BorgWarner
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TurboNews

The customer magazine of BorgWarner Turbo Systems

Two turbochargers offer impressive power and torque delivery in the Porsche Macan

Incredible performance

REVOLVOLUTION

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Editorial

Dear readers,

The internal combustion engine downsizing process is entering its next phase. While manufacturers such as Peugeot and Ford are already presenting their second generation of even more compact turbocharged diesel and gasoline engines, Volvo is developing an entire range of turbocharged engines based on just a single compact four-cylinder unit. The performance offered by the corresponding diesel and gasoline engines is determined by the respective turbocharging system. Porsche, on the other hand, is focusing on delivering maximum torque at very low revs. In this vein, the 3.6-liter (219 cubic inch) V6 in the new Macan SUV provides incredible pickup from just 1,350 rpm. You can read more about the various engine and turbocharging concepts that manufacturers are today employing in the current edition of TurboNews.

Downsizing is an important topic at BorgWarner – yet upscaling is just as important. To this end, turbocharger production is being significantly expanded. For example, the Oroszlány facility that we are presenting in this edition has been continuously expanded since it was established in 2001 – and now ranks as one of the highest revenue companies in the whole of Hungary. You can learn about how BorgWarner is preparing itself to continue supporting vehicle manufacturers throughout the world with pioneering turbocharger technology from both a technological and organizational perspective in an interview with Martin Fischer (Vice President & General Manager Europe) and Joel Wiegert (Vice President & General Manager Americas & Asia) on page 8.

By the way, our TurboNews is now also available in a special online edition at **www.turbos.bwauto.com/en/press/newsletter.aspx**. Whether you prefer to read online or hold the printed magazine in your hand, we hope you have fun reading the articles!

Günter Krämer
Director Marketing
BorgWarner

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Volvo presents pioneering modular engine concept with turbocharger systems from BorgWarner

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New facility in China

In September 2014, BorgWarner officially opened its second turbocharger production site in China. The Taicang facility enjoys a strategically favorable location in a key development region near Shanghai. It is set to significantly extend the production capacities of the turbocharger specialist, catering to the sharply increasing demand.

The main motivation behind the decision to open a second facility in China, alongside the existing plant in Ningbo, was to take advantage of the growth being recorded in the Chinese market and make the most of the increasing market share of turbocharged vehicles. Over the course of the last few years, BorgWarner Turbo Systems has successfully established itself in the Chinese market as a provider of high-grade and high-performance turbocharging systems. Due to ever stricter exhaust emissions regulations, the company is expecting the market for passenger vehicle turbochargers in China to more than double from 4.2 million units in 2014 to over 9 million units in 2019. The new facility has already been producing the latest turbochargers for various auto manufacturers since mid-2014 and is equipped for future growth. The site offers floor space of 15,000 square meters and a total area of 50,000 square meters. Some 150 employees currently work at the location, and this figure is set to increase to around 500 employees by 2018. The Taicang facility was designed according to the latest criteria and employs the latest production methods. It was also awarded LEED Gold certification (Leadership in Energy and Environmental Design) for its environmentally friendly construction. Thanks to natural lighting, as well as the use of solar energy and rainwater recycling, it has been possible to reduce the location's energy consumption by up to 22 %.

With its new LEED Gold-certified production plant in Taicang, BorgWarner is strengthening its long-standing relationships with customers in the Chinese vehicle market.

Bradford helps children

Responsibility for the common good is a corporate value that has long since been anchored in BorgWarner's philosophy.

The commitment of our staff across all company locations is an expression of their strong ties with their locations. It should therefore come as no surprise to hear that the Bradford facility supports the "One in a Million" charity, which provides assistance to children and young people from disadvantaged families in the Bradford area. The organization collects donations at numerous events and then uses these funds to establish and maintain both in-school and extracurricular educational offers for young people.

In 2014, the Bradford facility supported "One in a Million" with a whole range of campaigns. These included holding an open day on July 12, at which more than 800 guests welcomed the opportunity to take a tour of the facility – and make generous donations.

BorgWarner's staff also displayed full commitment the following weekend, when 30 employees first took part in a 24-mile run across three local mountain summits and still had enough energy to complete a 10-km run in Leeds the following morning. The BorgWarner team won the mountain race in a time of 5 hours and 51 minutes. Another BorgWarner team also demonstrated its winning qualities in January, when it secured first place at the "One in a Million" charity football event. However, the actual winners are the children and young people who will benefit from the donations collected at this and similar events.

Kibo makes donation to the ELA
(European Leukodystrophies Association)

229 BorgWarner employees gave it their all during the company run to help secure a healthy donation for the ELA.

Every step counts: This was the motto for the 229 BorgWarner employees in Kirchheimbolanden (Germany) who took part in the 2014 Palatinate Company Run.

But why exactly does every step count? BorgWarner Turbo Systems donated one cent to ELA for every step its employees took during the run. The ELA is in an association which sponsors medical research into therapies for incurable hereditary diseases. Working towards an even higher donation, BorgWarner employees in Kirchheimbolanden could also secure one cent per step on company walks during the fit@work campaign. Everyone involved covered a total of around 1.73 million steps during the two events. The company then ultimately rounded off the resulting donation to €18,000 for ELA.

You can find further information on the ELA at: www.elaev.de

Incredible performance

Barely introduced and already sold out: Porsche's compact luxury SUV, the Macan, celebrated its market launch at the end of 2013, and the first year's annual production volume of 40,000 vehicles sold out shortly afterwards. The turbocharging system employed by the Macan comes from BorgWarner, providing Porsche's V6 engine with a double boost.

The goal when designing the Macan was to make the vehicle a true Porsche. It was therefore clear that the vehicle had to feel like a thoroughbred sports car – but with a bit more ground clearance. The drive for a vehicle of this type clearly needs a lot of power. As such, the V6 unit in the SUV has been equipped with two K0 turbochargers that operate in parallel. The engineers at BorgWarner developed a high performance turbocharging system with waste gate that generates an impressive torque from very low revs and exhaust gas volumes. To achieve this, the waste gate remains closed at low revs to ensure that 100 % of the exhaust gas stream is fed to the turbine wheel. As the revs increase, the waste gate is opened and allows a portion of the total exhaust gas volume to be diverted away from the turbine wheel as a way of reducing exhaust gas pressure and preventing the turbocharging system overloading. Fresh air for the engine is initially compressed by the turbocharger and then fed via a special charge air cooler, which secures better cylinder filling and thereby greater efficiency.

Power from very low revs

The K0 turbocharger from BorgWarner is used in two different engines for the Macan. The Porsche Macan S with 250 kW (335 hp) comes with a 3-liter (183 cubic inch) V6 engine that employs one turbocharger per bank of three cylinders. The top model, the Macan Turbo, is powered by a 3.6-liter (219 cubic inch) V6 engine that also uses one turbocharger per bank of three cylinders. This vehicle offers truly impressive performance with its 294 kW (394 hp), 165 mph top speed and 0-60 time of just over 4.5 seconds. Thanks to its waste gate turbocharger, the Macan Turbo already delivers its maximum torque of 550 Nm (405 lb-ft) from just 1,350 rpm. The fact that the vehicle can also achieve 26 mpg US (31 mpg UK) makes this performance all the more impressive. The CO_2 emissions of just 208 g/km are also more than acceptable for a vehicle offering this kind of blistering performance. It goes without saying that the new drive already complies with the Euro 6 emissions standard coming into force in September 2015.

First turbos for V engines

The powerful V6 biturbo engine in the Macan marks a new milestone in the many years of successful collaboration between Porsche and BorgWarner Turbo Systems. While the turbocharger specialist in the past has mainly equipped the horizontally opposed "boxer" engines in the Porsche 911 with turbocharging systems, the company is now also working on Porsche's V engines. The fact that the renowned sports car manufacturer once again chose BorgWarner as its partner serves to underline the performance and quality of the company's innovative turbocharging technology.

The Porsche Macan: A thoroughbred sports car – but with a bit more ground clearance.

Photo Porsche Macan: José Luis Ruiz

550 Nm of torque available from 1,350 rpm: Two BorgWarner K0 turbochargers with waste gate make it possible.

"First and foremost, our guiding principle is to be as close as possible to the customer."

Increasing globalization and a rising number of customer projects on the one hand, growing competition and cost pressures on the other – BorgWarner faces a number of challenges in the turbocharger business. In the interview, Joel Wiegert and Martin Fischer reveal how the company is preparing itself at an organizational and a technological level to safeguard its leading position as a supplier of pioneering turbocharger technologies over the long term.

Dr. Fischer, Mr. Wiegert, you are both responsible for BorgWarner's turbocharger business in your role as General Manager. What does your job consist of mainly?

Joel Wiegert: BorgWarner's success in the various markets is based on our ability to optimize the business to local requirements. As General Managers, our main task is therefore to support the local sites in achieving BorgWarner's growth and profitability targets. For this, we have developed a business model we call 'Local Accountability, Global Strength' (LAGS), meaning that the individual sites operate in their respective markets with a considerable degree of autonomy. Our products, services and teams including all functions are completely localized so that customers receive the best possible service.

> "We have a very strong global footprint, enabling us to provide our customers with the best possible support locally." Joel Wiegert

Martin Fischer: The support we offer the plants has a strategic and an operational component. On the strategic side, 'Global Strength', we safeguard our technological leadership, ensure that we have the right products for the respective markets, create synergies, an effective supply chain, uniform processes, etc. On the operational side, 'Local Accountability', we support the plants locally in their day-to-day business, particularly when things are not going so smoothly and problems at the organization's interfaces or in working relationships with customers and suppliers need to be resolved.

Mr. Wiegert, you have been working at Turbo Systems for some time now. Did you know exactly what was in store for you as General Manager?

Joel Wiegert: In the course of my career, I have already had the opportunity to work closely with many different cultures, customers and countries. So based on the experience I gained in the USA, Mexico and China, I had a clear idea of the diversity of the cultures. One thing that continues to amaze me, though, is how the markets, product ranges and customer profiles differ from region to region. Again this highlights the importance of our operating model to position us for success in the growing regions of Asia and Americas.

You are in charge of North America, South America and Asia – what are the main differences between those regions?

Joel Wiegert: The biggest difference between the markets is their pace of development. China is expanding at a very fast pace, with double digit growth rates. The turbo market in North America is also expanding at a strong pace, while Japan and Korea are more mature markets that we look to gain additional share in. In South America, we see long-term growth potential in passenger car turbochargers and continued strength in the CV market.

What is the situation in Europe?

Martin Fischer: The market in Europe, on the other hand, is already very mature as far as turbo technologies are concerned. Installation rates in new passenger cars are between 70 and 80 percent. In this market where growth is at a somewhat slower pace, we aim to take the business forward primarily on the back of innovative technologies. One example I can give here is the eBOOSTER, which will secure us a position as a technological and market leader.

Dr. Fischer, you previously worked at another large automotive supplier in the USA. To what extent does BorgWarner differ from other companies in the sector?

Martin Fischer: BorgWarner has an impressively simple and successful operating model. It tells the organiza-

Dr. Martin Fischer has been working in the automotive industry for 16 years now. He started his career at Siemens VDO, where he held managerial positions in which he was responsible for various product groups. He later assumed regional responsibility for North and South America in the Electronics Division at Hella. Since January 2014, Dr. Martin Fischer has been responsible for BorgWarner's turbocharger business in Europe in his role as Vice President and General Manager Europe.

Joel Wiegert has been working for BorgWarner Turbo Systems for more than 12 years. He started in sales and engineering for commercial vehicle turbochargers. In the further course of his career he led the operational business of the commercial vehicle plant in Asheville, was decisively involved in building the plant in Ramos, Mexico and was responsible for the turbo business in China. For two years, Joel Wiegert has been responsible for the turbocharger business in his role as Vice President and General Manager Americas and Asia.

tion quite clearly what the decision-making structures are and who is responsible for what. Together with our regional structure, the LAGS model enables us to bolster and provide excellent support to our individual plants. We are therefore very fast, able to make decisions and close to the customer.

Nevertheless, do you have any ideas from your career so far that could be usefully transferred to BorgWarner?

Martin Fischer: Yes, the turbo business in Europe has experienced a strong boom over the last ten years. Growth is now slowing slightly and new competitors have entered the market. That is a business environment of which I already have some experience, which I can now contribute. It is a question of gaining a bit more ground on the basis of existing strengths. With a growing focus on discipline and efficiency, our business will continue to deliver good results.

What have you learned from the Americans?

Martin Fischer: American companies set great store by a clear vision. From this, they derive their strategy, which they then make very clear and transparent to their employees. And this big picture – what we set out to do and how we do it – is a very powerful management tool in my opinion, and one that I also see at BorgWarner. The second thing I very much liked in the USA was the can-do mentality and the pragmatism in working life. Strategy is translated fairly quickly into action. That is also how it is at BorgWarner.

The two of you are responsible for different regions. Where are the points of contact?

Joel Wiegert: Many of our customers are global players with global engine platforms, making it necessary for us to work closely together across regions. This puts us in the best position to meet local customer requirements while keeping to the global customer standard. Our global program managers and team lead the projects within the same country/region to match the customer lead location.

Are the sites not also in competition with one another?

Martin Fischer: The market makes it absolutely essential for our plants to work well together. We are spread across different sites, but serve one market together. And we need to see that as a team task. Therefore, we also meet regularly with all global strengths, set priorities together and move ahead with initiatives. Depending on the issue in hand, individual sites take on the management in the meantime and then make results available to the others. Of course, each plant's priority is still to be commercially successful itself, but we learned some time ago that we are more successful when we work closely together.

> "Thanks to our operating model, we are very fast, able to make decisions and close to the customer." Dr. Martin Fischer

So our plants support one another in order to achieve the best possible outcome for the turbo business as a whole.

A current example of a global project is the Drive-E modular engine family from Volvo. According to what criteria are projects distributed among the individual sites?

Joel Wiegert: First and foremost, our guiding principle when allocating to the plants is to be as close as possible to the customer. We have a very strong global footprint, i.e. a network of production sites spanning the entire globe, enabling us to provide our customers with the best possible support locally. For a global engine range such as the Volvo range, we also use the same suppliers worldwide, meet the same specifications and employ the same production processes. We accomplish this through leveraging our Global Strength organization which includes engineering, supply chain, manufacturing and quality. Our turbochargers are therefore identical, whether they are now being produced in Europe or China.

Volvo is also an example of how manufacturers are reducing their range of components. By contrast, the variety of turbochargers that BorgWarner develops for customers is increasing. How do you keep the rising number of projects manageable?

Martin Fischer: Our business has indeed become more development-intensive. We need more program teams, more developers and more production engineers in order to meet demand. In recent years, we have therefore invested heavily in our development and program management capacity. In order to continue improving the quality of the production start-ups, we need to continuously develop our employees' skills and provide them with the right tools.

What technologies are you working on in order to safeguard BorgWarner's product leadership for the long term?

Martin Fischer: One of our most exciting projects currently is the eBOOSTER, a fully electric compressor that offers enormous benefits in terms of performance and fuel consumption at very low revs. We already have one firm order to supply the eBOOSTER for engines in the premium segment and in 2017 will become the first supplier to take a large volume into series production.

Joel Wiegert: In Asia and the Americas, we are mainly introducing technologies that have already been tried and tested in Europe. Because European fuel consumption and emission standards are the most stringent worldwide, we have a portfolio of innovative products that give us a strong edge in the global market. Nevertheless, we are also working on new solutions outside Europe. For example, we are in the process of carrying over highly developed turbo systems from the passenger car to the commercial vehicle segment. In addition, our team in Asheville is working on a new, small turbo series capable of withstanding the tough conditions in which off-road commercial vehicles are used – based on our K0 series, which has been tried and tested a million times over. This is because there is increasing market

"We aim to offer the customer the best product – competitive prices are an integral part of that."

Joel Wiegert

"We have a nicely layered and well-filled pipeline for the next ten years in turbocharging."

Dr. Martin Fischer

demand for small-volume commercial vehicle engines with a displacement of up to three liters, which offer considerable benefits in terms of fuel consumption and emissions. Another new technology that is also meeting with strong interest in North America is the dual-volute turbine technology for gasoline turbo charges. This system optimizes low end torque performance and improves fuel consumption.

Martin Fischer: We are developing our technologies across three innovation horizons in all. In the short term, the task is to optimize the efficiency of existing turbos in terms of performance, fuel consumption, emissions and cost. In the medium term, we have technologies that are completely new, like the eBOOSTER, but which are already going into series production. Looking to the third innovation horizon, we are already preparing turbo systems for use with fuel cells, for example. So we have a nicely layered and well-filled pipeline for the next ten years in turbocharging.

BorgWarner aspires to be an innovation and quality leader. What role does the ability to compete on price play here?

Martin Fischer: These are three criteria we need to optimize in order to be a valuable partner to our customers. The more mature the market and the more competitors we have, the higher the expectations placed on our cost efficiency. Going forward too, we will never compromise on performance or quality. Cost-effectiveness is simply another optimization criterion our development teams have to meet.

Joel Wiegert: Innovation leadership, quality leadership and cost leadership are not mutually exclusive. We aim to offer the customer the best product – competitive prices are an integral part of that. In close cooperation with our suppliers, we therefore specifically develop components, designs and production processes geared to maximum cost effectiveness and as a result are able to offer our customers excellent value for money.

What are you currently focusing on at work?

Joel Wiegert: My focus is on two areas: We operate in a very dynamic market and need a strong organization and strong teams to support our growth over the coming years. The second key issue is our program launches. Even as the number of customer projects grows, we aim to ensure that series production start-ups are flawless and fulfil our customers' requirements without compromise.

Martin Fischer: I have used my first year at BorgWarner to develop a roadmap for the next few years. The issue of product leadership is particularly important to me. I intend to specifically push new technologies such as the eBOOSTER. We are also in the process of revising our commercial vehicles strategy. In this segment, we are planning a new product campaign for the next few years that will secure us a position as a technological leader. We also aim to improve further on the cost side so that we can meet the growing competitive pressures successfully.

Mr. Wiegert, Dr. Fischer, thank you very much for this interesting interview!

REVOLVOLUTION!

One engine, 1,000 opportunities: This is the revolutionary concept that Swedish automotive manufacturer Volvo is currently using to phase in its new gasoline and diesel engines, all of which are based on the same basic four-cylinder module with 2-liter (122 cubic inch) displacement. The various power levels are differentiated by the latest generation of exhaust gas turbochargers – which are primarily supplied by BorgWarner.

Volvo's goal when introducing the modular Drive-E engine concept was for engine size to no longer be of any significance in future. All previous four-cylinder, five-cylinder, six-cylinder and eight-cylinder engines are therefore to be replaced by compact 2.0-liter (122 cubic inch) four-cylinder drive units, which are vastly superior to their large-displacement predecessors in terms of both fuel consumption and emissions. Thanks to the use of the latest technologies, all of this has been achieved without compromising performance. In fact, the dynamic driving performance leaves nothing to be desired.

The turbo makes the difference

All new gasoline and diesel engines in the Drive-E range are identical in terms of bore, stroke and distance between the cylinders. They are equipped with many identical basic components, and other components such as the engine block and balancing shaft module also share many similarities. The respective turbocharging systems used represent the determining factor for the power output of the units. As a longstanding partner to Volvo in the field of gasoline and diesel turbocharging, BorgWarner was commissioned to develop turbochargers for all four gasoline units and the two more powerful of the four planned diesel drives.

The two T5 and T6 gasoline engines which are already available are each equipped with one K03 turbocharger that has a waste gate and an electrical diverter valve. The turbocharging system is fully integrated into the exhaust manifold and, just like the manifold itself, is manufactured from sheet steel. This allows an extremely lightweight and compact design, while also guaranteeing better thermal insulation. The turbocharger used in the T6 is additionally equipped with a special Roots compressor, which provides spontaneous pickup and high torque even at very low engine speeds. With its extremely high specific power output of 225 kW (301 hp) and impressive torque of 400 Nm (295 lb-ft), the T6 turbocharged engine is the best in its class. The K03 turbocharging systems for all gasoline engines are produced at BorgWarner's facility in Oroszlány, Hungary.

Turbodiesel with two-stage turbocharging

Just like the upcoming D5, the first D4 turbodiesel already available employs a

Futuristic design, innovative drive: Thanks to its "Twin Engine", the Volvo CX90 produces just 60 grams of CO_2 per kilometer.

The BorgWarner turbocharging systems are the components that allow Volvo's basic Drive-E engine to be offered in various performance levels.

regulated two-stage turbocharging system (R2S) from BorgWarner Turbo Systems. While one KP35 turbocharger works in unison with a K16 turbocharging system, the K16 in the more powerful D5 turbodiesel is combined with a type BV40 VTG turbocharger (variable turbine geometry) from BorgWarner. Combining one compact high-pressure stage that already generates impressive boost at very low revs with a large low-pressure turbocharger gives the Drive-E turbodiesel excellent response and pickup, while also providing high torque over a very wide rev band. The D4 generates 133 kW (178 hp) and offers an impressive torque of 400 Nm (295 lb-ft). The R2S systems are produced at BorgWarner's facility in Kirchheimbolanden, Germany.

CX90 impresses with "Twin Engine"

The absolute top model within Volvo's new Drive-E range will be a truly pioneering drive with the designation T8. Generating 298 kW (400 hp) and 640 Nm (470 lb-ft) of torque, this power unit has impressive performance data, yet emits an incredibly low 60 grams of CO_2 per kilometer in the luxury XC90 SUV. The solution lies in the "Twin Engine". Here, Volvo has combined a turbocharged engine with a 60 kW (80 hp) electric drive that also provides a 40 kilometer "electric-only" range optionally without the support of the internal combustion engine. This drive concept provides a compelling demonstration that driving pleasure and environmental protection are not mutually exclusive and can, in fact, be effectively combined with one another through downsizing with exhaust gas turbocharging.

Longstanding partnership

The ambitious Drive-E development project from Volvo represented a real challenge for the developers at BorgWarner – but one which an international team of experts was able to successfully overcome thanks to the many years of close cooperation between Volvo and BorgWarner. The new turbocharged engines impress both with their innovative technical concept and their excellent performance, fuel consumption and emissions values.

eLearning – The next level

If BorgWarner knew what BorgWarner knows, then the company would be even more productive. It was with this thought that the idea for an eLearning program came about at BorgWarner Turbo Systems at the start of 2012. The objective was to make the knowledge of individual employees working at various locations across the globe available to everyone at all sites using today's digital technology.

eLearning now acts as the central knowledge sharing platform for BorgWarner experts in the various countries. Anyone can add, check and expand their knowledge regarding the assembly and production of turbochargers on a daily basis. To this end, the eLearning program is set up like a kind of quiz. Available in seven languages, questions can be categorized based on their difficulty or specialist area. The questions themselves are formulated in such a way that more than one answer can be correct, which increases the degree of difficulty and makes the quiz quite a challenge.

BorgWarner is keen to bring together the pool of experience and valuable knowledge held by its employees in a database that the individual locations can then use to build on and share.

Learning the fun way

The system quite intentionally employs gaming characteristics, as it has been demonstrated that learning is significantly more effective when it is fun. Just like a games console, users must qualify to play at a higher level in the game – starting as beginners and then working their way up to expert status. They can view their own strengths and weaknesses by analyzing their statistics and also compare their performance against the average of their "opponents". The best player and the best site are announced each month, which in turn increases motivation.

Aside from the fun aspect, the eLearning program obviously also has a serious background. BorgWarner is keen to bring together the pool of experience and valuable knowledge held by its employees in a database that the individual locations can then use to build on and share. Users can find all relevant operating manuals and training documents linked to the respective question on the eLearning platform.

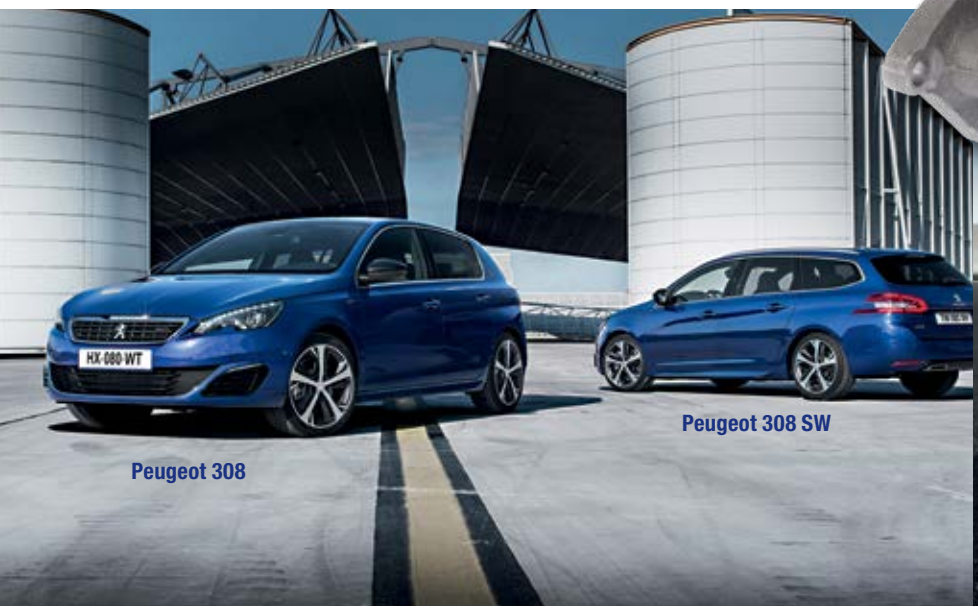
Digital classroom

With its eLearning program, BorgWarner is making detailed specialist knowledge available, while at the same time reducing the costs associated with training measures in the mid-term. Until now, experts have had to travel the globe to pass their knowledge on to others, and business trips like this can quickly cost €5,000 each time. The turbocharger specialist is also strengthening global teamwork with its eLearning concept. Many locations and employees throughout the world have already been involved in further developing the system. According to the developers, the opportunities are virtually endless, since the system is extended and improved on a daily basis.

Lion's heart

With its 308 and 508, French auto manufacturer Peugeot offers two attractive models for discerning car buyers. The 308 was just voted 2014 Car of the Year by the European press and the recently updated 508 has also received numerous international awards since its launch. Both vehicles are now available with a revised turbodiesel engine that employs BorgWarner's latest VTG technology.

The BV43 turbocharger from BorgWarner in particular excels through its use of VTG with s-shaped turbine vane adjustment.



Peugeot 308

Peugeot 308 SW

Peugeot 508

The new 2.0 liter (122 cubic inch) four-cylinder turbodiesel with common-rail injection was developed by a multinational team that included engineers from Peugeot in Paris (France), as well as turbocharger specialists from BorgWarner in Kirchheimbolanden (Germany) and Oroszlány (Hungary). BorgWarner provided a latest generation BV43 turbocharger with VTG (variable turbine geometry) for the new engine.

Latest generation VTG

The turbocharging system excels through its patented s-shaped turbine vane adjustments. Compared with straight turbine vanes, these optimize the engine's response by adjusting the angle and speed of gas at the turbine wheel input. Besides greater performance characteristics, the new VTG technology also improves the engine's efficiency at low revs. So that the new turbocharger can continue to perform its tough task reliably in the long term despite the extremely high exhaust gas temperatures in this application, it was equipped with a particularly robust turbine vane adjustment system. In addition to this, special wear-optimized and heat-resistant materials are used in the BV43 turbocharger. Thanks to integration of the exhaust manifold, the turbocharging system also boasts a very compact design.

Top performance in terms of power output and fuel consumption

The powerful new turbodiesel is reserved for the higher-spec versions of the 308 and 508. It sets new benchmarks with regard to both power output and fuel consumption, and is available in two versions. The BlueHDi 150 variant generates 110 kW (148 hp) and a maximum torque of 370 Nm (27 lb-ft), which is available from just 2,000 rpm. The BlueHDi 180 is able to generate 132 kW (177 hp) at a maximum torque of 400 Nm (295 lb-ft). Both versions easily fulfill the strict regulations of the Euro 6 emissions standard and consume up to 13 % less fuel than their predecessors.

The new engine is not only to be offered in Peugeot's vehicles. In future, it will also allow owners of Ford's Mondeo, S-Max, Focus and even the luxury Edge SUV to enjoy maximum driving pleasure with exemplary consumption and emissions figures.

Elegant design, smooth running, low consumption: Peugeot's 308 and 508 with the new 2.0 liter (122 cubic inch) turbodiesel.

Hungary writes success story

In August 2001, BorgWarner opens a new production site in Oroszlány, Hungary. With breathtaking speed, the number of employees increases from 22 initially to almost 800. The original 1,200 square meter plant now covers an area of more than 15,000 square meters –and ranks among Hungary's top companies.

Demand for turbochargers is booming at the end of the 1990s, driven by constantly increasing fuel prices and ever stricter emission standards. The management team at BorgWarner therefore decides to open a new facility in the Oroszlány industrial park. Just four months after the foundation stone is laid, the first turbocharger leaves the production line for the 1.8-liter (110 cubic inch) gasoline engine in the VW Passat and Audi A4. But what nobody could have possibly imagined back then was that the total volume of 300,000 production units originally envisaged would be greatly exceeded. Indeed, the location has supplied the Volkswagen Group with more than 1.3 million turbochargers of this type to date.

Flying start

Soon after the location is opened, it becomes clear that the production capacity, which is set up with a capacity of 350,000 units, is not capable of keeping up with the ever increasing demand. In 2003, a decision is therefore taken to construct an additional hall. The company then starts supply-

ing GM-Fiat with VTG turbochargers that same year and, sometime later, also VW. Less than a year later, production operations are once again reaching their limits, so the facility is extended one more time. The TFSI turbo commissioned by Audi now goes into production. This turbocharger and the variable turbine geometry turbocharging system for Fiat are the first serial production models to be manufactured in Oroszlány from the outset.

Business: One million turbochargers

In 2005, the location significantly expands its production capacity. For the first time ever, one million units are produced per year in Hungary. Due to the enormous demand, BorgWarner makes a further investment in the facility in 2007. This step proves to be a milestone for the location. Directly after opening the new building, the company reorganizes its production operations. The machining and assembly areas are separated, which also makes them more efficient. Eliminating any risk of cross-contamination between the two areas is a pleasant side effect of this reorganization.

At this time, BorgWarner Turbo Systems has already invested €25 million in the location. The facility is also supplying all important European auto manufacturers. Its customers include the Volkswagen Group – with VW, Audi and Skoda –, Renault, BMW, Volvo, General Motors and Fiat. Besides this, various products are also delivered to the overseas facilities of these vehicle manufacturers. In the fall of 2010, the ten millionth turbocharger leaves the production line.

Development with a capital D

In 2013, the facility is the largest company in Oroszlány in terms of revenue and enjoys a position near the top of Hungary's Top 500 companies. New offices and a workshop for prototypes: In 2013, the expansion program enters its fifth round and the facility now covers a total floor area of around 15,200 square meters. In the same year, the location passes the two million work hours mark without a single reportable accident. All employees are committed to safety and high quality standards – a result of continuous further training. This is underlined by BorgWarner's motto in Oroszlány: "Development is our way of life."

BorgWarner's Oroszlány facility today ranks among the top companies in Hungary.

In 2013, the site receives an award for its "Autonomous Work Teams" (AWT) project. The focus is on granting the 49 production teams more responsibility to strengthen the self-confidence of individual employees, thereby also improving motivation, discipline, loyalty, and ultimately quality and processes.

BorgWarner's latest project in Hungary is set to start in November 2014, when a campus is to be established in Oroszlány. BorgWarner Emission Systems is also planning a production plant for recirculation valves, cooling valves, control valves and thermostats. So this is certainly not the final chapter in BorgWarner's Oroszlány success story.

Next Generation EcoBoost

Confident and feisty – this is how Ford's latest passenger car models present themselves with their large radiator grill, reminiscent of an open-mouthed shark. A quick look behind the grille of the gasoline engine version generally reveals a small-displacement turbocharged engine with impressive performance. The most recent member of Ford's EcoBoost range of engines has a displacement of just 1.5 liters (91.5 cubic inches) and is boosted by a BorgWarner turbocharger.

The particularly compact B01 turbocharger has been designed to handle exhaust gas temperatures of up to 1,050°C and optimized in terms of boost pressure, efficiency and NVH properties.

Ford's generation of advanced turbocharged engines, which consistently follow the principle of downsizing, has been an unprecedented success story since the first EcoBoost gasoline unit was introduced back in 2009. Indeed, the two millionth EcoBoost engine left the production line in September 2013. This range of turbocharged engines includes the highly popular 2.0-liter (122 cubic inch) and 1.6-liter (98 cubic inch) four-cylinder units, both of which are equipped with BorgWarner turbochargers.

One engine for all

In 2014, Ford then presented the successor to the 1.6-liter (98 cubic inch) version with its new 1.5-liter (91.5 cubic inch) turbocharged gasoline engine. This new unit initially celebrated its premiere in the Chinese version of the Ford Mondeo and in the Ford Fusion, which is produced for the US market. It is now set to gradually replace its predecessor, also in models such as the Focus, Mondeo and C-Max, which are produced for the European market.

Latest turbocharger technology

The new drive employs direct fuel injection, variable camshaft adjustment and a particularly compact, latest-generation B01 turbocharger from BorgWarner, which has been designed to handle exhaust gas temperatures up to 1,050°C and optimized in terms of boost pressure, efficiency and NVH characteristics (noise, vibration, harshness).

The old 1.6-liter (98 cubic inch) engine already impressed with its combination of excellent dynamic performance and economy. Besides even better dynamic performance, however, the new 1.5-liter (91.5 cubic inch) turbocharged engine, which is available in two different power outputs, also offers significantly improved fuel consumption and emissions values. In the new Ford Focus, for example, the version with 110 kW (147 HP) achieves 42.5 mpg (US) and emits only 127 g of CO_2 per kilometer. Boasting even more impressive performance, the version with 132 kW (177 HP) still offers excellent consumption of 40.5 mpg (US) with 134 g of CO_2 emitted per kilometer.

Manufacturing in tune with customer and market needs

The close cooperation between the teams of developers at Ford and BorgWarner across the globe has once again led to an exceptional engine that is sure to impress many potential buyers. The new 1.5-liter (91.5 cubic inch) EcoBoost engine is manufactured in Europe and China for worldwide demands. BorgWarner produces the necessary turbocharging system for Ford's manufacturing locations locally at its facilities in Poland and Ningbo. This proximity to the customer guarantees a high degree of flexibility and availability.

Great performance, small drive: The new Ford Fusion with 1.5-liter (91.5 cubic inch) EcoBoost engine and BorgWarner turbocharger.

Focus on efficiency: In the new Ford Focus, the 110 kW version of the engine offers impressive consumption of 40.5 mpg (US).

Turbo goes to school

Getting young people excited about the work of engineers is the main objective of "Turbo goes to school", a competition organized by BorgWarner in Kirchheimbolanden (Germany) for the engineers of the future. At last year's third annual hosting of the competition, pupils from the Donnersberg district presented prototype vehicles they had developed themselves – and walked away with excellent prizes.

All 40 talented participants at a glance, together with their BorgWarner counterparts.

At this year's competition, a group of tenth grade pupils from the Nordpfalzgymnasium school won the day. A total of 40 pupils took part in the presentation at Kirchheimbolanden Town Hall on 11 July 2014, impressing the expert jury with their resourceful ideas, implementation and amazing passion for vehicle engineering. The task was to construct a vehicle that could cover a defined distance under its own steam, starting from a ramp.

Stefan Boschmann, Alexander Dinges, Daniel Kling and Samuel Unger took first place, while a three-pupil team from the Weierhof school in Bolanden took second place ahead of three youngsters from the Nordpfalzgymnasium school. The winners of the first three prizes were delighted to receive €250, €125 or €80 per team member, which they are to invest in driving lessons. The impressive commitment displayed by the other participants was also rewarded with special prizes.

Good ideas, secure future

The story of "Turbo goes to school" follows the special tradition of promoting young talent in Kirchheimbolanden. The idea for this competition came about completely by chance during a hallway chat between an engineer, a marketing guy and a staff member from the HR department, who were all keen to show that physics and engineering can be fun. I think we can all agree that this year's competition impressively demonstrated this. BorgWarner offers young people in the region a whole range of training and career opportunities, thereby also securing its own need for qualified employees. After all, securing the future of the constantly growing company also involves getting enough young people excited about turbo technology.

Delighted: The winners were full of smiles as they received the cup and €250 each to go towards driving lessons.

The winning model on its way from the ramp to the podium.