

# TurboNews

2/08 Issue

The Info Magazine of BorgWarner Turbo & Emissions Systems

## Volkswagen



NEW SCIROCCO OFFERS EYE-CATCHING DESIGN,  
IMPRESSIVE DYNAMICS AND LOW FUEL CONSUMPTION

### Bella macchina!

Lancia Delta sets standards in  
design and engine performance

### TDI for USA

Jetta turbodiesel masters the strictest  
emissions standard in the world

### Braking emissions

BorgWarner develops  
innovative EGR valve

# Stimulating the market

Dear Readers,

At the moment, news from the automotive industry generally does not mean good news. Following the massive slumps in revenue among vehicle manufacturers, the crisis is set to spread to the supply industry, which generates approximately 65 % of the added value.

In light of the severe drop in demand for new vehicles, it is therefore crucial both for auto manufacturers and their suppliers to generate new impulses in the market with pioneering, market-driven products. BorgWarner Turbo & Emissions Systems is in the fortunate position of offering technologies that help counteract the rising energy prices and cope with increasingly strict environment and climate protection legislation.

In this edition of TurboNews we are pleased to present the latest results of the successful cooperation between the turbocharger specialist and its customers – from the Mercedes-Benz C 250 CDI BlueEFFICIENCY Prime Edition, through the Lancia Delta, right up to the Jetta TDI and Scirocco from Volkswagen.

BorgWarner has also seen several success stories beyond the scope of current development work – as highlighted in reports on the TOP Award 2008, granting of the OHSAS 18001 certificate and the latest safety record at the Campinas facility in Brazil.

Best regards,

The editorial team

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Ulli Fröhn, Vice President Sales & Marketing Passenger Cars, on strategies for getting through the crisis

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**Lancia Delta sets standards in design and engine performance**

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## BORGWARNER INCREASES EMPHASIS ON FUTURE TECHNOLOGIES

# Getting through the crisis with innovations



In the last edition of TurboNews in the middle of the year we reported on the crucial expansion of our worldwide production capacities for turbochargers. Now, just a few months later, completely different topics are driving auto manufacturers and their suppliers. In the wake of the global financial crisis, the automotive industry is suffering an unprecedented global drop in demand. Even the emerging markets are showing significant downward tendencies. And this is not only affecting the passenger vehicle market. The demand for commercial vehicles in Europe and Asia is also slowing. There are also no signs of a recovery in North America for 2009.

As is the case at almost all automotive manufacturers and their suppliers, BorgWarner Turbo & Emissions Systems is now not focusing on expansion, but rather on efficient management of its capacities. Adjusting production to the significant drop in the number of calls from vehicle manufacturers is our key task here. We have reacted quickly with corresponding measures and will continue to check these regularly.

Yet despite this significant economic dip in the automotive industry, BorgWarner Turbo & Emissions Systems is still working at full speed and without compromise on a number of new projects and products. Like us, the customers with whom we are developing new drive concepts are also convinced that pioneering technologies – in particular for reducing fuel consumption and CO<sub>2</sub> emissions – are the best strategy for getting through the crisis.

The trend toward turbocharged gasoline and diesel engines throughout the world is continuing unabated. Exhaust gas turbocharging is currently the most effective way of improving the efficiency and environmental friendliness of internal combustion engines and thereby securing personal individual mobility in the long term. As a supplier of corresponding technologies and products, we retain an optimistic outlook for the future, despite the current economic situation in the automotive sector.

Even in these difficult times, we maintain our obligations and duties to our customers. Our staff members are working hard every day to ensure that both current and future challenges are met with and for our customers. We will do everything in our power to prove to you that our success is justified and that we will remain an innovative and reliable partner in and around the field of exhaust gas turbocharging in future.



Ulli Fröhn, Vice President  
Sales & Marketing Passenger Cars  
at BorgWarner Turbo & Emissions Systems.



LANCIA DELTA SETS STANDARDS IN DESIGN AND ENGINE PERFORMANCE

# Bella macchina!

Avant-garde lighting and exquisite furniture, elegant suits and breathtaking sports cars – when it comes to extraordinary design, Italy enjoys an enviable reputation on the world stage. With the new Delta, the Italian auto manufacturer Lancia has unveiled a new compact sedan that will set the pulse racing among lovers of Italian cars and style.

The new Delta, designed by Centro Stile, carries the tradition of great Lancia models into the future – starting from the classic Aprilia and Appia, through the Fulvia and Beta, right up to the Prisma, Dedra and Lybra. And there is a

large dose of the genes from the Lancia models that made automotive history in the new Delta. Genes, for example, from the Lambda, which was the first passenger vehicle worldwide to employ a monocoque body and independent

front suspension. Or the Aprilia, which achieved a drag coefficient of 0.47 at the start of the 1930s – a time when other vehicles struggled to beat a value of 0.60.



The new Lancia Delta brings Italian elegance to the compact class.

## Unique styling

At the very first glance, the Lancia Delta stands out from the crowd of modern cars with its unmistakable appearance. The beautifully elongated lines of the bodywork give a feeling of Italian elegance – from the impressive radiator grill, which houses the familiar shape of the Lancia emblem, through the sculptured contours of the hood and the trapezoidal pillars, right up to the narrow, vertical LED tail lights.

Particular highlights include the Granluce roof with a 7.5 square foot, transparent glass section that offers an interior ambiance flooded with natural light, as well as the two-tone paintwork applied in a complex coating process – a procedure which requires six hours more than standard processes and a high degree of technical skill. However, the results are worth it!

## Innovative drive technology

Just like in the past, the Lancia Delta fascinates not only with its design, but also with its drive technology. All the engines are turbocharged and employ the latest technologies for optimization of dynamics, fuel consumption and emission values. The engines that really stand out here are the new 1.9 liter twin turbo multijet diesel and the 1.8 liter direct injection turbocharged gasoline engine, which is being used for the very first time.

## Powerful diesel with twin turbo

One of the key design features of the new 1.9 liter multijet engine is R2S technology with two exhaust gas turbochargers from BorgWarner. The complete system consists of one compact KP35 turbocharger, which boasts low inertia and offers fast response at low revs as the high pressure stage, and one K16 low pressure turbocharger for the higher rev band.

Below 1,800 rpm, the exhaust stream powers the smaller turbine, which ensures instant reaction without lag and therefore excellent performance at low engine speeds. The larger turbine also spins at low speeds. In the mid rev band from 1,800 to 3,000 rpm (depending on the driving conditions), the larger turbocharger is then engaged to ensure precompression of the air which subsequently flows through the smaller turbo and provides fast power delivery and response. Above 3,000 rpm, the small turbocharger is then deactivated to allow the large, low pressure stage to release its full potential for the high performance band.

The R2S system helps the turbodiesel reach its maximum power output of 190 bhp and a maximum torque figure of 295 lb-ft, which is available from 2,000 rpm. With around 100 bhp per liter of displacement, the unit offers the kind of power density previously only available in highly tuned sports car gasoline engines. Another impressive fact is that a massive 75 % of maximum torque is available from just 1,250 rpm. This results in excellent pickup and overall engine response.

## More driving pleasure, lower emissions

The top end of the engine range for the Lancia Delta is rounded off by the 200 bhp 1.8 liter di-turbojet gasoline engine.



Making jet-like acceleration figures a reality:  
The K03 turbocharger from BorgWarner.

With direct fuel injection, turbocharging and variable camshaft adjustment on the input and output side, this unit delivers the ultimate in power and torque figures. The direct injection lowers fuel consumption, particularly for the power density on offer, while the turbocharger ensures an optimum torque curve with impressive pickup. And the exhaust gas recirculation effect due to the twin camshaft adjustment makes a decisive contribution in helping the new engine meet the strict Euro-5 standard.

When developing the first direct fuel injection turbocharged gasoline engine, the Fiat engineers trusted the comprehensive experience and expertise of the BorgWarner developers in Kirchheimbolanden (Germany). A K03 turbocharger with waste gate was modified to be perfectly aligned with the engine and combustion requirements. In a special design feature, BorgWarner employs a welded joint between the cast manifold and the turbine casing for the first time. The experts at BorgWarner were able to draw on experiences from an earlier project here, in which a sheet metal manifold had been welded to a turbine casing.

The close cooperation between the Fiat Powertrain engineers and the experts at BorgWarner led to the development of two engines, both of which offer real driving pleasure and impressively low fuel consumption.



NEW SCIROCCO OFFERS EYE-CATCHING DESIGN,  
IMPRESSIVE DYNAMICS AND LOW FUEL CONSUMPTION

# Volkssportwagen

Some 34 years after the premiere of the Scirocco from Volkswagen, the sports car is celebrating its rebirth for those on a tight budget. But this time, the new version of the sports coupé retired 16 years ago is not just a simple variation on the theme of the VW Golf. With its fierce looking front and dynamically sculpted lines, the new Scirocco is much more the rebellious stepson in the Golf family and is set to bring a breath of fresh air to the sports car segment.



A waste gate turbocharger from BorgWarner gives the small TSI engines a real power boost.

## Volkswagen sets trends

With its dynamic and sporty design, the highest quality standards and innovative technologies at a price that is "affordable for everyone", the new Scirocco is a clear statement of intent to VW's competitors. Volkswagen is clearly keen to set new trends here, rather than simply conform with what the competition is

doing. The attractive purchase price is made possible through use of components which are also employed in other successful models such as the Golf, Eos and Passat and are therefore already in large scale serial production. However, the Scirocco does offer a high degree of independence and exclusivity.

## When only a turbo will suffice

When it comes to engine downsizing, Volkswagen is a driving force in technological developments. The Scirocco is offered with an impressive portfolio of low-displacement yet powerful four cylinder engines of the latest turbo-charged direct injection generation. Alongside three 1.4 liter gasoline engines with power ranging from 120 bhp, through 158 bhp, right up to an impressive 197 bhp, a smooth running common-rail turbodiesel with 2.0 liter displacement and 138 bhp is also offered. Following in the footsteps of the Audi TT (see TurboNews 01/08), the Scirocco can therefore also make a claim to the "sports diesel" title – with acceleration from 0 to 62 mph in 9.3 seconds and impressive economy figures of 43 mpg (US)/52 mpg (UK), it unites high performance with sensational efficiency. The TDI also impresses through its extremely low CO<sub>2</sub> output of just 217-233 grams per mile.

The new Scirocco takes an aggressive stance, ready to take on the established sports car competition.



## SOUTH AMERICA'S AUTOMOTIVE INDUSTRY COMES TOGETHER AT AUTOMECC 2008

# Automecca

Automecc in São Paulo (Brazil) is the largest supplier trade fair for the automotive industry in the southern hemisphere. It was launched in 1993 to create a platform for the activities of automotive suppliers. This year, Automecc was split into two segments for the first time, namely the fields of light vehicles and heavy/commercial vehicles.

### Fit for Euro-5

The TSI engines also already meet the strict requirements of the upcoming Euro-5 emissions standard. The latest turbocharging technologies play a key part in helping these units achieve the ideal balance between performance and fuel consumption here. In the development of the 158 bhp engine, Volkswagen relied on the know-how of BorgWarner Turbo & Emissions Systems and a version of the company's K03 waste gate turbocharger. This boosting system has also proven itself in many other applications. Through combination with a compressor, the TSI offers real driving pleasure in all rev bands. It offers acceleration from 0 to 62 mph in just 8 seconds and provides impressive fuel consumption figures of 36 mpg (US)/43 mpg (UK). For even greater dynamics and a sportier feel, drivers can go for the optional 6-speed double-clutch transmission (DSG), which is also manufactured by BorgWarner. This transmission efficiently combines the advantages of both manual and automatic systems in a modern, high performance drive train concept.

The auto manufacturer Volkswagen has once again done justice to its "people's car" name and in the new Scirocco presents a sports car that is not only affordable to a wide range of potential buyers but also offers genuine everyday usability. With its exciting design, the new people's sports car sets itself apart from the masses of serial production vehicles on the market.



Around 440 companies from Brazil and 15 other nations presented their latest technologies, products and services at Automecc Heavy & Commercial. Alongside vehicle parts and components, the 24,000 visitors from 31 different countries enjoyed a first hand look at machines and accessories for dealers, repair shops and for overhauling engines. Products for lubrication, tools, diagnostics devices and much more were on show.

### VIP visit

The BorgWarner Campinas site was also represented at the fair and was fortunate enough to welcome a prominent guest to the booth. During the opening, Miguel Jorge, State Minister of Development, Industry and Foreign Trade, paid a visit to the BorgWarner Team. Sergio Veinert, General Manager of the Campinas facility, welcomed him and explained how auto manufacturers throughout the world are reducing emissions and fuel consumption with the help of BorgWarner turbochargers.

Alongside the latest technologies, BorgWarner also presented two rally cars with turbochargers at Automecc 2008.

### New contacts

Particular highlights at the booth not only included the products presented by Thermal Systems and Turbo & Emissions Systems, but also two rally cars equipped with booster systems from BorgWarner. Numerous South American customers of BorgWarner used the opportunity to get a closer look at the latest technologies and talk with Aftermarket Director Dirk Polte. Both he and Aftermarket Sales Manager David Dias Patrício are confident that the new contacts made at the event will lead to some interesting new projects, particularly for the Latin American market.



BORGWARNER CELEBRATES 30 YEARS OF TURBOCHARGER PRODUCTION IN ENGLAND

# Happy birthday, Bradford!

On 13 June 2008, the BorgWarner site in Bradford celebrated its 30-year anniversary. The facility, which manufactures over 400,000 commercial vehicle turbochargers every year, recently underwent a comprehensive program of modernization. Alongside Renault/Volvo and Daimler, the most important customer is the engine manufacturer Deutz that equips all its engines with turbochargers from the BorgWarner stable.



In parallel with the 30<sup>th</sup> birthday, the Bradford site also celebrated the successful completion of a comprehensive, multi-million pound program of modernization and investment, preparing itself for the requirements and challenges of the future. Howard Middleton, Lord Mayor of Bradford, his wife Colleen Middleton and further representatives from the local government and economy therefore also attended the celebration.

## Clear commitment to the Bradford site

Giles Richell, General Manager of the Bradford facility, greeted Howard Middleton with the words: "We are delighted that the Lord Mayor was able to pay us a visit so soon after taking office. Our company is proud to be associated with the City of Bradford, which has seen turbocharger production at this site for 30 years." He also stressed: "The massive investment we are currently making at the plant and in our employees is evidence of our commitment to the area and to our local workforce, many of whom have worked here for much of their working lives. Through this investment we aim to maintain our position as a market leader and world class manufacturer."

During a tour of the site, the prominent guests were able to get a closer look at the latest production systems. They also gained exciting insights into the latest boosting technologies with which the site enables commercial vehicle manufacturers throughout the world to meet the increasingly strict emissions standards.

## Over 420,000 turbochargers in 2007

Bradford lies in the county of Yorkshire in the North of England and is home to one of the longest established production sites of BorgWarner Turbo & Emissions Systems. The city's excellent transport connections and proximity to the industrial region around Manchester make it an ideal choice. Around 450 staff members produce turbocharging systems for the commercial vehicle engines of European manufacturers here. Indeed, turbochargers from Bradford can be found in a great number of medium to heavy duty trucks, buses, tractors, agricultural machines and boats that we see every day.

The site's production volume has risen in several steps from around 100,000 turbochargers in 1990 to the current level of around 420,000 units per year. In the last two years,

the site has been modernized with the latest technical developments to ensure that it can meet both the increase in production volumes and the increasing technological demands of customers. Highly automated manufacturing processes aligned specifically to the requirements of the commercial vehicle industry have, for example, been introduced. Additional production capacities were necessary to be able to handle the increase in demand for environmentally friendly drive technologies in Europe.

## Families join in the celebrations

On the occasion of the site's 30<sup>th</sup> anniversary, the Bradford facility also held an open day for the families of its staff members. The 750 visitors were able to trace the production process of a turbocharger at various stations that had been set up. Cut-away models also offered fascinating insights into the workings of the latest turbocharging systems. As a reminder of the anniversary and motivation for the next 30 years, every staff member received an anniversary jacket. Within the scope of a fund-raising campaign initiated by Lord Mayor Howard Middleton, the staff members collected over €1,000.





THE CAMPINAS FACILITY WINS THE FIRST  
CHAIRMAN'S EXCELLENCE AWARD FOR SAFETY

# One million man hours without a single accident

The staff members at BorgWarner's Campinas site in Brazil were the first to receive the new Chairman's Excellence Award for Safety, an award they accepted with great pride. This was to honor the achievement of one million man hours without a single reportable accident at work – the best result ever achieved within the company to date.

Safety has been a top priority at the Campinas site for many years, and the staff members have been fortunate enough to win no fewer than eight awards for their commitment since 2002. Their goal is to unite excellent performance with the highest safety standards. To this end, the staff members are regularly asked to immediately report any unforeseen occurrences or potentially dangerous situations. They are also given the authority to stop

production immediately in the event of an emergency if they detect a risk to workplace safety.

The Chairman's Excellence Award comes with a check for 20,000 US dollars, which BorgWarner donates to charity. The staff at Campinas decided to donate the money to three different institutions, namely to the Ingo Hoffman Institute, which supports families



General Manager Sergio Veinert (left) and Manufacturing Manager Gilvan Bezerra (center) accept the first BorgWarner Chairman's Excellence Award for Safety from Roger Wood, President of Turbo & Emissions Systems (right).

whose children suffer from cancer or blood disorders, to the Centro Infantil Boldrini, which treats children with cancer, and to the Casa de Repouso Bom Pastor, which looks after adults and parents in the course of cancer treatment.

NEW TURBOCHARGER FACILITY GETS READY FOR START OF PRODUCTION

# Poland ready to go

Just six months after breaking ground at the new production site of BorgWarner Turbo & Emissions Systems in Rzeszów, Poland, the site celebrated its topping out ceremony in September. And turbocharger production is set to start as early as January 2009.



Future staff members as well as manual workers, architects and engineers celebrated the completion of the shell of the building at BorgWarner's new turbocharger production site in Poland on 3 September. Arnaldo Lezzi – manager of the facility and "construction supervisor" – thanked everyone involved for their excellent cooperation in all phases of the planning and construction work that formed the foundation for the speedy imple-

mentation of the project. Once the carpenters had attached the tree to the roof truss as per the tradition, everyone present was invited to a large barbecue. The site is now in the final stage of construction.

Some 200 staff members are set to produce around 500,000 passenger vehicle turbochargers a year from January 2009 at the 5,000 square meter site in the Rzeszów

industrial park. Rzeszów is therefore an important site for the planned increase in capacity and growth strategy of Turbo & Emissions Systems in Europe, enabling BorgWarner to successfully meet the growing demand of European manufacturers for turbocharging systems to produce particularly economical and low-emission engines.

JETTA TURBODIESEL MASTERS THE STRICTEST EMISSIONS STANDARD IN THE WORLD

# TDI for USA

The Jetta is the best selling Volkswagen model in the US. And thanks to its optimized 2.0 liter common-rail turbo-diesel engine, since mid 2008 it has met the strictest emissions standard in the world: The US Tier 2 BIN 5. BorgWarner developed the boosting system of the TDI and has thereby paved the way for the latest diesel technology.

In the US market, diesel drives are becoming an increasingly attractive alternative to the dominance of the gasoline engine. The significantly lower fuel consumption and the extended range this offers are key arguments for the oil burner. However, to ensure that diesel engines meet what is currently the strictest emissions standard in the world (Tier 2 BIN 5), their soot particle and NOx emissions have to be significantly reduced.

Thanks to special coatings, the BV43 turbocharger from BorgWarner is ready for the use of low-pressure exhaust gas recirculation.



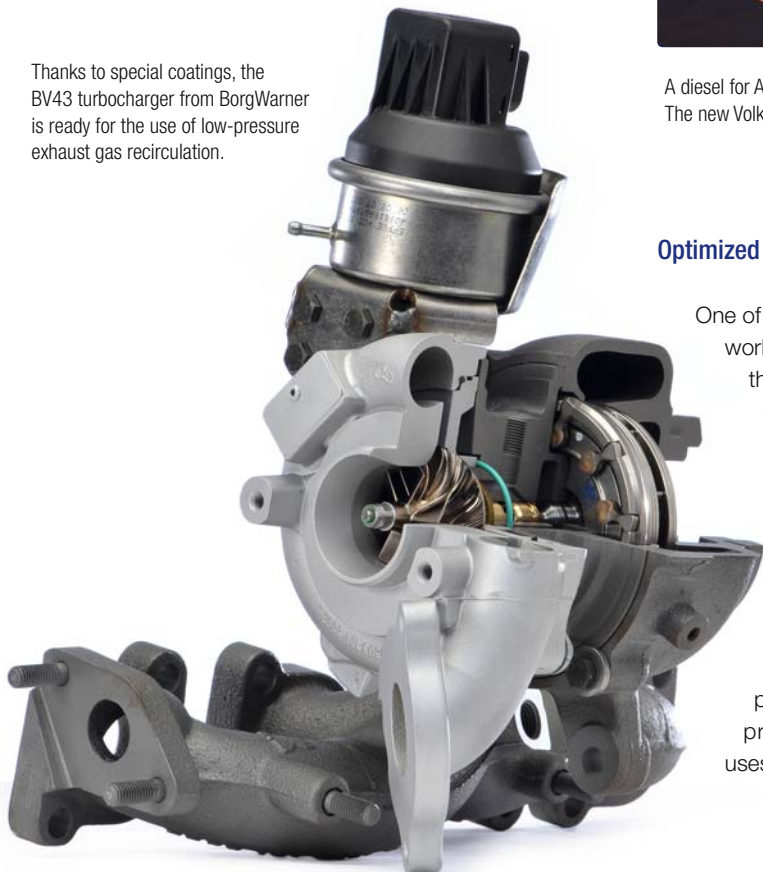
A diesel for America:  
The new Volkswagen Jetta 2.0 TDI.

## Optimized exhaust gas turbocharging

One of the first diesel engines in the world to overcome this hurdle is the 2.0 liter TDI unit with common-rail fuel injection system that Volkswagen uses in the Jetta. Using innovative technologies from BorgWarner, the combustion was comprehensively optimized, allowing emissions to be significantly lowered while simultaneously improving performance over its predecessor. The TDI engine uses a BV43 exhaust gas turbo-

charger with variable turbine geometry, which is already used in the EU5 basic engine, but which was further developed for use in combination with the low pressure exhaust gas recirculation.

The most effective approach for reducing nitrogen oxides within the engine is to operate the engine with the highest possible exhaust gas recirculation rates. To this end, a system of low pressure exhaust gas recirculation is used which draws in exhaust gas after the particle filter and then feeds this to the engine upstream of the turbocharger impeller.





## TURBO SYSTEMS WINS AWARD AT THE TOP BUSINESS MEETING

# TOP host

Transferring knowledge, optimizing processes, experiencing practical solutions – this is what TOP stands for, an initiative of the German Federal Ministry of Economics and Technology which promotes the exchange of experience between innovative companies. BorgWarner Turbo Systems GmbH in Kirchheimbolanden (Germany) has been participating in the initiative since 1999 and was recently presented with the TOP award 2008 for its contributions.

### TOP gives important impetus

The TOP business meeting was held at the start of October. Around 130 representatives from the political and economic arena attended the event. Hartmut Schauerte, parliamentary secretary of state to the Minister of Economics and Technology and representative of the federal government for small and medium-sized businesses, stressed the importance of TOP in his address: "Innovative companies secure long-term economic growth as well as workplaces and trainee positions. The open, practically oriented dialog within the TOP initiative is extremely successful in improving processes of innovation, especially in small and medium-sized companies. TOP thereby gives important impetus for Germany as a center of innovation."

### BorgWarner transfers know-how

At this year's TOP business meeting, Hartmut Schauerte presented the TOP award 2008 to BorgWarner Turbo Systems GmbH from Kirchheimbolanden. The automotive supplier has been taking part in TOP for around 10 years as host. In 17 previous events, it has highlighted to other companies how continuously improving products, production and services can successfully strengthen company value through increased productivity.

### Events bring concrete benefits

Around 200 one-day events are organized and held on the premises of the German technological leaders every year within the scope of the initiative. Thanks to these events, over 30,000 skilled staff members and managers



Hartmut Schauerte from the German Federal Ministry of Economics and Technology presents the TOP award 2008 to Frank Dück, Director of Operations at BorgWarner Turbo Systems GmbH

have gained practical insights into the use of new technologies as well as new organizational and management techniques since 1992. Surveys show that approximately 97% of participants in the events have been able to draw concrete benefits for their own companies.

The TOP initiative is supported by German Chambers of Industry and Commerce, by the Federation of German Industries, by the German Confederation of Skilled Crafts and by the Rationalisation and Innovation Centre of German Industry (RKV). The current program of events can be obtained from the F.A.Z.-Institut für Management-, Markt und Medieninformationen GmbH, Mainzer Landstraße 199, 60326 Frankfurt/Main or at [www.top-online.de](http://www.top-online.de).

However, in implementing the low-pressure EGR system, a technical hurdle first had to be overcome. The high temperatures and aggressive particles in the exhaust gas placed a high thermal and chemical load on the turbocharger. To offer protection against the extremely high exhaust gas temperatures and acerbic exhaust gas components, the engineers at BorgWarner therefore developed coatings for the compressor cover and the compressor wheel of the VTG turbocharger. The BV43 employs a milled and specially coated impeller wheel as well as a nano-coated compressor casing. This allows the temperatures of the recirculated exhaust gas to be effectively handled and prevents damage due to deposits.

### New ways of lowering emissions

With the further development of turbochargers for use in combination with low pressure exhaust gas recirculation, BorgWarner is opening up completely new ways of reducing emissions. This allows the developers of diesel engines to significantly lower both exhaust gases and fuel consumption without having to resort to complex and costly exhaust gas after-treatment systems.

MERCEDES-BENZ PRESENTS THE C 250 CDI BLUEEFFICIENCY PRIME EDITION

# A masterclass in

The new C 250 CDI BlueEFFICIENCY Prime Edition adds yet another chapter to the already outstanding success story of the Mercedes-Benz C-Class. With the new diesel engine, which celebrates its world premiere in this model, the renowned auto manufacturer shows that maximum driving pleasure is also possible with a minimum of fuel consumption.

## Exemplary in every way

2.2l displacement, 203 bhp, 369 lb-ft – this is the outline data of the completely new OM651 four-cylinder unit, putting it among the very best diesel engines of this displacement class. The new Mercedes-Benz C 250 CDI BlueEFFICIENCY Prime Edition accelerates from 0 to 60 mph in just 7.0 seconds and from 37 to 75 mph in a mere 9.2 seconds (5th gear). It boasts a top speed of 155 mph. Despite these superb performance figures, the vehicle runs at an impressive average

of 45 mpg US (54 mpg UK) of diesel (NEDC), and CO<sub>2</sub> emissions are also low at just 222 grams per mile. These figures put any other comparable vehicle in the shade.

At the same time, the engine convinces with its spontaneous response and smooth running and also offers significantly improved torque generation at low revs in comparison to its predecessor. In everyday driving situations, this means that the driver can cruise along at very low revs with a minimum of

fuel consumption. When it comes to untreated emissions, the new engine also races ahead of the competition. It already fulfills the forthcoming EU 5 emissions standard and offers potential for EU 6 and Tier 2 BIN 5.

## More efficiency thanks to R2S

With the C 250 CDI BlueEFFICIENCY Prime Edition, Mercedes-Benz presents the first model of its completely new series of four-cylinder diesel engines, which sets new standards in perfor-



Avant-garde on the outside, green on the inside: The new C 250 CDI BlueEFFICIENCY Prime Edition.



# efficiency

mance, torque, and above all in terms of exhaust gases and fuel consumption thanks to regulated two-stage boosting (R2S) from BorgWarner Turbo & Emissions Systems. The unit is available in various series and forms the basis of Mercedes' diesel engine production. It can be fitted both longitudinally and transversally and is also suitable for four-wheel drive vehicles. Three variants are initially planned for passenger vehicles in the form of the 200 CDI, 220 CDI and the 250 CDI. Mercedes-Benz's use of R2S technology in the 220 CDI and 250 CDI also represents a first; this is the first time that two-stage boosting has been used in a series-produced diesel engine for a Mercedes passenger vehicle. In order to make this a reality, the engineers at Untertürkheim drew on the unparalleled experience of the turbocharger specialist BorgWarner, which produces one of the most high-performance turbocharging concepts in the shape of the R2S system. This project therefore represents a seamless continuation of the cooperation between the two companies, which also led to the development of the previous engine with R2S for the Mercedes Sprinter.

The most powerful variant offers 203 bhp and makes a marked improvement of around 20% on its predecessor. At the same time, the maximum torque has increased from 295 to 369 lb-ft. Despite the enormous increase in performance, the new engine boasts fuel consumption of 44 mpg US (52 mpg UK) in a medium-class passenger vehicle, an improvement from 40 mpg US (48 mpg UK) for the previous model. Thanks to R2S, the new engine attains 95 bhp per liter displacement and achieves

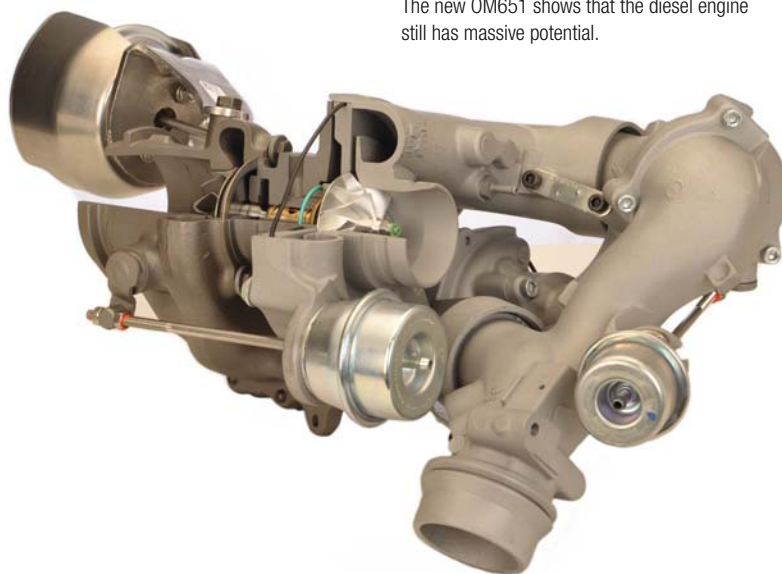
a new record for its specific torque at 172 lb-ft per liter. The new, lower output version of the diesel engine with 169 bhp offers low fuel consumption at 46 mpg US (55 mpg UK) and emits up to 13% less CO<sub>2</sub>. In comparison to a single turbocharger with variable turbine geometry, the R2S technology exploits its advantages fully with regard to reducing fuel consumption.

## Groundbreaking design

The regulated two-stage turbocharging from BorgWarner Turbo & Emissions Systems allows a variable, stepless adjustment of the turbine and compressor side for each engine operation point on the OM651. The advantage compared to the single-stage process is the increase in nominal output while at the same time improving the stationary torque at low revs and the acceleration through a fast buildup of boost pressure.

The R2S system consists of a small high-pressure exhaust gas turbocharger and a large low-pressure exhaust gas turbocharger, which are connected in

The new OM651 shows that the diesel engine still has massive potential.



series. Each turbocharger has a bypass channel as overload protection, which can be opened or closed via a gate. The two compressors are also arranged in series and are connected to a bypass. At low revs, the smaller high-pressure turbocharger provides spontaneous engine response and eliminates starting weaknesses. As the revs increase, the larger low-pressure turbocharger kicks in alongside the high-pressure turbocharger. This larger unit ensures a continuous increase in power output and then takes over the entire boosting function above a certain speed. Thus the R2S allows an outstanding torque curve across the entire speed range while at the same time reducing fuel consumption.

With the turbocharged OM651, the engineers of Mercedes-Benz and BorgWarner give a striking demonstration of how much potential for improvement there is even in the proven turbodiesel concept. The R2S technology is an important element here, which allows fuel consumption and CO<sub>2</sub> emissions to be reduced still further.

NEW EXHAUST GAS RECIRCULATION VALVE FROM BORGWARNER  
REDUCES COMMERCIAL VEHICLE EMISSIONS

# Overcoming the highest emissions hurdles

BorgWarner Turbo & Emissions Systems has developed a new exhaust gas recirculation valve that will enable heavy commercial engines and vehicles to comply with increasingly strict emissions standards. The electric-throttle style EGR valve will be manufactured in Illinois, USA, and will have its 2010 premiere at a leading commercial engine manufacturer.

Exhaust gas recirculation (EGR) is an effective method for reducing emissions of NOx (nitrogen oxide). Recirculating exhaust gas and combining it with the air and fuel mixture reduces combustion temperatures that produce the harmful NOx. The electric throttle style EGR valve offers precise and responsive control combined with high flow capability. It also provides excellent sealing and is highly resistant to the exhaust soot and condensate that can cause sticking.

A further advantage is its high-strength brushless motor actuator that works reliably in the most severe operating environments. The throttle style EGR valve can also be applied to passenger car applications and is easily integrated with an EGR cooler and cooler bypass valve.

## Controlled exhaust gas recirculation

BorgWarner engineers developed the new EGR valve to meet the need for high EGR rates and precise flow control. The valve has a brushless DC motor actuator with a gear train that has already proven its robustness and reliability in turbocharger applications. The torque from the DC motor is efficiently transferred by the two-stage gear train, which opens the throttle valve to control the flow of exhaust gas back to the air intake system.

The brushless motor offers high durability and an enhanced power-to-weight ratio. The sensors within the motor also provide feedback to a closed-loop control system to position the throttle valve and ensure precise control of the recirculated exhaust gas. All of the major components of the EGR valve, such as the housing and throttle valve, are made of stainless steel and improve heat and corrosion resistance. The throttle valve design ensures low leakage and reliable operation within the harsh diesel exhaust system.

"With our new EGR valve, we are helping commercial engine and vehicle manufacturers to comply with the increasingly tight emissions standards worldwide," said Roger Wood, President and General Manager BorgWarner Turbo & Emissions Systems. "New engine concepts for commercial vehicles require a greater use of state-of-the-art EGR systems. Thanks to our experience in the field of turbocharging and exhaust gas recirculation systems, we can optimally meet the growing demand in this market segment."



The electrical EGR valve from BorgWarner allows higher exhaust gas recirculation rates.



## BORGWARNER IN KIRCHHEIMBOLANDEN AWARDED OHSAS 18001 CERTIFICATE

# Safer thanks to OHSAS

Wherever work is performed, there is potential for risks. This also applies to a modern automotive supplier like BorgWarner Turbo & Emissions Systems. For this reason, a systematic approach has been taken for many years at the Kirchheimbolanden (Germany) site to further improve health and safety as well as environmental protection.

To efficiently bundle all health and safety measures, the plant has introduced a modern system of workplace safety management, for which it was one of the first plants in the Group to win an OHSAS 18001 certificate in May 2008 (Occupational Health and Safety Assessment Series).

## Integrated management system introduced

Yet requirements have not only increased in terms of occupational health and safety and environmental protection at the workplaces. Staff members must also master increasingly complex challenges in development, manufacturing and customer support. This is why an integrated management system was imple-

mented in Kirchheimbolanden which bundles the standards to which the site operates (TS 16949, ISO 14001 and OHSAS 18001) in a unified system. The new management system simplifies integration of workplace safety processes into the existing process landscape.

## Every individual carries responsibility

In the past, certain responsibilities were assigned to central specialist departments – for example workplace safety was assigned to the occupational health and safety department and quality to the quality department. The specialists in the individual departments were responsible for ensuring that their respective targets were met. With the new integra-

ted management system, processes are now viewed holistically. The responsibility for higher level targets now lies in all departments and is no longer controlled centrally. Every individual staff member is therefore responsible for workplace safety, environmental protection and quality – which should bring significant improvements in all areas.



## BORGWARNER CAMPINAS ATTENDS THE SAE CONGRESS 2008

# Ecological correctness

Since 1992 the Society of Automotive Engineering has been organizing the largest international trade fair in and around technology and mobility in Latin America: the SAE Congress in São Paulo. This year, the focus was on the latest developments in the field of "ecologically correct" technologies, products and processes to make vehicles safer, more interactive and more convenient. Around 170 exhibitors took part in the event, including auto manufacturers as well as suppliers of parts for passenger, commercial and off-road vehicles. Alongside the exhibition, a three-day program with technical lectures and events was offered. This attracted some 9,400 visitors – mainly engineers.

The BorgWarner Campinas site in Brazil was represented with two product divisions: Turbo & Emissions Systems and Thermal Systems. The most important vehicle manu-



facturers active in the South American market took the opportunity to gather information on the latest technologies in and around the field of turbocharging, exhaust gas processing and cooling.

Sergio Veinert, General Manager of the Campinas facility, and sales specialists from Turbo & Emissions Systems and Thermal Systems

BORGWARNER IN KIRCHHEIMBOLANDEN  
OPENS ITS DOORS FOR A FAMILY DAY

# Open day in Kibo

On 13 September, BorgWarner Turbo & Emissions Systems opened the doors at its facility in Kirchheimbolanden (Germany) and invited all staff members and their families to enjoy a family day. Around 3,000 visitors took the opportunity to take a look behind the scenes at the technological leader in the field of exhaust gas turbocharging.

## Exciting insights

With the family day, the company is keen to offer all staff members the chance to show their family their workplace and offer insights into the exciting work of an automotive supplier. On tours of the facility, the visitors could follow the design process of a turbocharger – from development and checking acoustics, combustion chambers and engines, through production and assembly of the individual components, right up to the vehicle in which the turbocharger is ultimately to be used.

The individual departments at BorgWarner Turbo Systems Engineering GmbH and the production and assembly centers had prepared various presentation stations at which staff members could highlight the function and sequences of the respective department and answer numerous questions. The trainees also presented their skills in action and showed workpieces they had produced themselves, including model motorcycles and a table soccer game.



## Positive response

Despite the rain, around 3,000 visitors made the most of the opportunity to visit one of the largest employers in the region. Everyone involved is now looking forward to the next event in 2010, when the Kirchheimbolanden site celebrates 50 years of turbocharger production.

At numerous stations, the visitors were able to follow the production process of a turbocharger.

## Publishing Information

## TurboNews – 2/2008 Issue

### Publisher

BorgWarner Turbo Systems  
Worldwide Headquarters GmbH  
Mannheimer Straße 85/87,  
D-67292 Kirchheimbolanden

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### Photographs

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Volkswagen

### Concept, design and lithograph

schulze, reister, grözing, werbeagentur ag, Germany  
[www.srgwerbeagentur.de](http://www.srgwerbeagentur.de)

### Printing

WDW Druck GmbH, Leimen-St. Ilgen, Germany

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