

# TurboNews

Magazine for Friends and Customers of BorgWarner Turbo Systems 2/02



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## Placing new trails

The first EPA-certified engine from  
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## Editorial

TURBONEWS INTRODUCES NEW TECHNOLOGIES AND PRODUCTS

## Even more thrust

Dear Readers,

In the last edition of TurboNews we asked for your opinion on our customer magazine. The large number of replies we received to our reader survey was both surprising and thrilling, and we thank you for your active involvement. You can see the extremely positive results of this survey in detail on the last page of this edition.

We especially thank all those who sent their comments on how TurboNews might be further improved. In fact, in this edition we have already incorporated the desire shown by many readers for more detailed reports on technical developments and new Turbo Systems products. You can see this in the article on the innovative eBooster system.

In this latest edition of TurboNews you can also find more interesting reports from the most diverse of areas at BorgWarner Turbo Systems. This edition's Q&A interview is with Ingrid Mangold, Vice President Human Resources. She reports on how various cultures at Turbo Systems have grown together and details how Product Leadership is being linked to initiatives and programs in Human Resources.

We have also included four articles that highlight some interesting applications of our turbochargers from three different fields, reporting on the highly successful application of BorgWarner turbochargers in the marine engines of MTU, the series launch of the high-tech SV410 product in the MACK Trucks, and the Audi 1.8T engine that uses K03 turbos. Last but not least, you can also find out the latest on the new partnership with CaseNewHolland.

We hope you have fun reading, and be sure to keep sending us any comments or criticism you may have!

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BORDERLESS GLOBAL ORGANIZATION  
AN IMPORTANT PART OF THE TURBO SYSTEMS VISION

## Creating a global village

The automotive industry continues to come closer together. Alongside acquisitions and mergers there is now a growing number of partnerships. A common theme of all these alliances is the international nature of the cooperation. The new vehicle and engine designs resulting from these partnerships will one day not only be manufactured in standardized production across the globe, they may also be developed at various locations simultaneously – a concept that also presents the supply industries with new challenges.

The aims are clear. Centralized basic development bringing together all available resources must be combined with global project development geared towards the needs of the customer. The smooth progression of projects is of paramount importance here. But how can we ensure successful cooperation between the customers' international development teams and our own development and customer teams around the globe?

An important first step is to tailor our own organization to meet these new demands. We at Turbo Systems have therefore delegated responsibility to so-called "Global Business Managers". Each of these GBMs coordinates, supervises and controls all local customer and development teams worldwide for one globally operating customer group.

You can find out more about successful examples of such cross-border development projects in this edition. These include the way development colleagues from Kirchheimbolanden and Asheville as well

as the customer team in Asheville worked hand in hand on the project with MACK Trucks (part of the VOLVO POWER TRAIN group), pooling all resources, test beds and simulation capabilities available worldwide.

Demands for smooth cooperation beyond company and country borders will continue to increase in the future. A borderless, global organization for the good of the customer is therefore an especially important part of BorgWarner Turbo Systems' vision. In the future we will see many more such projects where BorgWarner Turbo Systems successfully manages global engine development.



Ulli Fröhn, Vice President for Sales & Marketing at BorgWarner Turbo Systems.

MACK® TRUCKS AND TURBO SYSTEMS  
DEVELOP EPA-CERTIFIED ENGINES

# Placing new trails



In October 2002 new emissions standards were introduced in the United States for commercial vehicle engines. Yet long before they were actually enforced, these extremely strict directives required a great technological leap in the field of diesel engine technology for heavy commercial vehicles, and really tested the ability of both manufacturers and suppliers to innovate. The requirements of boosting systems for the new generation of engines have risen particularly sharply.

With the support of BorgWarner Turbo Systems, Mack Trucks has successfully stood up to the challenge and developed one of the first EPA-certified engines. The new in-line six-cylinder engine fitted in the MaxiCruise and Econodyne series is a 12 liter (732 cubic inch) model and is

tuned to offer between 246 and 338 kW (330-460 bhp). It has been designed specifically to meet the rigorous emissions limits, yet sacrifices nothing with regard to power, fuel consumption or service life. One of the ways the development team achieved this was to use the V-MAC® III, vehicle Management and Control system in combination with the latest fuel injection technology and cooled exhaust gas recirculation.

Another decisive component was the charging system used. The engineers at Turbo Systems developed an SV410 turbocharger with variable turbine geometry that meets all the specific demands of this engine application. To achieve the greatest possible efficiency and service life, the unit uses adjustable turbine

vanes with two-side bearings and cast titanium compressor wheels. There is an integrated sensor to monitor the speed of the turbocharger, while the pneumatic positioning of the turbine vanes is controlled electronically. To adapt the position of the turbine vanes perfectly to all engine operating points, the position of the vanes is monitored by a position sensor. However, the variable turbine does not merely control the exhaust gas recirculation, it also supports the engine brake – by providing optimum boost pressure under braking conditions.

The development targets set were extremely ambitious and it was only possible to achieve these through effective team work and close cooperation

between the developers at Mack Trucks and the Mack Team at BorgWarner Turbo Systems in Asheville. The group led by Robert Lebold was driven by great enthusiasm for the project and supported by the World Development Center in Kirchheimbolanden. The engineers in Kirchheimbolanden were in charge of developing the basic features of the variable turbines, while the customer customization and design work took place in Asheville. The new Mack engine was ready to run after just 30 months' development and meets all performance, fuel consumption and service life requirements, while conforming to the strict emissions regulations in the United States.



The new SV410 turbocharger with adjustable vanes and titanium compressor wheel.

INTERVIEW WITH INGRID MANGOLD, VICE PRESIDENT HUMAN RESOURCES

## Systematic Human Resources Development

The editorial team at TurboNews met with Ingrid Mangold to discuss the role of human resources development in realizing Turbo Systems' goal of global Product Leadership.

**TN:** Mrs. Mangold, you have been with Turbo Systems for more than 2 years now as Vice President Human Resources. What are your general impressions so far?

**I. Mangold:** I was immediately very impressed by the speed with which the company is growing and the flexibility with which our employees react to new market situations and customer requirements. Since I joined Turbo Systems, the company has opened additional sites and significantly increased the capac-

"We already have excellent people in all areas of the company, yet we all have potential for further development."

ity of established plants. We have also set up two new Technical Centers for innovative turbocharging systems and won new customers. What has made this possible is a workforce that is highly qualified, committed, open-minded and curious.

**TN:** BorgWarner Turbo Systems was founded in part from the former competitors KKK and Schwitzer. With sites spread out over different continents and cultures, how can we form a Turbo Systems community and create a seamless organization?

**I. Mangold:** This is precisely what my task as Vice President Human Resources involves. For many companies, Human Resources simply represents administrative tasks, yet at BorgWarner (and also at Turbo Systems) we have made HR a significant factor contributing to the company's success. The basis for this is defined in the goal to achieve worldwide Product Leadership,

which was set in 1997. To support this we have developed a Competency Model that forms the basis of our management philosophies and HR systems. This model is applicable across cultures and is used worldwide. This has helped us develop as an organization and find our own Turbo Systems identity.

**TN:** So what does that mean in concrete terms?

**I. Mangold:** Well, we looked into what made KKK and Schwitzer tick and developed a common vision for the entire company. We

created clear and efficient structures and defined global responsibilities. Alongside this, it was also neces-

sary to improve communications within Turbo Systems to further promote integration, unity, and global team spirit. A global Communication and Information Team (CIT) is working on this. Initial products, such as "The Turbo Way" Intranet site and "TurboWorld" global employee newsletter, have already been developed and rolled-out.

**TN:** You mentioned the vision of Turbo Systems. This includes talk of the "most talented people in the world." What human resources development programs have you implemented to support this?

**I. Mangold:** I basically work from the assumption that we already have excellent people in all areas of the company, yet we all have potential for further development. With the help of the Competency Model, which forms the core of our HR work, we can determine the needs of the organization and apply this analysis to individual development. We have also started introducing a culture of coaching and feedback and have held corresponding training sessions, such as "Coaching for Performance," "Development First" and the "Talent Leadership Program" – an intensive



workshop for leadership development. And naturally we offer these human resources development programs worldwide.

**TN:** And have you started to see any results or success from these efforts yet

**I. Mangold:** We certainly have! The integration of all sites into a seamless global organization is going very well as we have introduced various global teams and councils to support this. By bringing together the most talented people in the world, we have been able to

reach faster and better decisions. Of course, I have no illusions about changes happen-

ing overnight, but we view the difficulties we face as opportunities to learn.

**TN:** What challenges are you looking to tackle next?

**I. Mangold:** I see HR as a business partner, an internal service provider and a consultant; however, we still have a way to go for our customers to see it this way. This recognition is something we are striving for, and our Turbo Systems human resources initiatives support this effort. We are also working at the BorgWarner level to develop a human resources vision and prepare the HR organization for the future. These strategies will have an impact on the work of all HR staff members worldwide, on our services and on our customers. It is very exciting to be involved in these things, to overcome the challenges and to help shape the future. And I am confident that with everybody's support we will be successful.

TURBOCHARGER DEVELOPMENT FOR CASE NEW HOLLAND RACES OUT OF THE BLOCKS

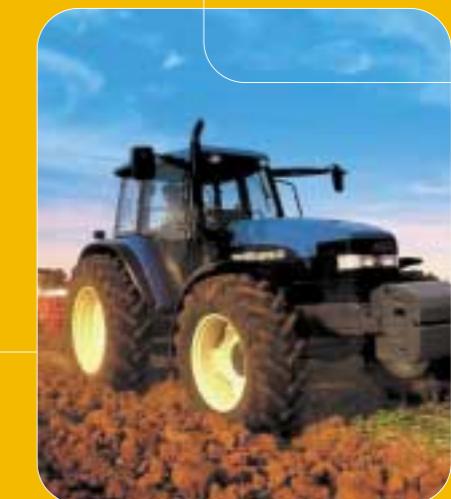
## Flying start

In 1985 the two companies Fiat Agro and Ford New Holland came together to form New Holland. The merger of Case Corporation and New Holland in 1999 then led to the founding of Case New Holland, today one of the world's largest tractor, combine harvester and construction machinery manufacturers. Case New Holland markets its agricultural machinery in some 160 countries under the brand names Case IH, New Holland and Steyr, while the construction machinery has such well-known brands as Case, Fiatallis, New Holland and O&K.

The renowned agricultural and construction machinery specialist has its headquarters in Basildon (UK). Alongside tractors, a large number of engines are also produced here and delivered to other facilities within the group. BorgWarner has been supplying the engine manufacturing facility in Basildon with crankshaft dampers for many years, and in 2000 the company then started cooperation in the field of turbochargers.

Case New Holland and BorgWarner Turbo Systems together started the development of a new generation of engines, known as the Genesis series. The Sales & Application Group of Turbo Systems in Bradford was closely involved in the project to ensure short development time and the high quality of the final product.

The development teams of both companies decided to go for K27.2 turbochargers, which offer excellent thermodynamic characteristics alongside outstanding quality and service life. A conventional turbocharger is now being used for the 114 kW version (155 bhp) of the new engine. The powerful 168 kW (228 bhp) version uses a turbocharger with waste gate.



Agricultural machinery by Case New Holland carries out heavy work in some 160 countries across the globe, since 2002 with the assistance of turbocharging systems by Turbo Systems.

TURBO SYSTEMS INTRODUCES EBOOSTER AS THE TURBOCHARGER SYSTEM OF THE FUTURE

# Charging twice for greater efficiency



**P**rotecting the environment and especially the climate are of crucial importance in the automotive industry. The European Automobile Manufacturer's Association has therefore committed itself to reducing average fleet consumption to 6 liters per 100 kilometers (approximately 40mpg) by 2008. This corresponds to a reduction in carbon dioxide emissions to 140 g CO<sub>2</sub> / km – representing a huge challenge for automobile manufacturers in the years to come.

Some examples of promising steps in reducing fuel consumption include reducing the displacement of the combustion engine or increasing the transmission ratio.

However, such modifications to reduce fuel consumption are always accompanied by a reduction in static and dynamic output. It is unlikely that end customers will accept the corresponding losses in vehicle power and comfort. These losses must therefore be offset by measures which have the least effect on fuel consumption and maintain as far as possible the performance characteristics of the original large displacement units. This is a difficult task, as smaller engines offer significantly less torque at lower engine speeds than their high capacity brothers. Yet this problem can be solved using a suitable, high performance turbocharging system. Alongside

those turbochargers that use a variable turbine or regulated, two-stage turbocharging (R2S), there is also increasing discussion on using electrically assisted turbocharging systems as a solution.

As technology leader in the field of turbochargers, BorgWarner Turbo Systems has carried out a comparative system study, in order to continue supporting customers with trend setting products in the future. Based on the result of this study the Turbo Systems development teams are intensively pursuing the innovative eBooster concept. This electrically assisted turbocharging system uses a flow compressor powered by an electric motor connected

to a turbocharger as an upstream or downstream component. In contrast to the electrically assisted turbocharger this system has a two-step operation with a series connection of two compressors. This multiplies the compression ratios of both units.

By using two compressors matched to one another it is possible to optimize the whole system to the particular application and expand its total performance characteristics. eBooster and turbocharger are two separate units. This has the distinct advantage that, when suitably positioned, the thermomechanical stress on the electrical and electronic components is significantly less than with electrically assisted turbochargers.

In the initial development stages of the eBooster the Turbo Systems engineers pursued two aims. First they wanted to prove the efficiency of the eBooster in

combination with the turbocharger on a combustion engine, and not only on the test bed but also in a road test. Close cooperation with various customers clearly demonstrated the superiority of the eBooster both for petrol as well as diesel engines. Secondly, the system had to offer from the outset the reliability and robustness for which all BorgWarner turbocharger systems are renowned.

Now that we know the potential of the eBooster system, the emphasis in development is on incorporating the eBooster into the structure of the on-board electrical system. Integration of the turbocharger system into a suitable 42V on-board electrical system would most likely be possible without further modification. However, from today's perspective the introduction of such a system in the near future is highly unlikely – at least in those vehicles actually capable of employing an eBooster.

Alongside further optimization of the compressor components and reduction of the mass moment of inertia of the rotor, the engineers' efforts are therefore being concentrated on a 12V solution compatible with the on-board electrical system. In view of the large number of new electrical consumers, a variety of steps are being taken in the automotive industry to improve the performance of the 12V on-board electrical supply system. Results show that the use of an eBooster in a modified 12V on-board electrical supply system is both technically feasible and practical.

BorgWarner Turbo Systems is working flat out on the further development of this very promising technology. For more detailed information on the current status of eBooster development please request a special report or a pdf file via e-mail from rai@3k-warner.de.



The performance potential of eBooster has already been proven in tests.

MTU FRIEDRICHSHAFEN PRESENTS MARINE ENGINES  
WITH IMPRESSIVE PERFORMANCE FIGURES

## Water power



With around 6000 bhp the yacht "Record" sweeps across the water.

A company's technological competence is proven not just on the global stage but also in specific niches, where special know-how is called for.

In the field of marine engines, where high power density, perfectly balanced system technologies and also visually attractive engines are in demand, BorgWarner Turbo Systems is the first choice supplier of innovative turbocharging systems. This is why MTU

Friedrichshafen has joined such successful manufacturers in the marine field as MAN, CAT and Volvo Penta in trusting the expertise, experience and products of Turbo Systems.

The 183 and 2000 series engines are a particular highlight here. At "Boot 2002" in Düsseldorf, MTU presented the 12V 183 TE94, already in its second development phase. With an output of 970 kW (or 1,320 bhp), it has vast power reserves for yacht applications at an even lower weight. Two K36.5 turbochargers with water-cooled turbine housings, integrated waste gates and milled compressor wheels not only help the engine to this remarkable power output, they also provide an impressive torque of 4,030 Nm (35,650 foot pounds).

And as the sales figures prove, MTU has scored an absolute hit in the "mega yacht" arena with the 2000 series marine engines. The 1,470 kW (1,999 bhp) 16V 2000 M91 has enjoyed particular success in its market sector and, once again, Turbo Systems provides the necessary boost here. Two K42 turbochargers with water-cooled turbine housings, milled compressor

wheels and integrated waste gates form the basis for the outstanding horsepower and torque figures of the engine. Yet the 16 cylinder model of the 2000 series is not the only engine to enjoy success at MTU.

On July 31, 2001 its smaller brother, the 12V 2000 M91, established a new world record. The "Record" yacht made the journey from Monte Carlo to London (3,854 km or 2,408 miles) in just 63 hours and 54 minutes – equipped with 4 MTU 12V 2000 M91 engines, no fewer than 8 K36.5 turbochargers and a total power output of 4,400 kW (4 x 1119 kW = 4476 kW) or 6,000 bhp. The turbochargers of these engines also used milled compressor wheels to optimize their service life.

The performance of the turbocharging systems provided by Turbo Systems has a decisive influence on the performance of MTU's marine engines. The thermodynamic characteristics of their turbochargers and their expertise in the use of water-cooled turbine housings, in particular with integrated waste gates, have established BorgWarner Turbo Systems as the product leader for customers across the globe.



A total of 8 K36.5 turbochargers charge the 4 MTU engines.

BORGWARNER SHOWS AT THE SAE CONGRESS 2002 IN BRAZIL

# Technology Meeting

Each year the Society of Automotive Engineering organizes the SAE congress, the largest international congress for technology and mobility in Latin America aimed first and foremost at technicians and engineers. More than 80 exhibitors took part in the 2002 event, 17 of whom were automobile manufacturers and parts suppliers for passenger cars, commercial vehicles and off-road vehicles. A three day program featuring technical forums and other events ran alongside the exhibition and attracted around 7,500 visitors.

It was the second time that BorgWarner had taken part in the congress – this year with a larger stand which, like in 2001, showed product ranges from Turbo Systems and Cooling Systems. Some of BorgWarner's most important customers, such as MWM, DaimlerChrysler, Cummins, Ford, International, Caterpillar or Volkswagen, visited the stand to find out more details on current technologies, while several other potential customers also took the opportunity to engage in discussions with

BorgWarner's Original Equipment Sales and Application Team. Overall, the SAE established itself as a friendly meeting

place for old and new business associates throughout the South American automobile industry.



The Original Equipment Sales and Application Team answer visitors' questions.



The BorgWarner stand became a platform for in-depth technical discussions.

AUDI A4 1.8T NOW ALSO WITH 190 BHP

# Superpower



The new 1.8 Liter turbo engine with 190 bhp turns the Audi A4 into an elegant sports sedan.



For the launch of the new Audi A4, the well-known 1.8 liter turbocharged engine was fully reworked to provide 163 bhp (120 kw) and conform to the EURO4 emissions standard. Yet now there is a new, even more powerful version of the 1.8T engine on offer in the A4: With 190 bhp (140 kw) and an impressive torque figure of 240 Newton meters (177 foot-pounds) the new unit takes over the role of the top four-cylinder sports model. It helps the A4 sprint from 0-60 mph in under 8 seconds and achieve a top speed of 146 mph (236 km/h).

The 190 bhp unit is descended from one of Audi's most successful engine families. The numerous 1.8T versions that have arisen in cooperation with BorgWarner Turbo Systems, have always offered high performance, smooth running, instantaneous throttle response and impressive power since their debut in 1994.

Quattro GmbH – also responsible for the powerful turbo engines in the Audi RS4 and RS6 – optimized the performance of the engine in close cooperation with the Turbo Systems engineers. Several modifications were needed to achieve the new figures. The engineers fitted a second charge cooler and completely revised the electronic engine management system. A red "T" on the grille and on the rear badge of the car indicate the force that lies within the most power turbocharged engine currently available in the A4.

The maximum torque of 240 Nm (177 foot-pounds) is available to the driver across the broad range from 1,950 to 5,500 rpm, while the peak power output of 190 bhp (140 kw) is achieved at 5,700 rpm. The front-

wheel drive A4 1.8T's average fuel consumption figure (28 mpg US / 32.5 mpg UK) is particularly impressive given the performance on offer here. And this 190 bhp version is of course in line with the EURO4 emissions standard.

The debut of 1.8T 4-cylinder turbo engine in 1994 was the beginning of a joint success story for Audi and BorgWarner Turbo Systems. Since that time both companies have maintained their excellent reputation in the field of turbocharged gas engines. And the success enjoyed by the turbocharged engine across the globe is the best endorsement the engineers could have hoped for.



BORGWARNER TECH REVIEW IN KOREA

## High-tech live

The presence of the Korean auto industry in international markets has grown significantly in the last few years. This has been linked to the new strategic thinking of the manufacturers to do their own development work and use more new technologies in their cars.

To accompany this trend, BorgWarner presented its entire product range for engines and drive trains at the sites of Hyundai and SsangYong in a Tech Review from 10 to 15 July 2002 in Korea.



The information offered by the BorgWarner team was greeted with keen interest by the Koreans.

This event, which is already a hit for BorgWarner in the United States, combines an exhibition of advanced products at the customer's site with interesting talks and exciting presentations.

BorgWarner Turbo Systems presented itself as the leading provider of innovative turbocharging systems for passenger cars, small commercial vehicles and

medium-sized and large trucks. The products on display by Turbo Systems aroused much interest, as both Hyundai and SsangYong understand the importance of turbocharging for modern diesel engines.

Christoph Rabe (Vice President for Finance and Controlling, also responsible for the Asian market), Thorsten Seehars

(Director for Sales and Applications in Asia) and Siegfried Ritter (Sales and Application Manager) were on site to represent Turbo Systems at the event. The lectures on "Turbocharging technology for diesel and gasoline passenger car engines" and "Turbocharging technologies for commercial vehicles" were particularly well attended.



TURBO SYSTEMS FORMS TEAM DETROIT TO SUPPORT NORTH AMERICAN OEMS

## Trendsetters

Fleet consumption and the emission of hazardous substances are also becoming increasingly important issues for passenger cars and light commercial vehicles in the North American markets. In contrast to Europe, large capacity, naturally aspirated petrol engines control the market in the USA. And it is especially in this sector that lowering fuel consumption and reducing harmful exhaust gases is setting the manufacturers a tremendous challenge, as the demanding customers are not willing to accept losses in performance or comfort. This is why there has recently been renewed interest in the use of turbocharging, both for passenger cars and as well as for pickups and SUV applications.

tacts for North American automobile manufacturers. The strengthening of the team by the appointment of Hartmut Claus at the beginning of 2002 (previously manager of project group Audi) has made a decisive difference and expands the know-how of the local group with knowledge and experience of European petrol engine turbochargers.

Team Detroit proves that for Turbo Systems, product leadership also means reacting to new trends early on. The company approaches manufacturers with individual needs in mind, thereby creating the basis for the development of new generations of turbocharged engines in North America.



The Detroit team in the Powertrain Technical Center in Auburn Hills:  
Hartmut Claus, Steve McKinley, Tom Grissom and Matt Delevan

BorgWarner Turbo Systems predicted this trend and has lost no time in assembling a team of qualified contacts. The "Team Detroit" operates out of the Powertrain Technical Center in Auburn Hills. It supports American OEMs on site with their ideas on developing turbocharged petrol engines – and also in the evaluation of diesel engines as an alternative drive unit.

The team members are Steve McKinley, Hartmut Claus, Tom Grissom and Matt Delevan. With over 40 years' turbocharger experience between them they are experienced and knowledgeable in all aspects of turbocharging and ideal con-

### The tasks of the Detroit team

- Business development with traditional OEMs and new suppliers of private cars and light commercial vehicles in the North American market
- Observation of the North American market
- Identification of key technologies and technological trends in North America

TURBO SYSTEMS SENDS RESIDENT ENGINEER TO INGOLSTADT

## Inside Audi

In its development of turbocharged engines Audi has for many years put its trust in the know-how of BorgWarner Turbo Systems. And the cooperation between the two companies has already produced a large number of outstanding petrol engines, the most recent example being the impressive V8 twin turbo unit of the Audi RS 6 we featured in the last edition of TurboNews. The string of common successes has long since established BorgWarner Turbo Systems as sole supplier of turbochargers for all Audi petrol engines.



To build on this trust and be in a better position to tackle the growing number of increasingly complex projects, in June 2000 Turbo Systems sent a resident engineer to Ingolstadt. Having fulfilled this role extremely successfully over a two year period, Andreas Lakämper has now come to Kirchheimbolanden as manager of the Audi project group.

The qualified engineer Marco Krah is to take over his position at Audi. In his office in Audi's SE House he will serve as the future interface between the development departments of both companies.

Before starting work at Audi, Marco Krah first underwent an almost 6 month long induction program in Kirchheimbolanden. Here he was given intensive training in customer care and project management by experts from the Audi project group, and in particular by Andreas Lakämper as the new manager of the project group. Before joining BorgWarner, Marco Krah worked in Reims/France as a project engineer for a noted supplier to German automotive customers. This allowed him to gain valuable experience working as an interface between customers and his own development department.

## RESULTS OF OUR TURBONEWS SURVEY

# Positive assessment

In the last edition of TurboNews we asked for your opinion on our customer magazine. A number of readers replied to our request and were very positive, providing us with the incentive to continue researching and preparing topics of interest in the future. These are the results of our survey:

## How would you rate...

### ... the information content of the articles?



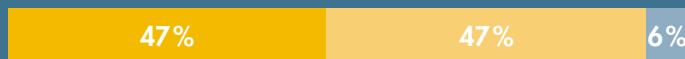
### ... the relevance of the topics?



### ... the design of TurboNews?



### ... the clarity of layout of TurboNews?



### ... the number of editions?



Very good

good

don't know

not very good

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**BorgWarner  
Turbo Systems**