boostermagazine

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Raising The Bar Through Partnership

Honeywell

On Track

- Turbo technology is contributing to performance that's redefining the norm for the latest turbo diesel V8s, three of which are due to be unveiled at the International Motor Show in Frankfurt. Honeywell's third generation VNT™ with REA is featured on each vehicle.

- A pioneer in ball bearing technology, Honeywell offers the ultimate bearing performance for light vehicles, racecars as well as commercial vehicles.

- Diesel SUVs in Korea look set to win even more plaudits after the introduction of Honeywell's third generation VNT™ technology into the Hyundai Tucson and the Kia Sportage.

- Honeywell's automotive customers can now benefit from true 24-hour engineering support, thanks to the newest turbo technology center in Shanghai, the biggest facility of its type in Asia.

- This year, Audi was once again triumphant at Le Mans, with Tom Kristensen, in the Garrett® boosted Audi R8, claiming his record-breaking 7th win.

- Media watch ... Turbo achieves wonders for diesel cars. For gasoline engines, the trend points at GDI combined with turbochargers.

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Listening and Learning

Dear Readers,

It gives me great pleasure to introduce this latest issue of Booster magazine, which focuses on the power of the partnerships that Honeywell is developing with its customers around the world.

Over the last eight months, I have had the opportunity to meet many of our customers and to listen to what they expect from Honeywell. The challenges vary, but there is a common requirement for boosting technologies that provide them with powertrain solutions to help them meet regulations and stay competitive.

I believe that it is our technology portfolio – and our commitment to invest in the turbo technologies of the future – that sets Honeywell apart and provides the foundation for effective partnerships with our customers.

The results of such collaboration can be seen throughout this magazine – from the third generation VNT™ technology boosting flagship V8s in Europe to the technology's first launch in Asia – on compact SUVs in Korea – and the remarkable success of Garrett®-boosted cars in the motorsports arena. Moreover, our commitment grows ever stronger, as evidenced by the opening of our new technology center in Shanghai, which makes round-the-clock global engineering service a reality.

However, the full potential of technology can only be realized when complemented by an ethos of true partnership. For example, our latest generation VNT™ turbo is now working alongside DPF systems to deliver significant gains in emissions control, and our engineers are customizing ball bearing technology for a commercial vehicle engine program to provide faster response, better fuel efficiency and built-in reliability.

I hope that you enjoy reading this latest edition of our Booster magazine. Thank you for your continued support.

Adriane M. Brown

Adriane Brown
President and CEO
Honeywell Transportation Systems

COVER:
The stunning V8 line-u
from Mercedes, BMW
Audi

TURBO TECHNOLOGIES REDEFINE PERFORMANCE STANDARDS
PARTNERSHIPS LEVERAGE OPTIMUM COMPETITIVE ADVANTAGE

2005 Customer Success

Honeywell's world-wide turbocharging capabilities make the company the ideal partner for global automotive manufacturers. Collaborative programs with OEMs are redefining the norm in engine performance, CO_2 reduction, low-end torque and in the application of advanced technologies such as DPF. The results speak for themselves.

Audi A8 4.2 TDI

Engine Specifications

- Engine layout – V8
- Displacement – 4134cm3
- Maximum Power – 325hp @ 4000rpm
- Maximum Torque – 650Nm @ 1600rpm

Garrett® GT17 VNT™

BMW 745d

Engine Specifications

- Engine layout – V8
- Displacement – 4423cm3
- Maximum Power – 300hp @ 4000rpm
- Maximum Torque – 700Nm @ 1750rpm

Garrett® GT17 VNT™

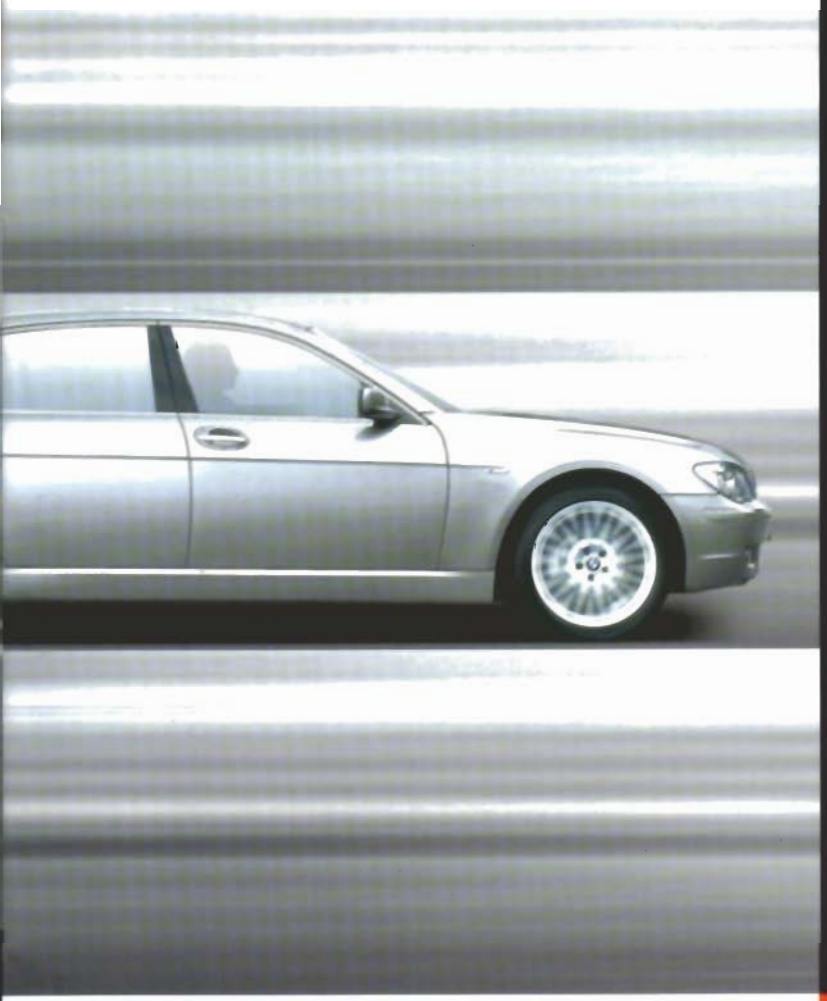
Mercedes S 420 CDI

Engine Specifications

- Engine layout – V8
- Displacement – 3996cm3
- Maximum Power – 314hp @ 3800rpm
- Maximum Torque – 730Nm @ 1800rpm

Garrett® GT17 VNT™

Highlights



Turbocharger Specifications

- Garrett® Twin Turbo GT17 VNT™ 3rd Generation
- Controlled by Rotary Electronic Actuator (REA)

Turbocharger Key Benefits

- Ultimate low end torque and power output
- Engineered for higher exhaust gas temperatures
- Meets stringent requirements linked to Diesel Particulate Filters (DPF)

Boosting the latest generation flagship V8s

THIRD GENERATION VNT™ TURBO BOOSTS FLAGSHIP V8s A PERFECT MATCH FOR DIESEL PARTICULATE FILTERS

Raising the Bar

Three flagship turbo diesel V8s look set to take center stage at the International Motor Show in Frankfurt.

Each of the new vehicles – the Audi A8 4.2 TDI, BMW's 745d and the Mercedes S 420 CDI – incorporates Honeywell's third generation Garrett® VNT™ turbocharging technology, which is boosting performance...and helping to set new standards in power, torque, fuel efficiency and emissions control.

In each case, VNT™ coupled with Rotary Electronic Actuation (REA) has helped to raise the performance bar for V8 diesels to unprecedented levels while accommodating the higher engine temperatures associated with DPF systems.

The boosting technology has helped increase power ratings by up to 21%, with all three engines delivering more than 300hp. In fact, in the case of the Audi, acceleration in the new diesel V8 outstrips the gasoline equivalent.

These stunning new vehicles demonstrate the power of effective partnership. Honeywell was the partner of choice for Audi, BMW and Mercedes for the previous generation of diesel V8s – now this spirit of collaboration, founded on VNT™ technology, has delivered passenger cars that redefine the norm.

These latest launches are symptomatic of the trend sweeping across every diesel segment. One year on from the launch of Honeywell's third generation VNT™ and the technology is acknowledged as a key enabler in delivering the power, torque, fuel efficiency and lower environmental impact demanded by manufacturers in every class of diesel cars.

DPF Technology

Diesel has been a key driver for CO_2 emissions reduction over the past 10 years, but now major technological advances are being made to deliver even cleaner engines.

Diesel Particulate Filters reduce emissions of particulates almost to zero. This progress in after-treatment technologies, particularly through DPF, enables diesel engines to reach ultra low levels of emissions that are 5 times lower than the ones required for Euro IV.

Such devices make for cleaner diesel cars – particularly when combined with advanced turbo technologies that can work within the higher temperatures demanded by DPF.

2005 customer Success

Ford Focus 1.8 TDCI

Garrett® GT17 VNT™

Engine Specifications

- Engine layout – 4 in line
- Displacement – 1753cm3
- Maximum Power – 115hp @ 3700rpm
- Maximum Torque – 266Nm @ 1900rpm

Turbocharger Specifications

- Garrett® GT17 VNT™ 3rd Generation
- Controlled by Rotary Electronic Actuator (REA)

Turbocharger Key Benefits

- Enables engine downsizing

First VNT™ 3rd generation turbo with REA on a 1,8 liter engine

BMW 330d

Garrett® GT22 VNT™

Engine Specifications

- Engine layout – 6 in line
- Displacement – 2997cm3
- Maximum Power – 231hp @ 4000rpm
- Maximum Torque – 520Nm @ 1750rpm

Turbocharger Specifications

- Garrett® GT22 VNT™ 3rd Generation
- Controlled by Rotary Electronic Actuator (REA)

Turbocharger Key Benefits

- Ultimate low end torque
- Engineered for higher exhaust gas temperatures
- Meets stringent requirements linked to DPF

Making driving fun while protecting the environment

Highlights

VW Passat 2.0 TDI 170 DPF

Garrett® GT17 VNT™

Engine Specifications

- Engine layout – 4 in line
- Displacement – 1968cm^3
- Maximum Power – 170hp @ 4000rpm
- Maximum Torque – 370Nm @ 2000rpm

Turbocharger Specifications

- Garrett® GT17 VNT™ 3rd Generation

Turbocharger Key Benefits

- Best-in-class power output for the 2.0l engine class
- Meets stringent requirements linked to DPF

A key boosting technology and DPF enabler

Volvo S60

Garrett® GT20 VNT™

Engine Specifications

- Engine layout – 5 in line
- Displacement – 2401cm^3
- Maximum Power – 185hp @ 4000rpm
- Maximum Torque – 400Nm @ 2000rpm

Turbocharger Features

- Garrett® GT 20 VNT™ 3rd Generation
- Controlled by Rotary Electronic Actuator (REA)

Turbocharger Key Benefits

- Increased peak torque and rated power
- Meets stringent requirements linked to DPF

Delivering increased torque and enhanced driveability

2005 Customer Success Highlights

Kia Rio
(Pride Diesel in Korea)

Engine Specifications

- Engine Layout – 4 in line
- Displacement – 1493cm^3
- Maximum Power – 111hp @ 4000rpm
- Maximum Torque – 240Nm @ 2000rpm

Turbocharger Specifications

- Garrett® GT15
- Thermo-decoupled turbine housing

Turbocharger Key Benefits

- Compact design
- Torque and maximum power output improvement

Garrett® GT1544V

Hyundai Elantra
(Avante XD Diesel in Korea)

Engine Specifications

- Engine Layout – 4 in line
- Displacement – 1493cm^3
- Maximum Power – 103hp @ 4000rpm
- Maximum Torque – 240Nm @ 2000rpm

Turbocharger Specifications

- Garrett® GT15
- Thermo-decoupled turbine housing

Turbocharger Key Benefits

- Compact design
- Torque and maximum power output improvement

Providing great fuel economy and vehicle driveability

India
Ready for Take-Off

The Indica from Tata Motors

A new era is about to dawn for Honeywell Turbo Technologies in India.

Honeywell stands on the threshold of rapid expansion in India, with a new production facility, new Indian suppliers and new people serving one of the most exciting automotive regions in the world.

At the heart of the program is a new 4250sq m assembly plant in Pune, which will begin shipping turbochargers in November 2005. By then the company will also have launched its first project with Tata Motors for a 1.4 liter Euro IV engine using VNT™ technology.

These milestones will be achieved thanks to outstanding team work between Europe and India, which involved hiring and training a new team, engineering six new applications for Tata Motors, launching components with India suppliers, building a new facility and installing and commissioning equipment.

"These are exciting times for Honeywell in India," says Sanjay Sondhi, Managing Director, Honeywell Turbo Technologies, India. "This investment reflects our confidence in an automotive segment that is among the fastest growing in the world, where annual production is predicted to reach over two million vehicles over the next five years."

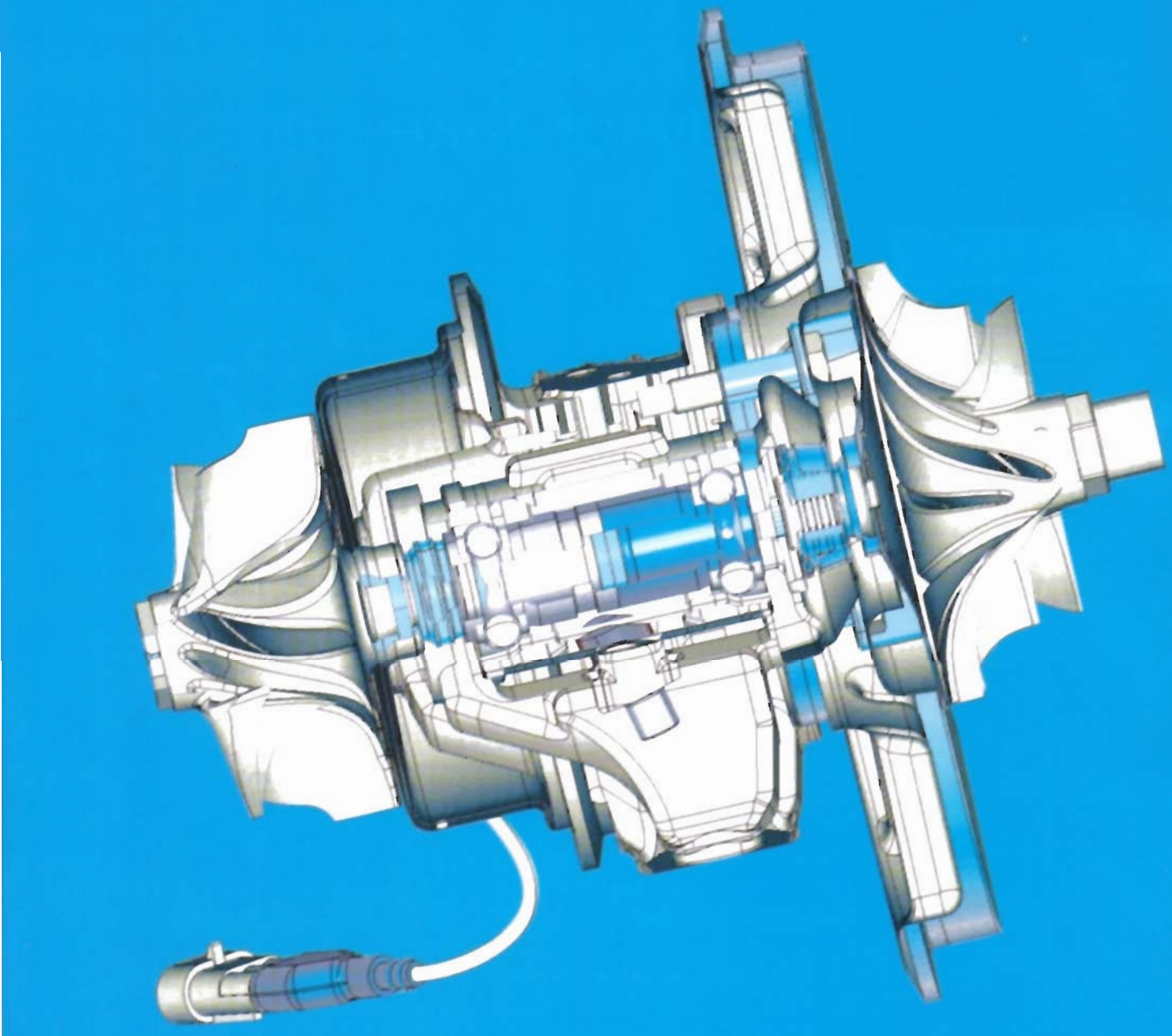
"Critically for us, diesel penetration is forecast to touch 35% and, with the adoption of Euro III and Euro IV emission norms, it is clear that turbocharging technology has an extremely important part to play in the future of India's passenger car and utility vehicle segments. We are also very excited about the potential of our VNT™ turbos in the commercial vehicle segment."

The new Honeywell facility will produce free-float, wastegate and VNT™ turbochargers, with a large number of parts being supplied locally through a wide and capable network of Indian suppliers. The facility will also include a center housing rotary assembly line, nozzle assembly and vibration sorting rig facilities.

"India is a marketplace that stands on the cusp of remarkable growth – I'm delighted that Honeywell now has in place the facilities and the people to contribute to India's future as a major force in the automotive industry," says Sanjay.

POWER, PERFORMANCE AND PRECISION ENGINEERING
BALL BEARING TURBOS BOOST NEXT GENERATION CV'S

The Ultimate Bearing Performance



From airplanes through racecars to skate boards – transportation owes much to the versatile ball bearing due to its low-friction advantage. In the 80s, Honeywell engineers began adapting it for use on Garrett® turbochargers.

Simple in concept, the design was in effect revolutionary. The Garrett® ball bearing is commonly called a "cartridge," which brings together a pair of angular contact ball bearings onto a common outer race. In one elegant, holistic assembly, the Garrett® ball bearing cartridge eliminates the need to have both radial and axle bearings, as has been the case for the commonly-used journal bearings. The ball bearings are capable of handling high thermal and mechanical load as well as extreme speed while providing efficient distribution of lubrication.

In 1988, the Garrett® ball bearing T2 turbo made its debut on Nissan Motors' Silvia gasoline engine, starting a trend that has grown into a cult in the US and Japan among car aficionados for Garrett® ball bearing turbochargers. In 1991, Nissan adopted Garrett® ball bearing technology with a T04S turbocharger in the IMSA (International Motorsport Association) GTP Championship, winning the race from 1988 to 1991. The technology went on to leave its mark indelibly in races such as CART and Le Mans, and has now become standard in World Rally and Le Mans due to its proven reliability and performance.

The first commercial diesel ball bearing turbo was developed for the 1997 Nissan Diesel PF6T engine.

"Compared to journal bearing, ball bearing technology provides a significant reduction in friction by replacing a sliding action with a rolling mechanism – resulting in a faster response during the rev-up of the engine," said Wayne Waszkiewicz, Director of Commercial Vehicle Product Engineering, Honeywell Turbo Technologies. "The design is also extremely reliable and durable. "

Since a ball bearing turbo requires less than half the oil flow of a normal turbo, it dramatically reduces the possibility of damage due to oil leakage. The fact that a ball bearing turbo can handle all kinds of loads makes it ideally suited for racing and other performance-demanding applications.

Honeywell engineers in the US are currently working on customizing ball bearing technology for a high volume commercial vehicle engine program aimed at meeting 2007 US emissions standards while making the engine more responsive and fuel efficient. At the same time, ball bearing technology is also being considered for commercial vehicle applications in China, where contaminated lube remains a concern.

Garrett® Ball Bearing Racing T

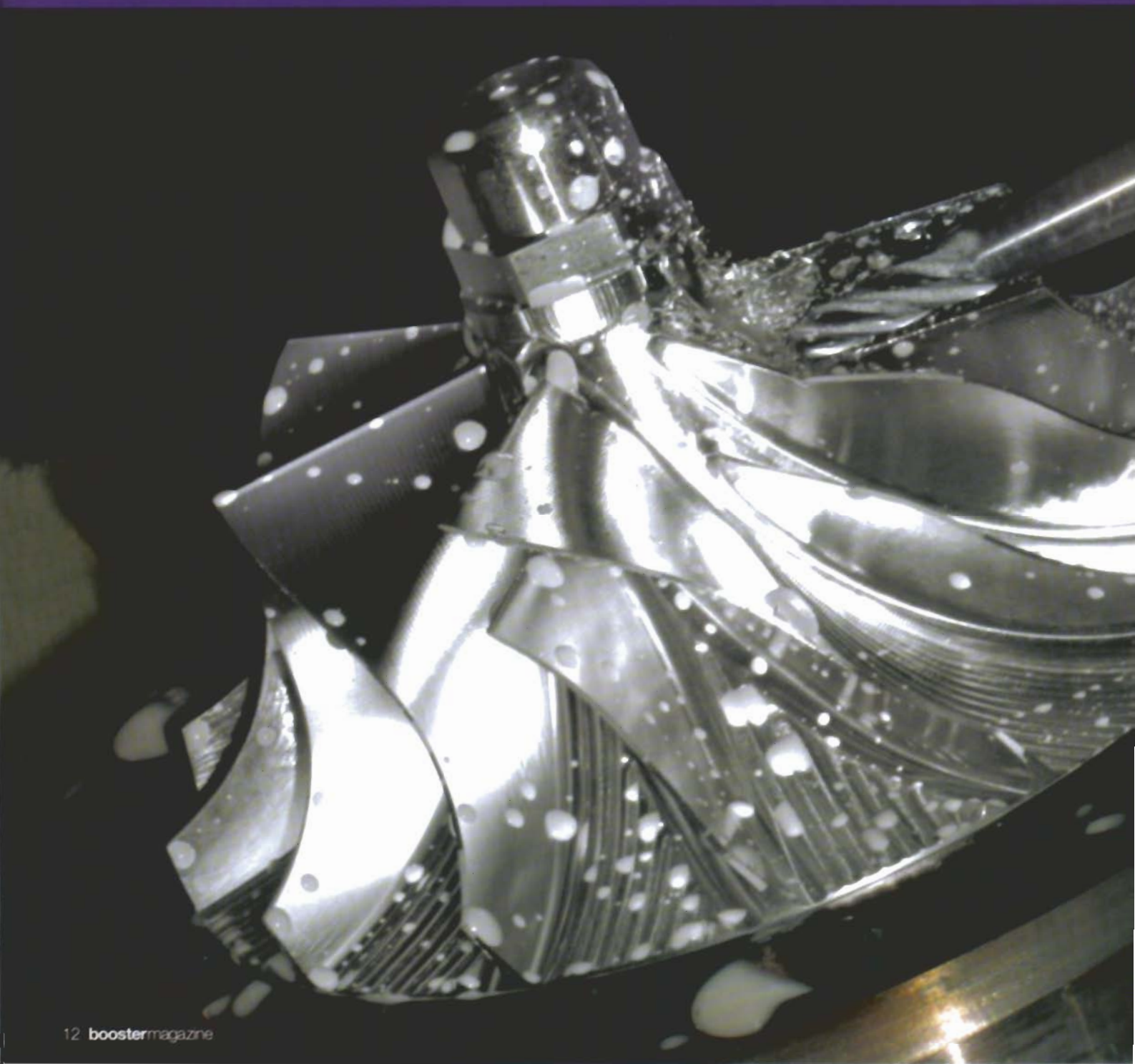
Higher Standards

Garrett® ball bearing technology exerts stringent requirements on materials and machining. For materials, Garrett® ball bearing assembly uses high-temperature tool steel, and for machining, its precision is controlled to ABEC 7 Class, just one level below the highest class rating.

Over the years, Honeywell engineers have made many improvements, refining an already robust design. At the same time, Honeywell's strategic alliances with highly qualified suppliers ensure that Garrett® ball bearing turbochargers deliver on both performance and value.

PEOPLE CENTERED CULTURE REAPS REWARDS
QUALITY AND PRODUCTIVITY EARN TOP SUPPLIER ACCOLADE

Be Proactive



Be Successful

Aikoku, based at Nagoya in Japan, has been supplying compressor wheels to Honeywell since 1998, and recently received a top supplier award in recognition of defect-free quality, 98% on time delivery and 20% year on year productivity improvements. It is this performance that has earned the company 'premier' supplier status for the last two years.

Aikoku believes that the secret of its success lies in its approach to business, which is founded on a public commitment that the company should exist in harmony with its employees, empowering them to take initiatives and be proactive.

Empowerment is much more than a state of mind at the Aikoku Alpha Corporation – it's at the heart of a business ethos that's delivering benchmark standards in quality and customer service.

This culture encourages a spirit of innovation and enables people to focus on the needs of customers – and the results speak for themselves.

The supply of fully-forged and machined aluminium compressor wheels to Honeywell has grown from 1481 units in 2000 to over 100, 000 units in 2005. Initially, Aikoku supplied Honeywell's race division but then came an opportunity to manufacture compressor wheels for the commercial diesel segment. Gradually, the partnership developed to a point where the company now ships to the US, Brazil and Japan, with Europe and other Asian countries soon to follow.

Max Kanamaru, Senior Managing Director at Aikoku, says that employees are true management partners.

"Our business employs people who share a common purpose, who are masters of their jobs, who thrive as team members and who demonstrate pride and responsibility in their work."

Aikoku's success is reflected in its rigorous approach to quality control and in its investment in advanced manufacturing technologies for the Honeywell production line, including automatic measurement systems and robotics. The team supporting Honeywell comprises 40 people integrated from engineering, manufacturing and sales.

Concludes Mr. Kanamaru: "We do not see ourselves as passive partners – our responsibility is to meet our targets but we should also go further by suggesting innovative ways of improving processes, in areas such as concurrent engineering, so that we add value both to Honeywell and to their customers."

The Asian

Paolo Carmassi
Honeywell Turbo Technologies' Vice President and General Manager, Asia, assesses the state of play.

From the sophistication of Japan's automotive sector to the enormous opportunities opening up in China, Asia is a region of true diversity. Flexibility is the prerequisite for success in Asia, where market conditions reflect the full dynamics of the global automotive industry.

Q: You have worked in both Europe and the US – how is Asia different from those two regions in terms of automotive trends?
A: Asia is a region of extremes, from the sophistication of Japan and Korea through to the emerging opportunities in China, with countries such as Malaysia, Indonesia and India also at varying stages of development. Asia is a much broader landscape than either Europe or the US. The challenge it presents makes it a fun place for me to be in.

Q: In the area of boosting, what are the major automotive trends?
A: Japan is much more akin to Europe – with a mature domestic marketplace and an aggressive goal of exporting overseas. Likewise, Korea is on a similar path but perhaps two or three years behind. In China, the domestic industry is focused mainly on heavy-duty trucks, moving towards light-duty trucks and leading eventually to passenger cars.

Experience

Q: So how does Honeywell tailor its technology for each segment?

A: Our customers in Japan are increasingly looking overseas and particularly to Europe - but they cannot compete simply with a 'me-too' product for diesel. So they are looking to put some spice into their offerings, and Honeywell offers a robust and innovative technology roadmap for their diverse boosting needs.

In Korea, the domestic segment is also mature but, for these manufacturers, it's about competing overseas on quality, price and, increasingly, technology. In fact, Korea is the first country in Asia to launch our third generation VNT™ technology on two diesel SUVs.

China is undergoing a rapid evolution, and the challenge for Honeywell is go to the marketplace with technology that is appropriate. This means focusing on the right technology for medium and heavy-duty diesel trucks, moving towards light duty vehicles, with passenger cars the last chapter in the process in about three to four years' time.

Q: What do customers in Asia expect from Honeywell – and what is the company doing to meet their expectations?

A: Our customers quite rightly expect that we support their strategies and are strong partners in helping them achieve their objectives. In Japan, this means developing technologies that suit their ambitions, including thinking outside the box. Moreover, we have the global strength to deliver for Japanese and Korean customers anywhere in the world and that's a unique capability.

China has a huge desire to make rapid progress, and we are ideally placed to support this ambition. We can help them make incremental progress while at the same time offering an accelerated route to developing the engines that will enable them to leapfrog ahead in terms of technology.

Q: What are the synergies between Honeywell's operations in China, Japan and Korea?

A: I think of synergies in the way we support our customers. Asia as a region is unique in the challenges it presents to our people. For example, there are nine different nationalities in the Honeywell Asia leadership team, and they work together, taking account of the variations in extreme business conditions. They think technology, they think value for money, and they think this in ten different configurations every single day.

Korea
A New Era Dawns

Honeywell's third generation Garrett® VNT™ turbocharger is making its Asia debut as a key performance component in two of Korea's most popular compact SUVs.

A joint engineering program with Hyundai and Kia, stretching back to 2003, will come to fruition with the unveiling of the newly packaged Hyundai Tucson and the Kia Sportage – two vehicles favored by Korea's younger generation for their versatility around town and for weekend trips away.

The Tucson and Sportage were previously equipped with wastegate turbos, but third generation VNT™ offered both the significant performance boost being sought by the manufacturers … and a fresh offering to young people loyal to the marques.

"A major factor in attracting Hyundai and Kia to third generation VNT™ is the 10% performance boost that the new turbo delivers," says B.H. Lim, General Manager of Honeywell Turbo Technologies in Korea. "We were very responsive in sharing a new turbo technology first developed in Europe, supporting our customers with dedicated engineering and service teams."

The newly-boosted Hyundai Tucson and Kia Sportage are scheduled for release in September 2005 – so becoming the first vehicles manufactured in Asia to be fitted with third generation Garrett® VNT™ turbochargers.

Looking ahead, Mr. Lim sees an even brighter future for this turbo technology. "By 2010, we expect more than 80% of our VNT™ offerings to be third generation."

Hyundai and Kia

Hyundai Business Group took over Kia in 1998. In 2000, after Hyundai Motor Company was spun off from the Hyundai Business Group, Hyundai Automotive Group was formed, consisting of Hyundai Motor Company, Kia Motors Corporation and other automotive related companies.

Although Kia and Hyundai operate as separate companies in the marketplace, they share R&D facilities and parts distribution networks. The two operations also benefit increasingly from shared platforms, transmissions and engines.

Japan
Thinks Global, Acts Local

Worldwide businesses increasingly require global support – so when Japan's automotive manufacturers focus on the European market, they turn to major partners like Honeywell for key enabling technologies.

Honeywell's Japan operation has a significant track record in innovating the future – from the Garrett® ball bearing T2 turbo in the Nissan Silvia gasoline engine in 1988 to the first Garrett® ball bearing turbo for commercial diesel in 1997.

But business never stands still. Now there's a new challenge for Japanese manufacturers - the diesel segment in Europe. The question may be as simple as whether water-cooled or air-cooled center housings are right for Europe, but Honeywell not only has the experience to provide the answer… but also to deliver the technology.

The current priority for Japanese OEMs is the launch in 2007 of vehicles using Honeywell's third generation Garrett® VNT™ turbocharger.

"Our strength lies in our ability to tailor services to our local customers while allowing them to benefit from our worldwide capabilities and competencies," says Isao Tahara, General Manager of Honeywell Turbo Technologies in Japan. "Our global account teams work closely with each customer to add value in areas such as product development, application engineering, product launches and on-going support.

"Our customers in Japan are demanding shorter development lead time – 18 months now compared to 36 months four to five years ago. Critically, we are able to leverage advantage by using our global expertise and industry knowledge and offering direct support in Europe to meet the requirements of partners such as Toyota, Honda and Nissan."

But in the end, it's Honeywell's portfolio of innovative technologies that adds greatest value. Indeed, according to Mr. Tahara, forward-looking Japanese car makers are already testing some of Honeywell's latest turbocharging technologies.

Round the World

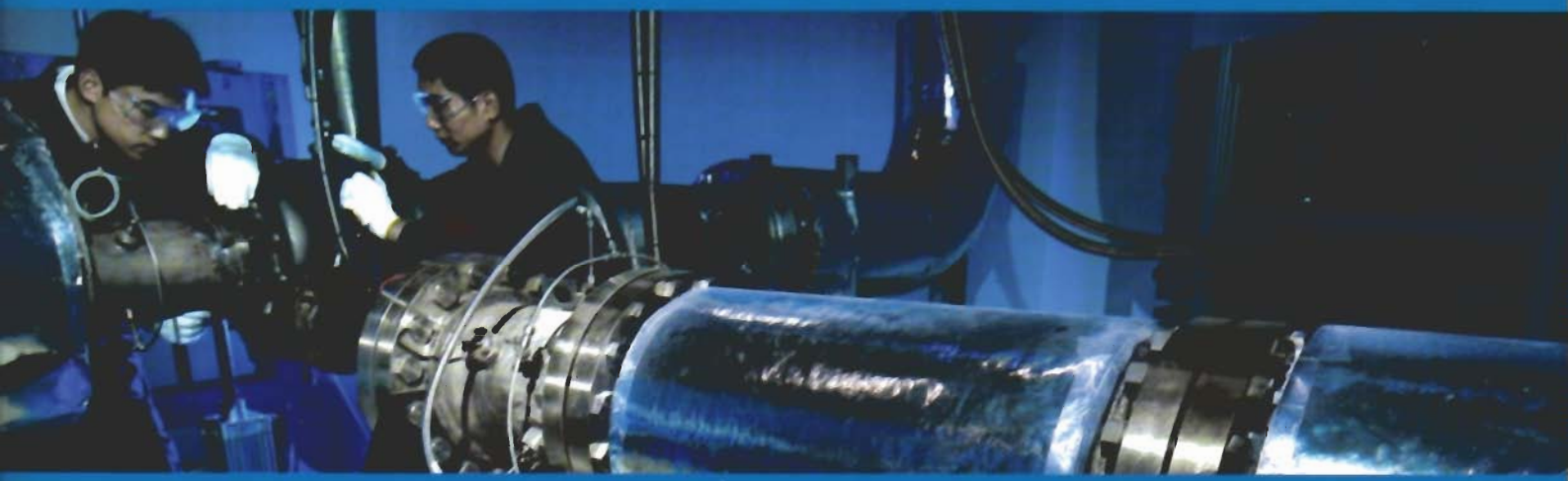
Honeywell has officially opened its Shanghai Technology Center, the largest turbocharger research facility in Asia.

The research center employs 200 engineers and technicians working in core engineering competencies including structure and fatigue, aerodynamics, rotordynamics, vibro-acoustics, metallurgical and product engineering. A test lab facility will focus primarily on turbocharger performance and reliability testing.

With the addition of this state-of-the-art Shanghai research center, Honeywell Turbo Technologies' global engineering network - with technical centers also in Europe, North America, and Japan - is now capable of delivering round-the-clock service to its automotive customers around the world.

While the opening of the facility is another milestone in the technological legacy of Honeywell's Turbo Technologies business, it is just one aspect of Honeywell's automotive presence in China. The company has operated a turbo manufacturing facility in Shanghai since 1994, producing nearly two million turbochargers in the last eleven years. With growing domestic demand for diesel engine trucks in China, Honeywell expects to produce more than 550,000 turbos this year to meet the needs of its customers.

Round the Clock



Emissions Regulations

Drive Clean Diesel

INTERVIEW W. ADDY MAJEWSKI

W. Addy Majewski, the creator and editor of DieselNet.com, an online information service focused on clean diesel engines and diesel emissions, is an engine emission technology consultant based in Canada. Booster magazine recently interviewed Mr. Majewski on the drivers and trends of worldwide diesel emissions regulations.

What are the historical trends regarding emissions regulations?
Early emissions regulations, such as those introduced in the US in the 1970's, focused on emissions of carbon monoxide and hydrocarbons from gasoline engines. By the 1990's, the priorities had shifted, and the control of particulate matter (PM) and nitrogen oxides (NOx) emissions - mainly from diesel engines - became the focus of new emissions legislation.

It's my view that environmental priorities will gradually shift from exhaust emissions to the emission of greenhouse gases (GHG), and to energy supply. This in turn will stimulate the development of more energy-efficient powertrains, including those utilizing advanced diesel engines.

Why is energy supply a factor behind diesel emissions regulations?
The limited production capacity of crude oil and natural gas will become a serious limiting factor for the world's fossil fuel dependent economy. The "peak oil" year (i.e., the maximum supply year, after which the production will no longer satisfy demand) is predicted by some to occur as early as 2008-2010. The world's oil and gas fields are declining in production at an average rate of 4 to 6% per year, while the demand is growing at an estimated 1.7% per year. As a result, energy conservation becomes imperative.

You mentioned greenhouse gases. How is climate change related to emissions regulations?
Increased usage of diesels, as witnessed in European Union countries, helps reduce fuel consumption and CO_2 emissions. This results in increased PM and NOx emissions. But PM emissions can be controlled with little adverse impact on fuel economy, although more progress needs to be made in NOx reduction technologies.

In the US, climate change factors still have little impact on shaping environmental policies. GHG reduction regulations for light-duty vehicles have been adopted in California, but are facing legal challenges.

How do health concerns impact diesel emissions regulations?
Based on the medical research evidence, particle pollution has been recognized as an increasingly serious public health issue. As a result, diesel emissions standards are being adopted worldwide that require the use of particulate filters on practically all types of new diesel engines.

In terms of NOx, it has been associated with the formation of photochemical smog and tropospheric ozone. As a result, it has become one of the major targets among regulated diesel emissions. However, since too stringent NOx standards result in poorer fuel economy and increased CO_2, future NOx emissions limits will likely be balanced with the CO_2 emissions reduction targets in countries focused on reducing GHG emissions.

Particulate filters seem to have been widely recognized as an effective device in reducing PM emissions. Is there any consensus on how to control NOx emissions?

So far, there is no worldwide consensus on NOx emission regulations. For example, compared with EU, the US has adopted much more stringent NOx requirements, with Japan occupying a position in the middle of the two. This is the case largely because no current diesel NOx control technology is universally acknowledged as an elegant, feasible solution that includes an acceptably low fuel economy penalty. It's quite possible that future technology will be based on engine design approaches, utilizing HCCI (homogeneous charge compression ignition) combustion or other new combustion technologies.

What role will turbocharging play in meeting diesel emissions regulations?

Turbochargers have become an integral part of both light and heavy-duty diesel engines. To meet emissions standards as well as performance targets, advanced diesel engines require turbochargers that offer improved control - for example, through variable geometry technology - and increased boost pressure, such as through dual-stage turbocharging.

CLEAN DIESELS ELIGIBLE FOR TAX CREDITS IN US

American drivers who purchase newer, cleaner-burning diesel cars, trucks and SUVs will be eligible for the same kind of tax incentives as purchasers of gasoline-hybrid electric vehicles under a new national energy bill passed by US congress and signed into law by President Bush on August 8, 2005.

"These incentives are an important step in expanding the demand for energy efficient vehicles," said Allen Schaeffer, Executive Director of the Diesel Technology Forum. "Now that diesel vehicles will be eligible for the same advanced-vehicle credits as hybrids, we expect similar growth in the clean diesel segment," added Mr. Schaeffer.

The U.S. Department of Energy reports that if diesel vehicles reached a 30 percent share of demand by 2020, it would reduce U.S. consumption of oil by 350,000 barrels a day.

Record Breakers

It was a race that rewrote the history books. Tom Kristensen, in the Garrett® boosted Audi R8, claimed his 7th win in 24 hours of Le Mans, including the last six races in succession. Kristensen's victory also capped a record of six consecutive wins for the VW group at Le Mans — one for Bentley and five for Audi.

In doing so, he became the most successful driver in the history of the event – and all this despite new regulations limiting the power available to the team.

The rule changes introduced by the ACO (Automobile Club de L'Ouest) meant the teams running older cars, such as Audi, had to limit the maximum airflow to the engine, so reducing the power available in the case of the Audi by 30hp.

In addition, the team had to accommodate 50kg of ballast. Audi took the strategic decision to work within the new rules rather than build a hybrid car or develop a new engine.

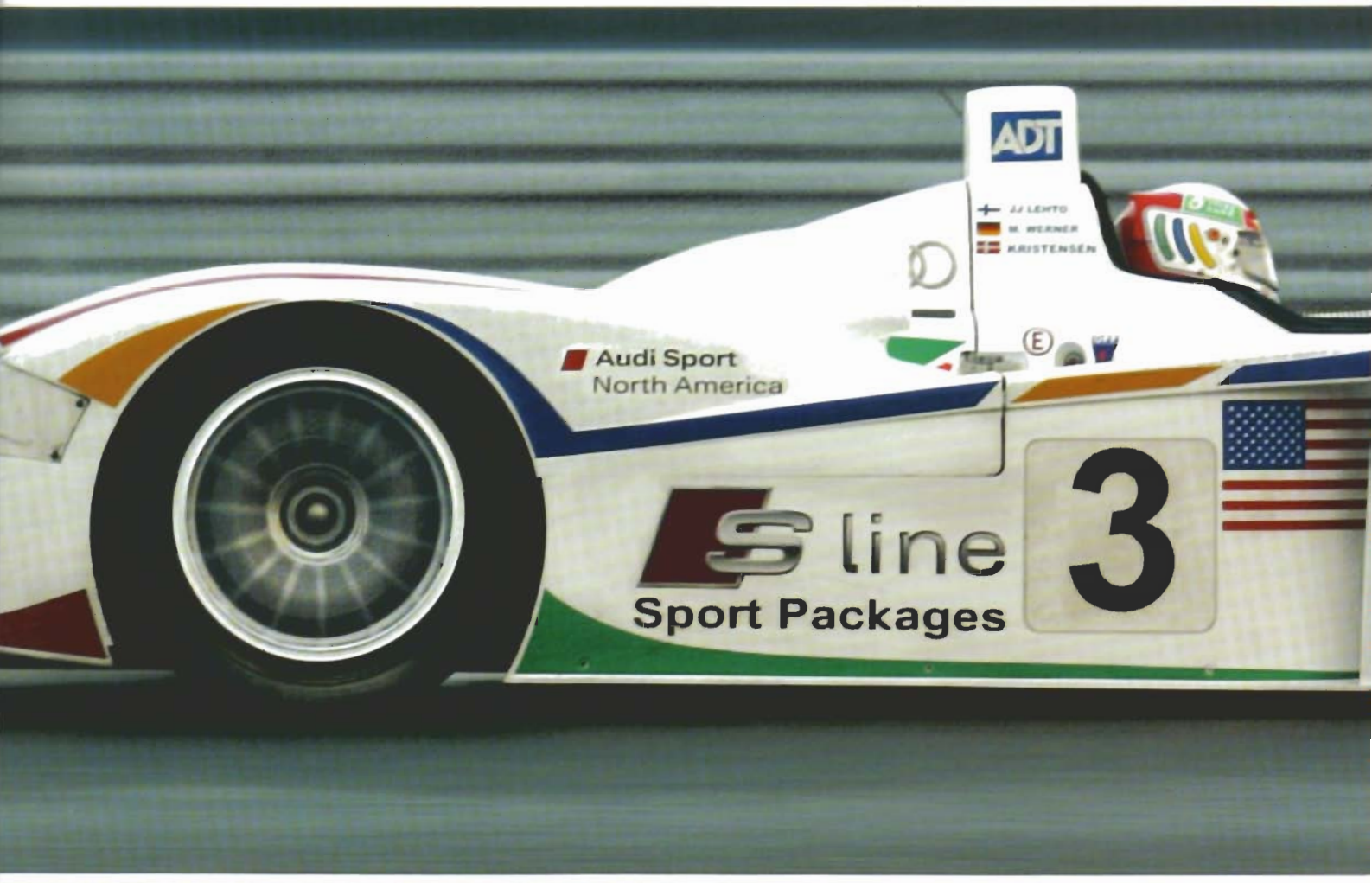
At first, the pundits' concerns over a lack of power seemed justified, but in the end the regulations actually enhanced the Audi durability .. and the team brought home yet another stunning victory.

The success was no surprise to Honeywell Motorsports Manager, Doug Milliken. "From the moment we began working together on the engine program, Audi showed an extraordinary commitment and determination to win the race. Audi prides itself, as a brand, on its quality and reliability, and sees Le Mans as a fantastic way of communicating those values".

Now Audi is looking to its next generation of racecar, due to debut at Le Mans in 2006. There's speculation about whether they will follow the Peugeot route, which is coming to Le Mans in 2007 with a turbo diesel racecar.

"But one thing is certain, they won't come to the race without an engine that is proven... and a potential race winner," says Doug.

In fact, there is speculation that diesel technology will encourage other OEMs to enter the Le Mans arena, as the manufacturers prove not just the durability and fuel efficiency of this technology, but its ability to outperform gasoline engines.



AUDI STORMS TO 24-HOUR OF LE MANS SUCCESS
KRISTENSEN SETS NEW RECORD

Power with Durability

At Le Mans, engine configurations offer a variety of strategies for achieving the maximum allowable airflow. These configurations bias one or two of the three independent variables that determine maximum airflow – displacement volume, engine speed and air inlet density.

The airlet restrictions introduced at Le Mans challenged engineers at Audi to maximize the engine boost benefits of their turbocharged engines within the new specifications set by the organizers.

Turbocharging enables engines to deliver high levels of performance with significantly lower internal inertia loading because the smaller, and therefore lighter, reciprocating components are operating at lower speeds.

Excerpt from SAE Technical Paper #2002-01-3362 authored by Doug Milliken, Honeywell.

Fast Track To Success

GARRETT® RACECAR SETS NEW STANDARDS PARTNERSHIP DRIVES ENGINEERING EXCELLENCE

When the Garrett® Pontiac Sunfire racecar was first unveiled at the Mazda NHRA Sport Compact Nationals in early August 2004, it was a major surprise to fans and insiders alike. But that was just the beginning.

The car won that race setting a national record, announcing the arrival of a serious player in Hot Rods and immediately proving the power of the new partnership between Honeywell engineers, Bothwell Motorsports and driver Ron Lumus.

From that moment, the racecar has been a huge success, resetting the national record 15 times, with a personal best of 7.88 secs at 189.20mph.

The Garrett® Pontiac Sunfire is currently the world's quickest front wheel drive unibody racecar- and its success is no accident. It's the culmination of an intensive program of engineering and true partnership between Honeywell and the Bothwell team.

"We started literally with a blank piece of paper – it was down to the team to optimize the performance and to create a car that would win," recalls Steve Bothwell, the crew chief of Bothwell Motorsports.

"We had just four months to make it happen, but we quickly realized that there were major hurdles to overcome. If we'd had a 40x40 space then there was no problem but an engine compartment is very limiting. We must remember that in a turbocharged car all the loads work off each other – the wastegate, the blow-off valve, the drop across the intercooler, the turbo speed. It's no easy feat to make everything work together - but we were clear that we wanted a car that would win races and set national records."

Steve Bothwell cannot praise the involvement of Honeywell engineers highly enough, as they worked in parallel with the Bothwell team to solve significant technical challenges.

"Most people race their turbos at 70% because they cannot overcome all the other restrictions, such as air inlet, whereas we run our turbos at 110% - we spin it at 130,000 rpm and we've had no failures. Our car is basically a rolling science experiment."

Since its debut, the Garrett® Pontiac Sunfire Racecar has raced 12 times and won eight of those starts. The car and driver lead the points in NHRA Sport Compact drag racing series.

Ron Lummus – In His Own Words

Ron Lummus learned his trade racing VWs, and had been winning multiple championships and setting records all over the world in the previous 15 years. But when he was offered the seat in the Garrett® racecar he was presented with a whole new set of challenges.

"I've raced all my life, but even for me the first time we raced the car was very special.

"Jumping behind the wheel of something that weighs 2,250lbs where all the steering and horsepower is laid through the front wheels is an arm-wrestling experience and takes a surprising amount of finesse.

"What amazes me is that the team achieved so much in such a short space of time – but then everything that Honeywell gets involved in is done with enormous professionalism. Smart people make the difference."

Media Watch

Turbo achieves wonders for diesel cars, which, after winning over European drivers, are becoming popular in other parts of the world. For gasoline engines, the trend points at GDI combined with turbochargers. Here is a selection of the latest quotes in the media.

"Turbochargers have become a virtually universal feature of modern car diesel engines, giving them far superior performance than their slow (and smelly) predecessors and at last allowing diesels to match – almost – petrol cars for pace while providing up to 30 percent better fuel consumption."

"How to turbocharge performance", Financial Times, June 8, 2005

"We are convinced that the future of diesel is just beginning."

Eckhard Cordes, head of DaimlerChrysler's premium Mercedes Car Group as quoted in the Reuters article "Auto Show- Diesel, hybrids vie for Europe's car buyers" in March 2, 2005

"Diesels have an advantage over gasoline- electric hybrid powertrains because they are less expensive and less complex to build. And they deliver about the same fuel economy gains as a hybrid."

"Mercedes begins diesel drive", Automotive News, June 20, 2005

"Better fuel economy and lower emissions from gasoline direct-injection engines are getting closer."

"After rocky start, direct-injection engines make a comeback, although challenges remain", AutoWeek, May 27, 2005

"A key part of the new engines is turbocharging, which lets smaller, lighter engines deliver the same power as larger engines."

"EU rules push, then slow diesel", Automotive News Europe, March 21, 2005