong type, you can do a lot of damage. Check with the manufacturer or distributor to be absolutely certain that the lubricants you are thinking of mixing are compatible.

#### Viscosity

Viscosity is a way of measuring the 'thickness' or 'flowability' of oil. Oil thins when heated and thickens when cooled. Viscosity is classified by the Society of Automotive Engineers (SAE): the lower the number, the thinner the oil and so the more suitable it is for cold temperature use. A monograde is oil whose viscosity is defined at only one temperature, either high or low. A



It's not an exaggeration to say that oil is the lifeblood of an engine, and nowhere is it more important than in the turbocharger. Oil fulfils three essential functions: it lubricates, cools and cleans metal parts that would otherwise overheat and grind to a very messy halt!

The turbocharger is subjected to temperatures in excess of 1000° Centigrade: it spins at up to 200 000rpm; it has to withstand severe pressure differentials; and it is designed and manufactured with tolerances measured in ten-thousandths of an inch. It is estimated that more than 90% of turbo failures are caused by oil problems, the most common of which are:

- Contaminated or dirty oil, which leads to bearing scratching or scoring and causes excessive bearing wear.
- Lack of lubrication: as the turbo runs at very high speeds, even a momentary loss of oil pressure can cause overheating and destroy the bearing system. Lack of lubrication results not only from low oil pressure, but also from kinks and/or clogs in the oil inlet line.
- Use of the incorrect oil.

multigrade must meet both high and low temperature viscosity requirements simultaneously. A viscosity modifier additive produces a thickening effect at high temperatures but is dormant at low temperatures.

This makes multigrades a popular year-round choice for hot summers and harsh winters. Multigrades are recognised by the dual viscosity designation (e.g. 0W-40 where the '0W' is the low temperature or winter designation and the '40' is the high temperature designation). Because turbos spin so fast even when the engine is cold, there is a move by manufacturers towards specifying oil with a low viscosity such as '0W' so that it gets to the turbocharger bearings quickly. Again, ensure that you comply with the manufacturer's recommendations, to prevent damage.

#### Keep it clean

Finally, a word about keeping the lubricant free of contaminants. Many oils these days have a detergent additive that keeps the engine clean, but in so doing they transport small particles of carbon ('coke') around the system. The older the oil or the more overheated the engine has become (overheating accelerates the production of coke), the more particles will be held in the oil flow. The oil filter will trap some of these particles but if the oil isn't changed according to the manufacturer's recommendations, it actually becomes abrasive – think of it as a thin grinding paste – and that will do your turbocharger bearings no good at all! We said at the beginning of this article that oil is the lifeblood of the engine. Think how a hospital deals with a transfusion, selecting only the right blood group and handling with extreme care. Adopt the same principles with your oil and you'll eliminate many of the causes of turbo failure.

When drivers hear the word 'Porsche' and 'turbo' in the same sentence, it instantly conjures up images of real power for pure driving pleasure. The newest Porsche 911 Turbo, launched last year, is certain to meet these high expectations. It is the first petrol-engined vehicle ever to use a VTG<sup>™</sup> turbocharger for greater efficiency and performance. Up to now, variable turbine geometry (VTG<sup>™</sup>) has been reserved for diesel engines. The technical challenge for its application in a petrol engine was to develop materials that can handle the significantly higher exhaust gas temperatures of up to 1000°C found in these engines. Working together with Porsche, BorgWarner Turbo & Emissions Systems succeeded in developing a turbocharger with VTG<sup>™</sup> technology for the 911 Turbo.



# Porsche & BorgWarner develop the first VTG<sup>TM</sup> for a petrol engine

The adjustable turbine vanes sit right at the heart of the turbocharging system and can be closed to generate high boost pressure at low revs and low exhaust flow rates. This vastly improves response and pick-up at low speeds compared to conventional turbochargers. Additionally, the petrol engine with VTG<sup>™</sup> displays significantly greater efficiency over the entire performance range compared to today's standard turbochargers with wastegate. This in turn leads to further improvements in fuel consumption over a wide rev band.

Despite its similarity to the diesel version, the engineers at BorgWarner had to completely redevelop the cartridge - the most important component of the VTG<sup>™</sup> - to meet the high demands in terms of exhaust gas temperatures. The particular challenge was to find highly heat-resistant materials with the right tribological and thermal expansion properties that would allow the necessary surface qualities and tolerances to be manufactured reliably. In the course of development, new aerospace materials were also used, some of which had never before been used in car or turbocharger design.

<complex-block>



Aerospace materials help cope with the intense heat

#### A massive boost

The 3.6 litre engine in the new 911 Turbo has two BV50G turbochargers with electrical VTG<sup>™</sup> actuation. These help the 6-cylinder boxer engine generate just over 470bhp, some 59bhp more than its predecessor. Nominal torque has also been increased by 44 lb.ft to over 450 lb.ft. At the same time, the engine developers have been able to expand the rev band in which this massive power is available, to further improve the already legendary performance of the iconic sports car. On the previous model, maximum torque was available between 2700 and 4600rpm. The new engine generates its 457 lb ft of torque in the entire range from 1950 to 5000rpm. With manual transmission, the new 911 Turbo sprints from 0-60 in under four seconds – and the version with the new Tiptronic S is 0.2 seconds faster. The top speed of both versions is 192mph. Perhaps more impressive than the increase in power is the lower fuel consumption of the new 911 Turbo, which averages an impressive 22mpg (20.8mpg in the Tiptronic S)..

**Optional Overboost Facility** 

The flexibility of the 911 Turbo can be enhanced even further with the optional Sport Chrono Package Turbo, available for the first time. By engaging the Sport button adjacent to the gear lever, this feature enables the driver to activate a short-term turbocharger 'overboost' function at full throttle, giving an increase in boost pressure in the mid-speed range by 0.2 bar for up to ten seconds and improving torque by 60Nm to 680Nm. In this configuration, the time required by the 911 Turbo with manual transmission for intermediate acceleration from 80 to 120kph (50-75mph) is reduced by 0.3 seconds to 3.5 seconds.

#### Driving technology forward with VTG™

Following the successful premiere in the Porsche 911 Turbo, BorgWarner expects its VTG<sup>™</sup> technology to find a broader base of petrol engine applications in the next ten years. Compared to other boosting concepts, VTG<sup>™</sup> represents the best priceperformance ratio after the wastegate turbocharger. It offers the performance and dynamic behaviour of a larger normally aspirated engine with significantly lower fuel consumption. Hans-Peter Schmalzl, Vice President Technology at BorgWarner Turbo & Emissions Systems predicts that, "Gasoline engines with exhaust gas turbocharging and direct fuel injection will enjoy the same kind of success as diesel engines".



## The world's first turbocharged diesel boxer engine

Subaru has always been a great believer in the horizontally-opposed engine, claiming that the opposing pistons in a flat engine configuration effectively balance out each others' vibrations, giving smooth, seamless, fluent power delivery right through the rev range. Even more important, the design is shorter and shallower than other engines, which means they are more compact, lightweight and very rigid. A horizontallyopposed engine can also be fitted way down in the chassis, to give a very low centre of gravity. This reduces body roll for safer cornering and also enhances handling precision during rapid manoeuvres such as a sudden lane-change on a motorway.

Now, for the first time, the company has introduced a turbocharged diesel engine which, it claims, is a highly rigid unit with low levels of noise and vibration. Not only does this eliminate the need for a balancer shaft to counter uneven combustion pressures and general roughness, but Subaru's first turbo diesel is as compact as its petrol sisters and combines unusually strong pulling power at low engine speeds with high-rev throttle-response.



# Turbo's Hoet new website WWW.turbos-hoet.com

#### **Online ordering**

In the beginning of 2008, the Turbo's Hoet website has been updated. By adding a great deal of technical support on the website, we want to make life of our customers easier. For example, a turbocharger can now be fully identified and ordered on line.

#### **Turbo Problems Analysis**

You will also find useful tips on the website which will help you solve problems concerning a turbo yourself. From an engine which switches to 'secure mode', to lack of power, and from a high oil consumption to blue smoke emissions : a number of checkpoints will enable you to ensure if the turbo really needs to be changed. This tool is easy to consult and can make you save a lot of money!

#### Webshop and Stockchecker

Using the Webshop and Stockchecker, a turbocharger can be found and ordered easily. Looking up by model, motor code, turbocharger part number and OE number enables you to find the right turbocharger. When ordered before 12.00AM, you will receive the part the next day. If necessary, we can offer an express delivery and assure a same day delivery.

#### Download

On the download section of the website, you will find some interesting folders, as well as nice photo material.

#### Contact

For technical advice, specific or general questions about turbochargers : please feel free to contact us. These pages contain all required information on phone numbers and e-mail addresses.

This website has been designed for the use of our customers. If you have any comments, we would like to hear them : use the contacts section of the website.

# Turbo's Hoet official dealer for Holset in France





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After having had a intensive collaboration in Belgium and The Netherlands with Cummins Turbo Technologies, the manufacturer of the Holset brand, it is the turn of France, for which we have received the official distributorship.

Holset is renowned for its strategic technologies for medium and heavy-duty diesel engines. The know-how of Turbo's Hoet in this area has been rewarded with the thrust of Holset.

Besides our workshop, we currently hold a large stock of Holset turbochargers, which enables us, together with our European partners, to reply rapidly to customers' needs, for who time is money...