

# DEUTZ<sup>®</sup>WORLD

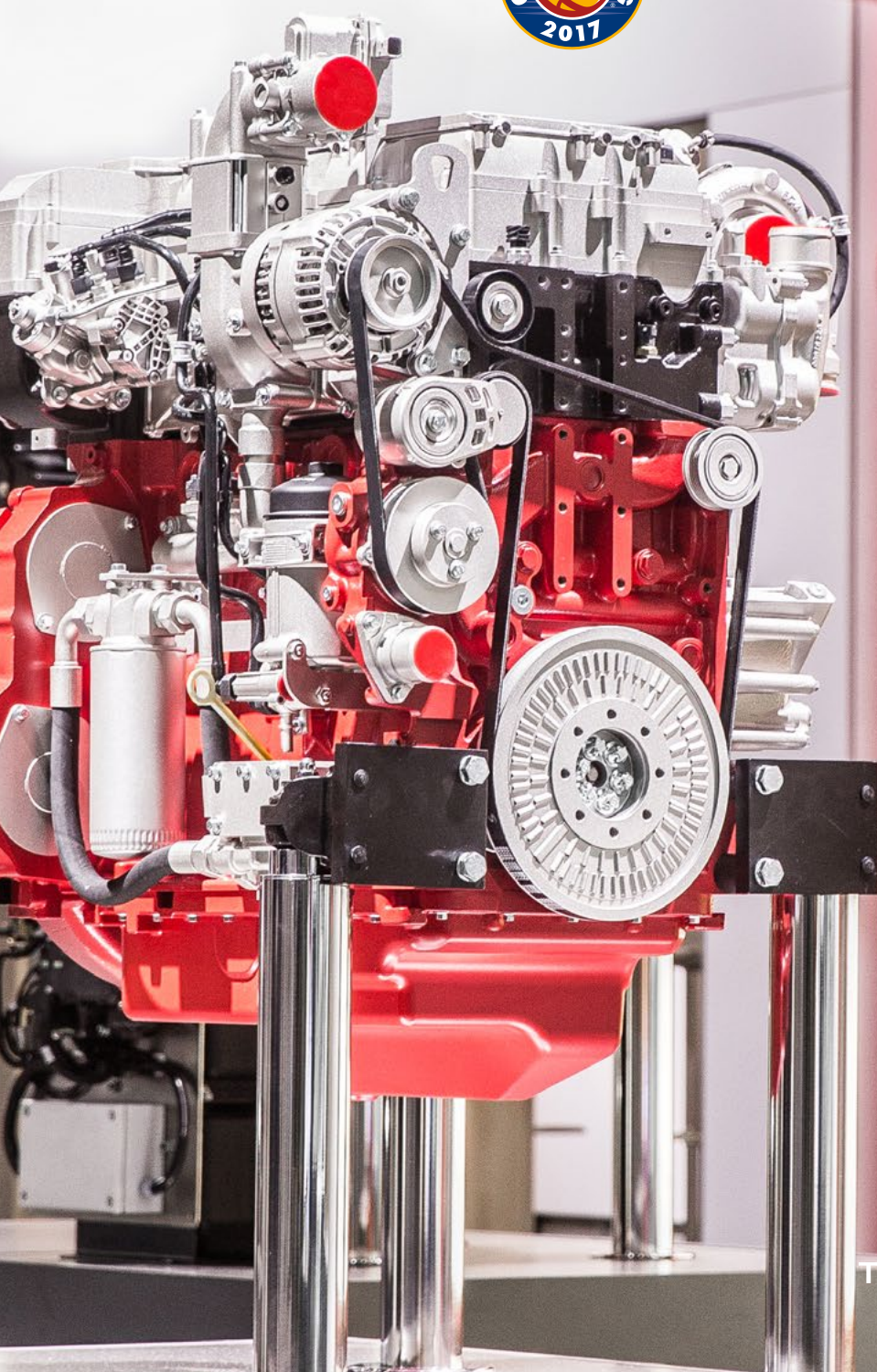
Edition 1 | 2017

The customer magazine of DEUTZ AG

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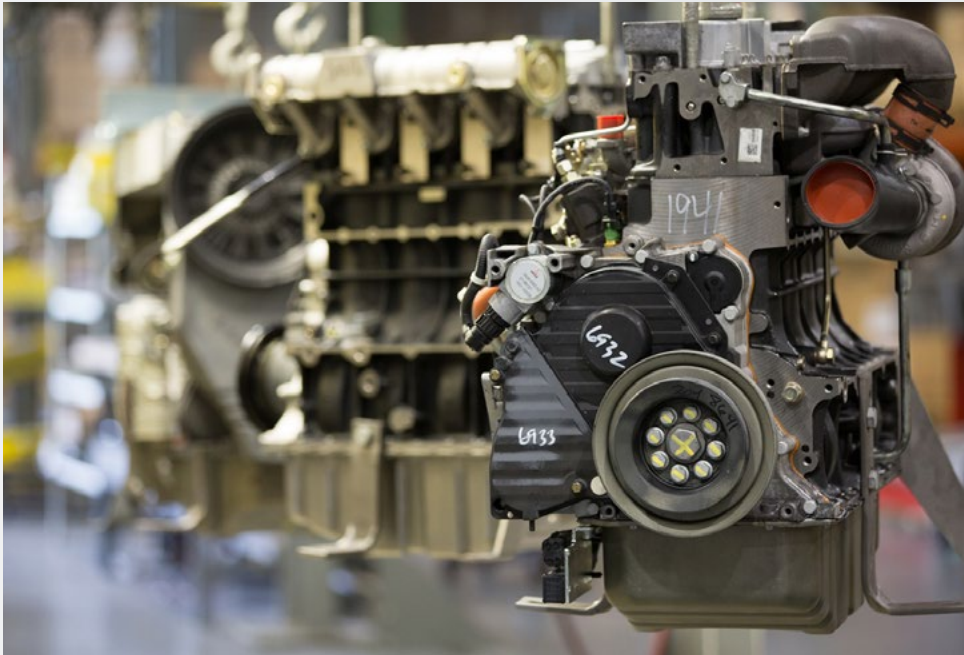
The engine company.



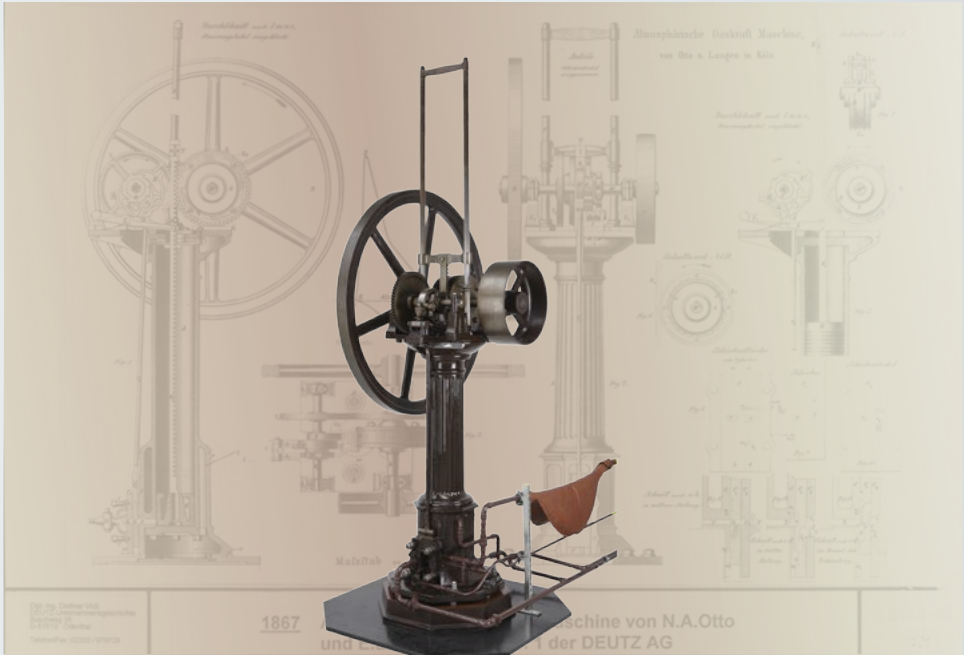




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**Dear readers,**

On 1 January 2017, Dr Frank Hiller assumed his new position of Chief Executive Officer at DEUTZ AG. In his interview with DEUTZWorld, the engineer introduces himself to our readers. On pages 6 and 7, he tells us which associations he has with DEUTZ and which topics are particularly close to his heart in his new role as CEO.

In March, we get to enjoy a very special highlight: the CONEXPO in Las Vegas, where the latest products and developments from the construction machinery sector will be presented. Viva Las Vegas! DEUTZ would not dream of missing this exciting event. Our article on pages 8–9 reveals which innovations we are packing for visitors of the trade fair. A true product highlight: our TCD 2.9 and 3.6 high-torque engines, which are not only powerful but also extremely efficient, with low space requirements and performance values under 56 kW. No need for an SCR system here! The perfect solution for compact mobile work machines. (P.10) While we are reporting on CONEXPO, our American DEUTZ subsidiary deserves more than an honourable mention. Turn to page 12 to learn the secret behind the success of the DEUTZ Corporation. Incidentally, “success” is also the key word for our engines. Thanks to their modern exhaust gas after-treatment system, DEUTZ engines for the upcoming emission stage V already achieve an impressively high exhaust gas quality. All we need now is a “CO<sub>2</sub>-neutral diesel”. Find out what that is and whether it could really become the engine of the future in our article on page 16. Modern technologies with their increasingly complex hardware and software also pose growing challenges for our service department. Our article on page 18 sheds light on how DEUTZ Service deals with these challenges.



For a massive contrast to our modern, electronically controlled engines, turn to page 22 and enjoy our throwback to 1867. Back then, the first DEUTZ engine was just being presented to the world for the first time. The very same engine is still ready for operation today, kept safe in our museum in Cologne-Forst. This year, it is celebrating its 150th anniversary. A great example of the high quality and long service life of our engines.

We hope you enjoy the read!

Your  
DEUTZWorld editorial team

Note: Gender differentiation has not been applied in this document for reasons of improved legibility. The relevant terms apply for both genders in the sense of equal treatment.



DEUTZ concludes long-term supply contract with Putzmeister for “Stage-V-ready” engines



DEUTZ TD 2.2

DEUTZ and the Putzmeister Group have entered into a long-term supply contract for Diesel engines with a cubic capacity of 2.2–12 litres, continuing their long-standing, successful partnership. Putzmeister trusts in DEUTZ “Stage-V-ready” engines to meet the requirements of the upcoming emissions stage for its screed and concrete pumps and will be introducing them into the market gradually from 2017. The globally operating manufacturer of special machinery, headquartered in Aichtal near Stuttgart, is preparing its product range for the EU Stage V emissions standard, which will come into force in 2019. For its screed pump segment, Putzmeister has chosen the particularly compact DEUTZ TD 2.2. When Stage V comes into effect, the engine will replace the DEUTZ D 2011 currently in use. The company’s concrete pumps will be equipped with DEUTZ engines with a cubic capacity from 2.9 to 12 litres. Matthias Ruppel, CEO of Putzmeister Concrete Pumps GmbH, explains: “DEUTZ’s worldwide service network provides exactly the right support for our machines. The DEUTZ engine portfolio covers both the highly regulated European market and numerous other regions, some of which have widely differing legal requirements. This allows us to serve every market while working with just one engine supplier, reducing both costs and complexity.” Michael Wellenzohn, member of the DEUTZ AG board of management for Sales / Service and Marketing, adds: “This supply agreement reinforces the enduring collaboration between DEUTZ and Putzmeister. We are delighted to be working together to achieve the conversion to Stage V engines. Our product range is ideally prepared for this challenge.”

“A Nordic Christmas” at Gürzenich

The DEUTZ choir took its audience on a “Nordic Christmas” journey during this year’s Advent concert at the Gürzenich festival hall. Supported by the Domstadt Philharmoniker, the choir performed popular and traditional Christmas songs alongside Danish, Norwegian and Swedish pieces. The renowned Danish soprano singer Lisa Tjalve, who had already joined the choir for many projects and trips in the past, delivered a moving “Ave Maria” and other songs – her impressive voice has been a wonderful addition to the choir. Furthermore, they were supported by the Danish-Swedish junior students of the “Northern Vocal Ensemble”, who rang in the Christmas season in style with their skilful performance of Nordic Christmas tunes.



Events 2017

FINANCIAL CALENDAR

**16 March**  
2016 annual financial statements

**4 May**  
Annual General Meeting in Cologne

**9 May**  
Interim management statement for the first quarter of 2017

**3 August**  
Interim management statement for the first half of 2017

**7 November**  
Interim management statement for the first to third quarter of 2017

FAIRS

**March**  
7. - 11. CONEXPO – CON / AGG 2017  
Las Vegas / USA

**November**  
12. - 18. AGRITECHNICA 2017  
Hannover / Germany

DEUTZ at the international trade fair “Fuels of the Future 2017”



More than 500 visitors from 30 countries visited this year's “Fuels of the Future 2017” conference in Berlin, the leading event for the German and European biofuel industries and an important forum for exchange between international players from politics, business and research. Of course, DEUTZ attended the 14th International Conference on Renewable Mobility as a partner, emphasising its commitment to the development of CO<sub>2</sub>-neutral drive systems.

Besides the presentation of different biofuels, which already make the CO<sub>2</sub>-neutral operation of combustion engines possible today, the event focussed on the increasing diversification of drive technologies and the research into and production of different fuels from renewable energies. These are topics in which DEUTZ is playing an active role. Dr Markus Schwaderlapp, head of research and development at DEUTZ AG, explains: “In future, it will be possible to achieve carbon neutrality in diesel engines by using synthetic fuels. Researchers are currently looking at ways of producing synthetic diesel fuel that can be mixed with fossil diesel in any ratio or used alone, using green electricity and a special method of electrolysis (power-to-liquid). We believe these so-called ‘e-fuels’ mean there is still great potential for diesel, even in the longer term.”

In initial projects, DEUTZ has already approved this type of fuel for use in certain engines. A CO<sub>2</sub>-neutral seminar boat is cruising German waters on a solar-powered electro-hybrid drive, supported by a DEUTZ “BF6 M1013 M” engine on overcast days. This engine has been approved for paraffinic gas oils (XtL) in accordance with EN 15940 and can be operated with a range of CO<sub>2</sub>-neutral fuels. At the moment, hydrated vegetable oils (HVO) from recycled vegetable oils and waste fats are being used, but liquid fuel made from natural gas (GtL) and biomass (BtL) are equally possible, and e-fuels (PtL) will follow in the near future.

“As an engine manufacturer, it is important that we play an active role in the development of fuels and draw the right conclusions for our own product development. Going forward, this will enable us to successfully position the benefits of the combustion engine – robust, mobile, flexible and suitable for use by itself – in the drive-system mix of renewable mobility,” says Dr Schwaderlapp.



DEUTZ makes dreams come true

The DEUTZ Christmas campaign, “DEUTZ makes dreams come true”, has been running for several years in support of a social project. In 2016, the DEUTZ Christmas tree was once again transformed into a “wishing tree”. Last Christmas, members of DEUTZ got the chance to fulfil the Christmas wishes of approximately 120 children from the social project „Kalker Kindermittagstisch“ in Cologne. The kids had attached their wishes on little notes to the DEUTZ wishing tree. The „Kalker Kindermittagstisch“ project gives the children daily hot meals and provides help with their homework. In addition, the charity project cares for the concerns and needs of the socially disadvantaged children and their families. Thanks to the admirable commitment of the DEUTZ team, all of the kids’ dreams came true, and their lovingly wrapped gifts were given to them right on time on Christmas Eve – just like last year! Our employees of the Cologne-Kalk plant also collected money and were able to donate 300 euros to the project.



The new face of DEUTZ Service.

How does DEUTZ offer such extraordinarily comprehensive service? The answer is simple: it is all thanks to the DEUTZ Service staff and their extensive expertise. The corporate appearance of DEUTZ Service is intended to reflect this: its new communications and marketing concept focuses on the service experts, lending an authentic face to DEUTZ Service. Its slogan – “We care. We support. We deliver. DEUTZ Service.” – expresses this direction in a nutshell.





As of 1 January 2017, Dr Frank Hiller is the new Chief Executive Officer of DEUTZ AG. A native of Stuttgart, Hiller (50) previously held managerial positions at MAN Truck & Bus AG and Leoni AG and has extensive expertise and experience in the field of mechanical engineering. The engineer talked to DEUTZWorld about upcoming challenges in engine manufacturing and his personal goals for DEUTZ.



► “We wish to cooperate with our customers in long-term, stable partnerships and offer them secure, pioneering technologies.”

# DEUTZ loves engines

**DEUTZWorld:** Dr Hiller, you have been the new Chief Executive Officer of DEUTZ AG since 1 January 2017. What made you take this position, and what do you associate with DEUTZ as a company?

**Dr Frank Hiller:** As the world's first engine factory, DEUTZ looks back on an impressive history featuring renowned, pioneering personalities such as Nicolaus August Otto, Eugen Langen and Gottlieb Daimler – and many more. At the same time, DEUTZ is still one of the prime innovators in the market. The DEUTZ brand is synonymous with competence, technological diversity and high-quality products. I am very pleased to be managing a company with such a rich tradition and, as the new CEO, help the company to continue providing our customers with the right solutions in the future. This also includes reinforcing our market position, business success and attractiveness for our customers and the capital market.

**DEUTZWorld:** What are your impressions from your first weeks with the DEUTZ team?

**Dr Frank Hiller:** Our company has highly competent employees who feel very close to DEUTZ. The members of DEUTZ are proud of “their” company and identify strongly with their own products. This reliable loyalty is what makes a company successful. Competent, motivated employees are a great strength and an excellent asset allowing us to offer our customers top-class products.

**DEUTZWorld:** Which current challenges do you see for engine manufacturers such as DEUTZ, and what do you plan to do about them?

**Dr Frank Hiller:** Increasingly strict emissions requirements have been the primary

driver of innovation in our industry during the past years. The accompanying increase in complexity of our product and the shortened technology cycles have doubtlessly been challenging for everyone involved. We have to continue developing our engines further and further – not least because of additional emissions regulations for which we need to be prepared. New developments and solutions also include alternative drive concepts, e.g. gas versions, and the realisation of hybrid drive solutions.

Another important topic is the ever-progressing digitalisation and its inherent opportunities. Thanks to their electronic control units, our engines already have a high level of intelligence, and we have access to a large amount of data. We could create great value for the end customers by using them intelligently, e.g. to provide better service.

**DEUTZWorld:** Do you have an idea which topics will be particularly close to your heart in your role as CEO?

**Dr Frank Hiller:** We must always stay abreast of the times. The increasing digitalisation is particularly important to me, as I have stated already. We wish to cooperate with our customers in long-term, stable partnerships and offer them secure, pioneering technologies. The topic of “total cost of ownership” also plays an important role. Internally speaking, I aim to strengthen the team spirit of our staff further and use their existing potential more efficiently. Profitable, sustainable growth and the aforementioned intensification of our business success are important not only for meeting the expectations of the capital market, but also in terms of their motivating effect on our own employees.

**DEUTZWorld:** Dr Hiller, what can customers expect from you?

**Dr Frank Hiller:** Our customers and their needs are my absolute top priority. We want to offer our customers impressive, high-performing, high-quality products at competitive conditions. I consider our culture of innovation a valuable asset that will determine our future. DEUTZ loves engines.

## About our partner in conversation

Dr Frank Hiller studied mechanical engineering at the University of Kaiserslautern. After completing his doctoral studies, he worked as a project engineer for KUKA Welding Systems + Robot Corporation in the United States. He later became a research assistant at the Centre for Production Technology of his alma mater. Following eight successful years with ThyssenKrupp Automotive AG in Bochum, where he most recently worked as President of ThyssenKrupp Federn GmbH, Hiller assumed the position of Chairman on the board of F.X. Meiller Fahrzeug- und Maschinenfabrik GmbH & Co KG in Munich in 2005. Additionally, he was the single chairman of Rathgeber AG from 2007 to 2009. Between 2009 and 2013, he held the position of Management Board Member for Marketing, Sales & Services at MAN AG in Munich. Before assuming his new role as CEO of DEUTZ AG, he was a Member of the Board at Leoni AG in Nuremberg.



## DEUTZ at CONEXPO 2017

# Welcome to Las Vegas

**CONEXPO in Las Vegas (7–11 March) is the most eagerly anticipated trade fair of the construction vehicle sector in 2017. Under the headline “FUTURE DRIVEN – Engine Technology for Tomorrow”, DEUTZ will be presenting its expanded engine portfolio with a cylinder capacity of 2.2–18.0 litres. The DEUTZ stall will focus on multiple new diesel engines at once with capacities of 5.0 / 9.0 / 12.0 / 13.5 and 18.0 litres, respectively. They will be presented in the United States for the first time.**

Every three years, international representatives of the construction vehicle industry meet at CONEXPO at the Las Vegas Convention Center to exhibit their latest products, equipment, services and technologies. At the last event in 2014, more than 120,000 guests visited 2,400 exhibitors on an area of approximately 200,000 square metres in the heart of the entertainment metropolis in the Nevada desert.

This year, the DEUTZ stall (S-85230) will span 220 square metres in the South Hall and host the American premiere of the new four-cylinder diesel engines (TCD 5.0 and TCD 9.0) and the six-cylinder TCD 12.0, TCD 13.5 and TCD 18.0 models. The new TCD 2.2 three-cylinder in a diesel and gas version and the new gas variety of the trusted TCD 2.9 four-cylinder will also make an appearance.

In 2016, the new DEUTZ TCD 5.0 already celebrated its world debut at Bauma in Munich. Its serial launch is set to take place in 2019, on time for the next EU Stage V emissions standard. With a cylinder capacity of five litres, this particularly compact diesel engine (equipped with turbocharging and intercooling systems) offers 100–150 kW of power and a torque of 890 Nm. The engine is designed on the basis of the downsizing principle, generating more performance at a lower cubic capacity. It can replace larger engines or simply provide a higher performance at the same size. In addition, the engine works more efficiently and saves fuel thanks to its low weight. The installation dimensions and client interfaces are virtually identical with those of the well-known TCD 4.1, which is a benchmark for compactness. With its pipe-free construction that displays a reduced number of parts, the platform, which was redeveloped from scratch, drew

particular attention. In order to bypass heat protection measures, a stringent separation of the hot and cold side was implemented alongside reduced power loss in the oil and water cycle. The engine also has an overhead camshaft, a cross flow cylinder head with a high cross-linking of parts and functions, maintenance-free hydraulic valve-clearance compensation, and a robust dust and shock-resistant cylinder head cover. With the TCD 5.0 engine, DEUTZ aims to fill the performance gap in the range between 100 and 150 kW while offering a new technological basis with outstanding product properties. In order to satisfy the high emission regulations of EU Stage V, the TCD 5.0 will be equipped with the tried-and-tested DEUTZ exhaust gas treatment, consisting of diesel particulate filter (DPF), Selective Catalytic Reduction (SCR) and diesel oxidation catalyst (DOC), which are already successfully deployed in Stage IV.

### New engine family with 9.0 – 18.0 litres

The new TCD 9.0 will be another DEUTZ highlight in Las Vegas. The four-cylinder diesel engine with a cubic capacity of nine litres offers a performance of 200–300 kW and a torque of 1,700 Nm. Thanks to its extremely compact design, it is easily installed in a variety of machines – especially excavators and wheel loaders.



*The DEUTZ TCD 9.0 (left) and TCD 5.0 (right) will be presented to the American market for the first time at CONEXPO.*

In addition, DEUTZ is planning to develop two in-line six-cylinder engines, the TCD 12.0 and 13.5 with 400 kW/2,500 Nm and 450 kW/2,800 Nm, respectively. Much like the TCD 9.0, they adhere to a uniform family concept with a shared customer interface and a high percentage of identical parts. In the future the DEUTZ TCD 18.0 will mark the top end of the performance scale. The engine, designed as a series-6 cylinder, has up to 620 kW and 3600 Nm of torque.

All four engines are part of a cooperative project conducted together with the Liebherr Group. DEUTZ distributes the engines produced by Liebherr under its own brand name via the global network of DEUTZ retailers and service providers. The company further plans to manufacture the TCD 9.0 in its own Chinese joint venture DDE on a licensing basis in order to serve its local customers better. The engines will be launched for the EU Stage V, US Tier 4, China IV and EU Stage IIIA emission stages from 2019.

### New gas and diesel engines to expand the lower output range

DEUTZ is not only focusing on the upper end of its performance range: a total of

three new engines are launched in the lower range. At an output of 56 kW, the new three-cylinder version of the successful TCD 2.9 four-cylinder TCD 2.2 will provide a viable alternative especially for the lower load range in the area of material handling and compact construction machinery. In addition, DEUTZ introduces two liquid-gas versions (also referred to as LPG or propellant) of the TCD 2.2 and TCD 2.9. The engines are called G 2.2 and G 2.9, respectively, and are particularly well-suited for forklifts used indoors: liquid gas significantly reduces emissions, allowing the machines to meet the criteria of EU Stage V using a three-way catalyst without a complex exhaust gas after-treatment system.

The new DEUTZ Smart-EAT system will also be exhibited at the fair. This solution for exhaust gas treatment consists of a so-called Single Unit, in which the DOC, DPF and SCR (incl. dosing unit) can all be accommodated. The exhaust gas treatment technology has thus been integrated extremely compactly in just one component. This gives the client additional installation space in his machine. If required, the SCR system and DOC/DPF unit can also be installed separately as a so-called flexible unit, allowing the available space to be utilised more efficiently. The system adheres to the modular logic of the tried-and-tested DVERT construction kit (DEUTZ Variable Emission Reduction Technology), which provides the best individual solution for any application.

Besides presenting its new engines, DEUTZ will also be showcasing its comprehensive service range, which now includes a power pack for the popular TCD 3.6 engine. It is ready to install upon delivery and comes with a pre-installed cooler. The so-called „Xchange“ programme is also included in the service range. It provides professionally remanufactured engines and components as a fast, economically feasible and environmentally-friendly alternative to purchasing a new vehicle.

## FUTURE DRIVEN. ENGINE TECHNOLOGY FOR TOMORROW

DEUTZ at CONEXPO: South Hall, stall S-85230. More information about CONEXPO 2017 is available at [www.future-driven-deutz.com](http://www.future-driven-deutz.com)





# Powerful, compact, efficient

## DEUTZ high-torque engines

Many applications of an engine require high torque. But this does not necessarily require a large engine. DEUTZ high-torque engines offer a great deal of torque at a compact size and performance values under 56 kW. This helps the customers save installation space and weight and even does away with the need for an SCR system, as the legally relevant performance threshold is not exceeded.



*Heli successfully uses the TCD 3.6 HT in forklift trucks of its G series with a loading capacity of 5 to 7 tonnes.*

With the introduction of high-torque (HT) varieties of its successful TCD 2.9 and TCD 3.6 engines, DEUTZ offers optimal solutions for compact mobile working machines that require maximal performance in their class. This includes wheel loaders, where the available torque allows for strong momentum, or single-drum compactors, where the work hydraulics starts up to activate vibration at low speeds.

The DEUTZ high-torque varieties reach a torque that is normally only achieved by larger engines in higher classes, which is an advantage for several reasons. Up to a capacity of 56 kW, the current emissions directive (EU Stage IV) and the upcoming Stage V, which will come into effect in 2019, does not require a SCR system. Correspondingly, no urea tanks or lines need to be installed, and the engines do not require any additives for operation. This allows the manufacturer to reduce cost, complexity and installation space, provided that the relevant performance threshold is not exceeded. In terms of torque, standard 56-kW engines reach their natural limit at a certain point, depending on the desired application performance. With the launch of its high-torque engines, DEUTZ is deliberately expanding the area of application of its engines below 56 kW.

### The benchmark for engines below 56 kW

DEUTZ' TCD 3.6 High Torque already set the benchmark for engines below 56 kW when the EU Stage IV/ US Tier 4 emissions directive came into effect. This four-cylinder engine boasts considerable values of 390 Nm at 1300 min<sup>-1</sup>. For EU Stage V, its maximum torque can even be increased to 405 Nm at the same speed, as the currently used DEUTZ Oxidation Catalyst (DOC) – the so-called “DOC-only” solution – is replaced with a diesel particulate filter (DPF). A DPF facilitates an even higher torque. The larger DEUTZ engines with a cylinder capacity of 4–8 litres are already equipped with DPF as standard in Stage IV, which has a positive effect on their performance.

Their installation can be simplified further using an optional power pack with attached cooler. This gives DEUTZ customers access to a product that offers top performance, minimal installation and application scope and short delivery times.



*DEUTZ TCD 2.9 (below) and TCD 3.6 high-torque engines (above) offer maximum torque within their performance class of less than 56 kW.*



The TCD 2.9 High Torque is even more compact and boasts 375 Nm. This increase of torque from 300 Nm was made possible by an enhanced power unit. With its four cylinders, the water-cooled serial engine features a cooled exhaust gas recirculation system, turbocharging and intercooling. The powerful common rail injection system as well as highly efficient combustion secure maximum engine performance with ultra-low fuel and emission values.

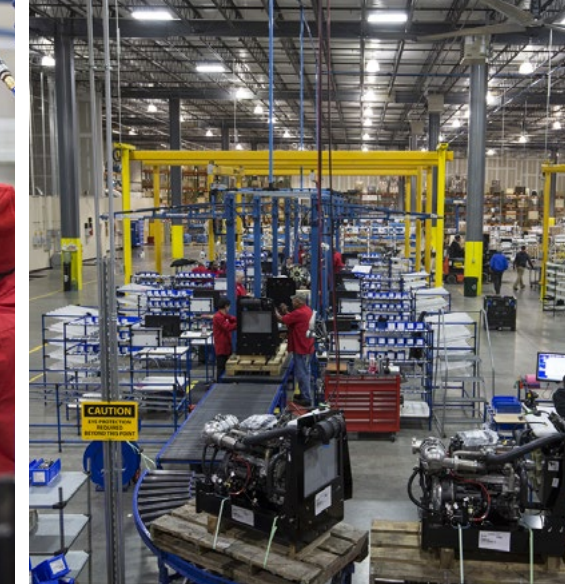
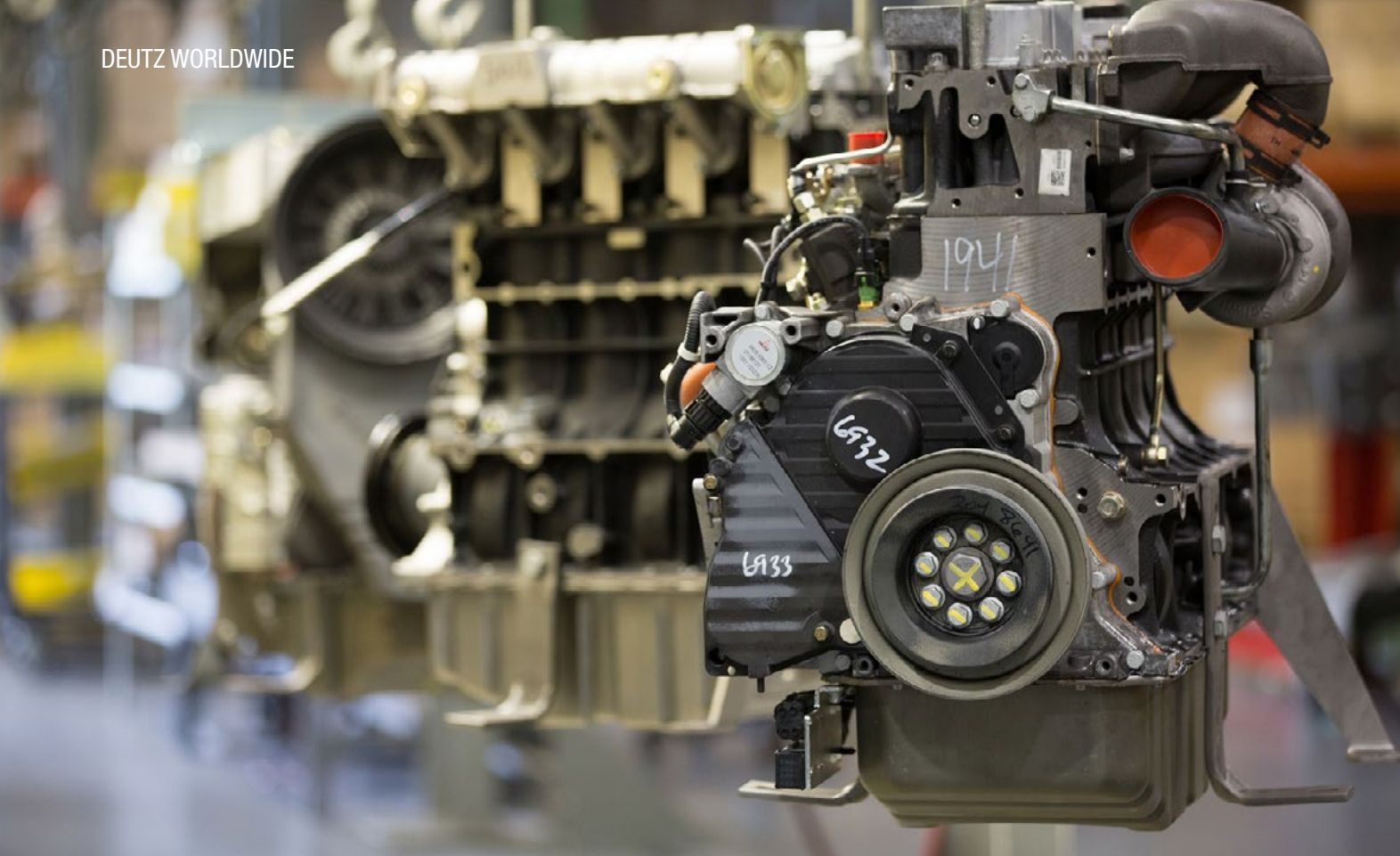
For EU Stage V, DEUTZ will be launching another high-torque variety: the D 2.2 three-cylinder engine. The D 2.2 HT meets the standards of the world's strictest emission directives, EU Stage

V and US Tier 4, at a maximum performance of 18.4 kW. No exhaust gas treatment or recirculation system are required for compliance with these standards. DEUTZ is offering a product in the range below 19 kW that allows its customers to forego the use of exhaust gas treatment systems entirely while still complying with the strict emission limits required by law.

### Heli trusts in high torque for forklifts

Not only construction machines are benefiting from DEUTZ high-torque engines – customers in the field of material handling are also choosing the compact strong engines. The forklift specialist Heli successfully uses the TCD 3.6 HT in its G series with a loading capacity of 5–7 tonnes. These heavy forklifts offer strong momentum, which the DEUTZ high-torque engines provide at all times. Heli particularly appreciates the considerable cost advantage and the simplified use of the “DOC-only” solution. The lower maintenance effort required constitutes an additional advantage for the final customer.





# DEUTZ Corporation ... because it works!

**For our American subsidiary, DEUTZ Corporation, CONEXPO in Las Vegas is an important global trade show, taking place every three years. DEUTZ engines already played a key role in the mechanisation and development of North America 150 years ago. Today, DEUTZ is a powerful player in the USA, and the employees of DEUTZ Corporation work hard to reinforce this strong position every day.**

As early as the late nineteenth century, DEUTZ engines played a key role in the motorisation and development of the North American continent. Various companies imported the engines from Cologne and distributed them in the United States, including the company Otto Gas Engine Works, established in 1894. In 1951, the Diesel Energy Corporation intensified the use of DEUTZ engines in the North American market. Four years later, the same Diesel Energy Corporation

became a subsidiary of DEUTZ; since 1974, it has been trading under the name of DEUTZ Corporation. The DEUTZ Corporation is an established name in the US market today, just like the DEUTZ engines.

Headquartered in Norcross, Georgia, it is the largest subsidiary of DEUTZ AG. It oversees the entire range of DEUTZ engines available in North, Central and South America, providing drive solutions along the entire product cycle from first draft to prototype and production release. With al-

most 200 employees, DEUTZ Corporation is responsible for sales, customer service, parts procurement and applications engineering for the entire customer base and all OEM partners in North, Central and South America.

DEUTZ Corporation adds value for some of its key OEM partners, with Value Add Production. "We provide economical and practical solutions at a high quality and short turnaround times. This allows us to ensure delivery at exactly the right time, based on the requirements of our customers," explains Robert Mann, President and CEO of the DEUTZ Corporation. DEUTZ Corporation moved its Value Add production line from Norcross to Pendergrass, Georgia, in June 2016. The base engines are delivered from Germany and then adjusted to the specific requirements of the OEM partners. Along with the relocation, two new production lines were added. This expansion has allowed the DEUTZ

Corporation to increase its production and offer cost savings and additional expertise to even more OEM partners. "Thanks to our international supplier contracts and the vast amount of components and parts purchased by DEUTZ every year, we were able to pass on significant cost savings directly to our partners," says Robert Mann.

DEUTZ Value Add Production shares its premises with the DEUTZ Xchange engine remanufacturing operation. Since July 2008, the company has been remanufacturing Xchange engines for distribution in North America and parts of Latin America. The DEUTZ engines 1011/2011 and 912/913, the most successful DEUTZ ranges in North America, are the basis of its core production. Its portfolio further includes the DEUTZ engines 1012/1013, 1015/2015 and the 2012 and 2013 models.

The strong position of DEUTZ Xchange is reflected in the list of its current partnerships: since April 2016, JLG Industries, Inc. has been cooperating with the American DEUTZ subsidiary in order to receive DEUTZ Xchange replacement engines for the aerial work platform (AWP) used in the JLG repair programme. "Our quality products and the fact that our replacement engines are offered by all DEUTZ retailers were the deciding factors in awarding this project," Mann continues. In October

2016, a similar contract was concluded with Terex Aerial Work Platforms (AWP) Reconditioning Services: DEUTZ Xchange offers replacement engines for the pneumatic repair system Genie®, e.g. for lifting platforms, scissor lifts and telescopic handlers.

But the Xchange business is not the only strong suit of the DEUTZ Corporation: in September 2016, the first DEUTZ Power Center was officially opened in North Kansas City. Employing 17 professional members of staff, the DEUTZ Power Centre Midwest is the first of its kind offering special application technology and technical sales staff specifically to small and medium-sized machine manufacturers that use DEUTZ products. In addition to the DEUTZ Power Center Midwest, another Power Center is located in Rock Hill, South Carolina. Both are designed specifically to provide support to OEM partners and consumers within their respective region. Each DEUTZ Power Center is typically supported by a DEUTZ Service Center in the same area, offering repairs and emergency services for DEUTZ engines in its own state of the art facility. The mechanics also carry out customer visits. Beyond the services described, the DEUTZ Service Centers also sell original DEUTZ spare parts and liquids to customers, retailers and trained OEM traders working with DEUTZ equipment. In January 2017, the

first DEUTZ Service Center opened in St. Louis, Missouri.

"Our thoroughly trained staff can help our customers with any issues regarding the various DEUTZ engines," Ben Sanders, Branch Manager of the St. Louis DEUTZ Service Center, explains. The technicians at the DEUTZ Service Center carries out a variety of tasks ranging from simple oil and filter changes to more in-depth, advanced diagnostics and the complete replacement of engines. "Thanks to our new Service Center, we can offer DEUTZ customers exactly the support they need and deserve. Our personal contact with the customers additionally provides us with constant feedback. This allows us to adapt our products and services to the constantly evolving needs of the industry even better," Sanders continues.

Decades of success have proven that the approach taken by the American DEUTZ subsidiary works exceptionally well. In March 2017, the DEUTZ Corporation will be in the front row at CONEXPO in Las Vegas once again to showcase what it has been best at for decades: economical, convenient solutions at the highest quality.

**Find out more: [www.deutzamericas.com](http://www.deutzamericas.com).**



# DEUTZ establishes a subsidiary in Korea

DEUTZ has established an official subsidiary in Seoul (South Korea). A Japanese subsidiary is planned for the coming months. This emphasises the increasing significance of the two East Asian countries for DEUTZ. Korea and Japan are two of the most important markets for mobile work vehicles, with considerable export volumes in the fields of construction machinery and material handling. Some of their manufacturers are among the largest in the world. Over the past years, DEUTZ has had great success in customer acquisition in the region: Hitachi and Takeuchi for construction machines, TYM for agricultural tractors, Clark in the field of material handling, etc.

The increasing complexity of engine systems resulting from stricter emissions legislation requires close proximity to all customers. Close cooperation with their R&D departments is crucial for joint success.

Bernd Freudenmann, DEUTZ Vice President Sales & Service Asia, explains: "The establishment of companies in Korea and Japan is an important step for DEUTZ' long-term market success in these strategic locations. It allows DEUTZ to meet the requirements of its customers in the region much more efficiently."



Local DEUTZ experts support the cooperation on a cultural and linguistic level. In addition to hiring local sales staff, DEUTZ will establish a local technical support team to support its customers' engineering, quality and service as thoroughly as possible.

# A new DEUTZ Service Center opens in the US

The new St. Louis site provides OEMs and end clients with fast, reliable support for their engines.

The DEUTZ Corporation has officially opened its new DEUTZ Service Center in the US. Together with the existing DEUTZ Power Center Midwest, this new facility in the St. Louis region aims to offer first-class customer service for all DEUTZ product ranges.

"No matter which DEUTZ engine a customer may be using, our trained employees are ready to help," Ben Sanders, Branch Manager of the DEUTZ Service Center in St. Louis, explains. "The technicians in our DEUTZ Service Centers can

do anything, ranging from simple oil and filter changes to extensive, state-of-the-art diagnostics or even a complete engine replacement."

DEUTZ Service Centers offer scheduled maintenance and emergency services for DEUTZ engines, either in their garages or directly at the customer's location, thanks to mobile service technicians and trucks. In addition, DEUTZ Service Centers sell original DEUTZ replacement and maintenance parts and working materials to customers, retailers and qualified OEMs whose plants are powered by DEUTZ engines.

"The opening of this new Service Center enables us to offer our customers the support they need," Sanders assures. "Our direct contact with the customers further provides us with valuable feedback, which helps us to adapt our products and services to the constantly changing requirements of the market."

The DEUTZ Service Centers also provide a benefit to OEMs within their service regions. With a DEUTZ Service Center, they can count on fast, state-of-the-art diagnostics on location and repairs carried out by experienced DEUTZ technicians.

"Our DEUTZ Service Centers are designed to maximise our customers' efficiency and productivity," Robert Mann, CEO and Managing Director of DEUTZ Corporation, explains. "We strive to provide the best engine support available in the entire industry, and this additional Service Center is another step in the right direction."

The new St. Louis location will expand the availability of DEUTZ support in the Midwest, covering customers from eastern Missouri, Illinois and northern Indiana. A grand opening ceremony will take place at the new location in the spring of 2017.



# DEUTZ at Middle East Electricity 2017

On 14–16 February 2017, 1,500 exhibitors from 130 countries presented their new developments in the field of energy technology, energy efficiency and electrotechnology at Middle East Electricity in Dubai, the largest trade fair for power production, transmission and distribution in the Middle East. DEUTZ was present at the Dubai World Trade Center to showcase its latest solutions for mobile power generation.

Under the headline "Future Driven – Engine Technology for Tomorrow", the company presented the new DPS (DEUTZ Power Solutions) genset portfolio across 42 square metres in the German Pavilion. These diesel aggregates produce an electrical output of up to 1,000 KVA for a multitude of applications. One of the highlights of the DEUTZ stall was the

world premiere of the DEUTZ DPS Hybrid 13 and DPS 20 genset systems with an output of 13 and 20 KVA, respectively. These complete genset systems consist of a diesel engine and all other components (generator, control panel, frame). They are available with or without an enclosure.

In addition, the DPS Hybrid 13 is capable of progressive hybrid operation using either a

battery or a solar module. If the engine generates more power than needed, excess energy will be stored in the battery. The latter can support the engine when needed or even cover the entire energy supply, resulting in fuel savings of up to 65 per cent. In the case of a downtime of the diesel engine, the battery can keep the genset running for up to 24 hours. The solar hybrid variety is equipped with a solar panel that can cover most of the required energy supply by itself in sunny regions. Its diesel engine only starts temporarily as a supporting energy source during peak times or on overcast days, which facilitates particularly economical operation in terms of fuel and maintenance and ensures a very long service life. In addition to their economical benefit, the DPS Hybrid solutions also constitute an environmentally-friendly source of energy.

DEUTZ also showcased its trusted "Telco" engine, DEUTZ BF4M 2011, which is ideal for use in the rapidly growing African mobile communications sector with an output of up to 64 KVA. It is distinguished by its 1,000-hour oil change interval and low fuel consumption. DEUTZ assembles the gensets locally at its Moroccan subsidiary, MagiDEUTZ. "Africa and the Middle East are among our most important genset markets," explains Georg Diderich, DEUTZ Senior Vice President for Sales & Service in EMEA (Europe, Middle East & Africa). "Being on the spot in Morocco, we can provide our customers with rapid and immediate support for everything – from sales and equipment supplies to servicing. Our complete 'made by DEUTZ' gensets are designed precisely to meet market requirements, combining top OEM quality at reasonable overall cost."

# World of Concrete 2017

DEUTZ presented their latest product portfolio at World of Concrete from January 17 to 19 in Las Vegas, Nevada. The company's presence at the international exhibition and conference for concrete construction was organised by the American DEUTZ subsidiary.

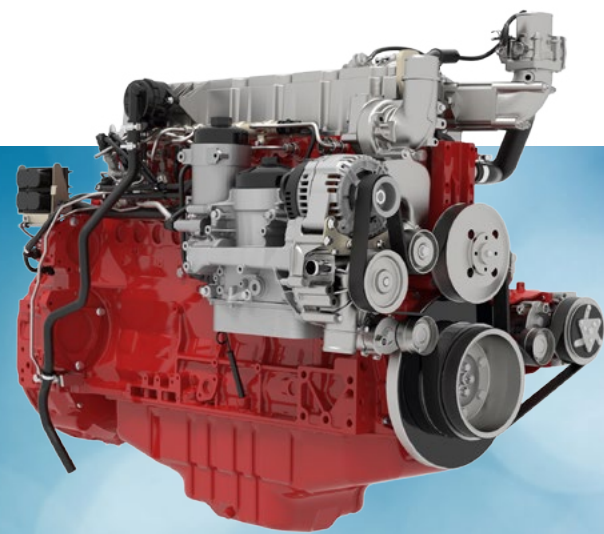
Robert Mann, President and CEO of the DEUTZ Corporation (Norcross, USA), explains: "We very much appreciate our participation in the World of Concrete. Here we can hold discussions with our customers and receive feedback on how well our engines work. It is also a good opportunity to find out how our service network supports our engines in the field."





# The CO<sub>2</sub>-neutral diesel

Modern exhaust gas after-treatment systems have reduced the emission of toxic substances such as nitric oxides or soot particulates almost to zero. What remains is CO<sub>2</sub>, which is inevitably generated when fossil fuels are used in combustion engines. But thanks to synthetic fuels, even traditional drive systems can achieve CO<sub>2</sub> neutrality.



Combustion engines do not have a great reputation. They are considered harmful to the environment and dirty – especially the diesel engine is infamous for the latter. Modern, highly developed models do not deserve their bad name, however. DEUTZ engines designed for the upcoming EU Stage V are equipped with diesel oxidation catalysts (DOC), diesel particulate filters (DPF) and selective catalytic reduction systems (SCR) for impressive emissions quality throughout the entire map range. In figures: 95 per cent of nitric oxides and more than 99 per cent of particulates are filtered.

This produces a lower particle load than contained in the air of many metropolises around the world.

The pollution issue is essentially a thing of the past – all that remains is the question of reducing or eliminating CO<sub>2</sub> emissions. CO<sub>2</sub> (carbon dioxide) is a gas that occurs naturally in the atmosphere and is added to any sparkling beverage. It does not pose a direct threat to humans or our environment. Scientists have

► **DEUTZ is developing perspectives for the CO<sub>2</sub>-neutral operation of diesel engines in order to reap their benefits in an environmentally-friendly way.**

found, however, that the quantity currently released on a global scale has a negative impact on global warming, making it a central issue in all measures intended to stop climate change. It is impossible to limit the amount of CO<sub>2</sub> emitted when fuel is burned, so the emissions level remains parallel to consumption levels. As a result, many are predicting the demise of the combustion engine in the near future. This prediction is inaccurate.

rate. As the world transitions from fossil to renewable fuels, combustion engines will continue to play an important role in the future. Its advantages remain indispensable especially in the off-road sector, which constitutes the core business of DEUTZ.

## The drive of the future

There is no single right answer to the question of which drive system will prevail. Electric, hybrid and combustion engines all have their individual advantages depending on the application required. While a small personal car intended for inner-city traffic can already run perfectly well on an electrical engine, heavy-duty applications such as excavators or tractors require powerful, efficient and self-sufficient diesel engines. Electric drives are inapt for these purposes, as the required amount of energy would be too high to carry in a battery. To illustrate: A 590-litre diesel engine tank in a tractor is sufficient for 10 hours of ploughing work in the fields. A battery providing the same amount of energy would have a volume of 4,500 litres and weigh more than 15 tonnes.

DEUTZ is developing perspectives for the CO<sub>2</sub>-neutral operation of diesel engines in order to reap their benefits in an environmentally-friendly way. Due to their low fuel consumption, diesel engines are generally more CO<sub>2</sub>-friendly compared to other combustion systems. But the ultimate goal is to achieve a neutral balance using renewable fuels and a closed CO<sub>2</sub> cycle.

## Synthetic fuels

The principle underlying the use of synthetic fuels is simple: Their generation absorbs the same amount of CO<sub>2</sub> from the atmosphere as is emitted during the combustion process. This is achieved by electrolysis, which separates water into hydrogen and oxygen using electricity. For a CO<sub>2</sub>-neutral result, this electricity must come from 100 per cent renewable sources such as wind or solar energy. In the next step, the hydrogen thus generated reacts with CO<sub>2</sub> to form a synthetic gas. This process can yield both gaseous (power-to-gas) and liquid (power-to-liquid) fuel. Diesel fuel produced in this way can be mixed and used with fossil diesel at any proportion thanks to its chemical properties. Power-to-X, then, refers to the production of synthetic fuels (X) made from renewable energy (power) in a CO<sub>2</sub>-neutral cycle.

The process has various advantages. Firstly, the resulting fuel can be stored and transported easily and used in regular combustion engines. Secondly, it is a convenient option for storing electricity gen-

erated from renewable energy in a small space. These properties suit the needs of DEUTZ' clients perfectly. The perspective of using combustion engines in a CO<sub>2</sub>-neutral way is supported by leading scientists. Prof. Bert Buchholz from the Faculty of Mechanical and Marine Engineering at the University of Rostock explains: "Liquid hydrocarbons from renewable sources have a high energy density. For mobility applications, they are urgently needed to store sufficient amounts of energy with relatively low storage capacities, especially when it comes to applications with particularly high energy requirements such as work or off-road vehicles."

Research into the necessary manufacturing processes and how to implement them efficiently at an industrial scale is still ongoing. In addition, the necessary renewable energy sources must be developed further. Nevertheless, the topic shows that diesel engines and combustion engines, in general, have potential for a sustainable drive technology in the long term.

## Decarbonisation with hybrid technology

The path to synthetic fuels is still long, and DEUTZ is already working hard to reduce the CO<sub>2</sub> emissions of fossil fuel engines further. This reduction of carbon use is called decarbonisation. It starts with the constant optimisation of fuel consumption and continues with the hybridisation of drive systems, whereby regular combustion engines are combined with electric engines and generators that store excess energies and support the combustion engine whenever needed. This lowers the fuel consumption and CO<sub>2</sub> emissions of the overall system. DEUTZ has already realised such a drive system successfully

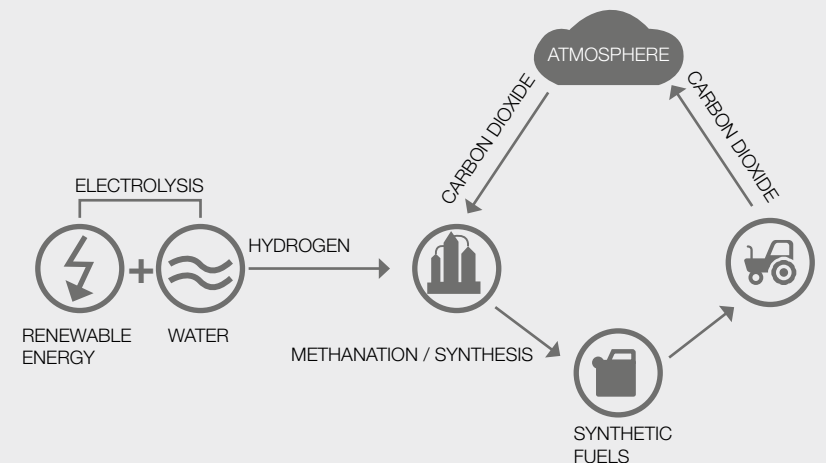


Hybrid technologies can decrease the CO<sub>2</sub> emissions of combustion engines run with fossil fuels. During a research project, DEUTZ successfully cut the fuel consumption of an industrial excavator by 40 per cent.

during a research project involving an industrial excavator.

The same effect can be achieved by using a hydraulic hybrid system that channels excess energy into a pressure storage unit, from which it can be retrieved when needed. DEUTZ has also demonstrated this variety successfully, using the example of a wheel loader. Hybrid systems save a considerable amount of fuel, especially in combination with economical diesel engines: The hybridised excavator cut fuel consumption by up to 40 per cent.

## CO<sub>2</sub> cycle – synthetic fuels for combustion engines







# DEUTZ service – more than just spare parts

From a technological perspective, modern, electronically-controlled engines are far removed from their mechanical predecessors. Shortening technology cycles and increasingly complex hardware and software pose challenges to the service segment, too. DEUTZ are tackling this growing complexity with a comprehensive service spectrum comprising parts, diagnostic tools, special equipment and garage expertise.

**O**n account of the continuously increasing requirements of emissions legislation, modern diesel engines are equipped with a whole range of additional systems. DEUTZ was one of the first engine manufacturers to launch its solutions for Stage V on the market at an early stage in order to provide its customers with the best possible support for product planning and the transition of their products to the new emissions level. As these products are entering the market, the DEUTZ service network is being prepared for the accompanying technical challenges. In addition to the worldwide provision of spare parts, this particularly includes the provision of training in all required maintenance, diagnostics and repair tasks for the new generation of engines to all service partners. For DEUTZ, the business relationship is not over once an engine has been sold – quite the contrary. DEUTZ believes in its maxim: “service – for a machine’s lifetime”.

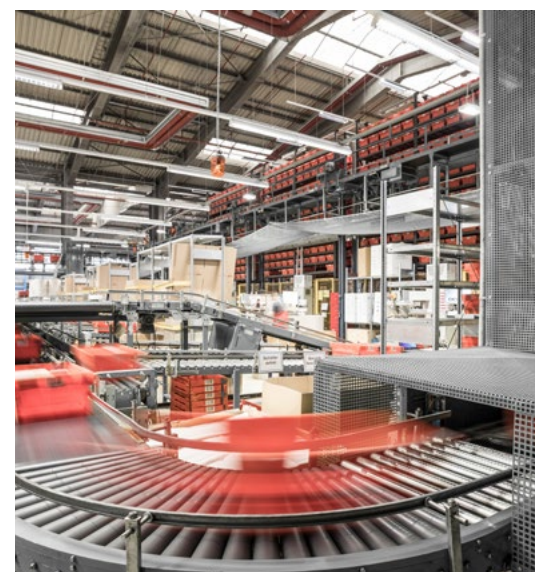
Engineering services and products for all things engine, turnkey solutions (such as complete sets with a cooling system and SCR tank), defined maintenance sets (virtual kits) and rapid, competent help from the global DEUTZ service network whenever and wherever it is needed – these are only some of the products and services offered by DEUTZ throughout the entire lifetime of an engine or other machine. Above all, DEUTZ’ mechanical engineers need expertise and the right equipment – such as

the SERDIA diagnostic tool – to service and repair complex engines. SERDIA provides technicians with the required systems support on site, allowing them to analyse the engine and exhaust gas treatment systems fast and efficiently and offering possible solutions for quick trouble-shooting in the field. Customer requirements are increasing constantly, not only in terms of service quality but also with regard to reactivity. The strong DEUTZ service network ensures that the right point of address is available within no time flat whenever needed: 13 sales companies and more than 800 sales and service partners are available to provide competent customer service in more than 130 countries at any time. Regular, intensive training programmes ensure that all DEUTZ service partners are thoroughly familiar with the latest developments in DEUTZ engine technology.

Similarly thorough: the availability of spare parts from DEUTZ. Providing our customers (who are collectively using approx. 1.6 million DEUTZ engines in the field) with spares quickly, affordably and safely is our top priority. The SERPIC spare parts catalogue facilitates the fast, safe identification of all engine parts currently in use. Approximately 40,000 different spare parts for DEUTZ engines are in stock and can be dispatched from the Cologne-Kalk logistics centre and ten regional warehouses to any location. The central warehouse in Kalk moves 4,500 orders with a total shipping weight of more than 35 tonnes on a daily

basis. Orders received by 5 pm are dispatched on the same day. This allows the company to guarantee high availability of all machines and vehicles running on DEUTZ engines.

Customers should only use original spare parts to ensure that their expectations in their DEUTZ engines are met to their full satisfaction throughout the entire service life of the product. Original DEUTZ spare parts are designed, tested and approved especially for use in DEUTZ engines – to ensure maximum performance and lifespan. DEUTZ Original spare parts and working materials keep this promise. To make sure that a DEUTZ remains a DEUTZ.



## Spotlight on the customer

Thorsten Müller has been the Director of the DEUTZ AG Service Business Segment since 2015. DEUTZ World has interviewed him to find out which role he allocates to DEUTZ as a systems supplier and how the company is tackling the growing challenges facing it in the field of service.

**DEUTZWorld:** Mr Müller, what is the significance of the service segment for DEUTZ?

**Thorsten Müller:** For machine manufacturers such as DEUTZ, service is crucial: no customer would buy a complex industrial product such as an engine without taking advantage of a bundle of accompanying services and additional products. This starts with application engineering, i.e. the integration of the engine into the machine of the equipment manufacturer, and continues in the form of a competent, world-wide service network providing maintenance and repairs of the engines in the field. In its capacity of a systems supplier, DEUTZ must be available at all times and to any customer group as a point of address, advisor and trouble-shooter. Excellent service is our best way of distinguishing ourselves from our competitors and deepening customer loyalty. DEUTZ knows: good service sells engines and contributes significantly to the success of the company.

**DEUTZWorld:** What particular challenges does the service segment pose?

**Thorsten Müller:** Emissions legislation is the most important driver of technological development in our industry. Requirements for engine emissions have increased dramatically over the past years, and this trend is continuing. As a result, engines are becoming more and more complex as technology cycles shorten: while previous generations of engines were still essentially mechanical products, engines today are extremely complicated systems combining hardware and software. This has considerable implications for service, especially in terms of the technical equipment and qualification of our service network. Without the necessary equipment, such as our diagnostic tool SERDIA, modern DEUTZ engines cannot be tested or repaired reliably. Only certified DEUTZ partners are capable of offering satisfactory service – others struggle. This gives us considerable responsibility. We must do everything to meet the high expectations in our service network in every place where our products are used: all over the world.

**DEUTZWorld:** How can DEUTZ master these challenges?

**Thorsten Müller:** We support our OEM customers in reducing complexity, for instance. For many of our current engines, we will be offering power packs: plug-and-play solutions containing all relevant systems from cooling to exhaust gas treatment. In addition, we provide comprehensive engineering services in order to help our customers integrate their DEUTZ engines. The traditional After-sales segment is all about availability, on the other hand: the client’s machine has to run. This is our top maxim. The constant expansion of our global service network is one way in which we realise this goal: last year, we built new service centres in the United States and South America. In Asia, we are working to improve our service logistics on a continuous basis within the scope of a supply chain project in China, Singapore and Australia. We aim to guarantee our high service level of more than 96%, which our European customers already enjoy, all over the world. Our replacement engine programme is another important aspect: we are constantly expanding the range of short-block and long-block engines available from our Xchange facilities in Ulm (Germany) and Pendergrass (USA). Our goal is to deliver replacement engines within 3–5 days, which is considerably faster than on-site repair. The new engine comes with two years of global warranty, just like a new one.

**DEUTZWorld:** What role do people play in this?

**Thorsten Müller:** In addition to everything relating to capacity and processes, humans are the most important factor for DEUTZ. Our employees and their qualifications, from storage staff to on-site technicians, are the foundation of our success and, as such, the success of our customers. During the past year, for instance, we introduced a web-based e-learning tool to provide our employees and service partners with further training. We aim to



expand this tool further over the coming months. We consider this a useful, modern addition to the wealth of on-site training courses we organise in our international branches and, in particular, in our Cologne training centre. In 2016, we carried out almost 500 training sessions worldwide for more than 4,000 clients and staff of the DEUTZ service network.

**DEUTZWorld:** How will service at DEUTZ develop in the future?

**Thorsten Müller:** The increasing complexity of modern engine systems and the consequences this trend entails for us and our customers will continue to influence and increase the significance of service. We, the DEUTZ team, are meeting this challenge head-on by constantly expanding our service network and product range. We will continue to intensify and reshape our work with our service partners. This year, we plan to launch a new online service portal that will allow our customers to buy Original DEUTZ spare parts and additional products from their local DEUTZ service partners securely and easily over the internet. Of course, we are constantly working on our products, too: our plans range from the introduction of new power packs for additional model ranges in our Engine Plus programme to Xchange products to facilitate repairs appropriate to market value. Focussing on service is a long-term strategy for us: it enables us to offer a convincing, comprehensive package that will keep our customers and us successful in a highly dynamic, competitive industry.



As the EU Stage V standard is introduced, DEUTZ is reintroducing gas engines. The required expertise has now been accumulated at the development facility in Cologne. Five gas test benches have already been commissioned to finalise the engines, and more will follow.



## DEUTZ expands gas engine competences



The DEUTZ test engineers measure performance, torque and fuel consumption at the gas test bench.



DEUTZ G 2.2 on one of four performance test benches currently in operation.

Even though the first DEUTZ engine – the atmospheric gas-powered engine of 1867 – ran on gas, the current DEUTZ product portfolio for mobile machinery consists exclusively of diesel engines. As gas engines are becoming increasingly popular in the compact segment, especially for material handling applications such as forklifts, DEUTZ will be introducing two LPG versions of the TCD 2.2 and TCD 2.9 on the occasion of the EU Stage V emissions standard from 2019. LPG stands for “liquefied petroleum gas”. It is also referred to as liquid gas. The three-cylinder and the four-cylinder engines are a consistent engine platform that allows customers to choose between a diesel and a gas engine. The result are extensive synergies for their integration, e.g. in terms of their connectors and the availability of spare parts. This saves money and development efforts.

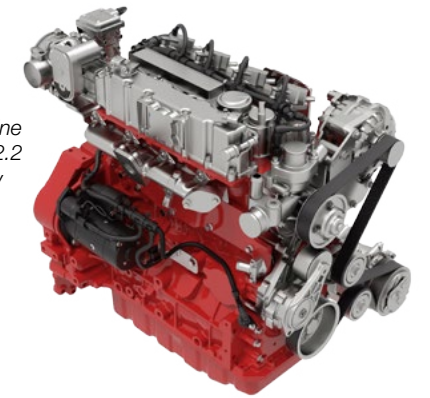
Due to the respective systems, however, certain changes are inevitable. The LPG varieties largely differ by their fuel preparation method, cylinder head, sensor technology, and exhaust gas treatment system. And, of course, their main distinguishing feature: a spark plug with a pencil coil replaces the fuel injector of the diesel version in the same position. This ultimately transforms the diesel engine into an Otto engine.

The engines are particularly well-suited for equipment used in closed buildings: liquefied petroleum gas has considerably lower emissions than diesel fuel, meeting the EU Stage V requirements by way of a three-way catalyst. No complex exhaust gas after-treatment system is necessary. The test benches in the development department must capture these technological differences, too.

### New fuel requires a new infrastructure

DEUTZ has continuously expanded its testing capacities in order to keep up with the ongoing gas engine development. This challenged the available testing facilities: test benches had to be equipped in a way that made both diesel and LPG available as a fuel in the test cabins. To achieve this, multiple gas tanks were incorporated into the ground, containing three different LPG compositions. Standard LPG is available to the test engineers in their everyday development runs. In order for the LPG engines to be certified, two additional, special mixtures had to be made available. LPG is a mixture of propane and butane, which is used at a different ratio depending on the region and time of year. Both extremes must be accounted for (in accordance with ISO 8178-5: “30 vol.% propane to 70 vol.% butane” and “85 vol.% propane to 15 vol.% butane”).

To ensure ideal testing conditions, the tanks are kept at a constant temperature of approx. 26 degrees Celsius. This results in correspondingly constant pressure conditions, facilitating higher safety and more reliable measurements. At present, the gas engines spend most of their developmental cycle on four performance test benches, where general combustion and mechanical development are carried out alongside exhaust gas after-treatment inspections. The responsible DEUTZ engineer Willi Meiling explains: “During individual tests (30–120 minutes each), the engineers carry out performance measurements (performance, torque, fuel consumption), emissions tests in accordance with legal requirements, friction measurements, tests of the knock behaviour and detection and vibration measurements. In addition, endurance tests between 100 and 1,500 hours are run on the basis of DEUTZ specifications.”



The DEUTZ G 2.9 four-cylinder engine and the three-cylinder derivative G 2.2 will be launched in 2019 for the new EU Stage V standard.

► DEUTZ has continuously expanded its testing capacities in order to keep up with the ongoing gas engine development.

Extraordinary conditions can be tested on special test benches. Even though the engines only pay short visits to these test benches, the corresponding developmental steps are important elements for testing if the engines meet customer requirements. The responsible DEUTZ project manager Markus Meyer explains: “The first special test bench that has been established for the gas engines is the cold chamber. It enables experiments on starting the engine. The cold chamber makes it possible to test gas engines at temperatures as low as minus 20 degrees Celsius. This ensures that DEUTZ engines work reliably even in extreme climates.”

### Heightened safety requirements

Parallel to the adaptation of the fuel supply, the safety technology in the test chambers had to be adjusted to the new LPG supply. When diesel fuel combusts, the cabin ventilation must be switched off in order to prevent fanning the fire; in the case of a gas leak, this measure would be counter-productive. If gas enters the test bench, several valves reduce the amount as much as possible while simultaneously channelling more air into the cabin. This intensified air exchange prevents the gas from reaching a flammable concentration.

DEUTZ has consistently continued the expansion of its gas engine competencies in the test field. Additional facilities will follow the cold chamber and the four performance test benches currently in operation. Next on the list is an acoustic test bench and a height test bench for operation with gas engines. Further performance test benches will be added alongside two test benches for official inspection of the engines. DEUTZ is well on the way to its market launch in 2019.



# When the world was set in motion

The atmospheric gas-powered engine is considered the “no. 1 engine” of DEUTZ AG. It started off the success story of the company, then still known as “N. A. Otto & Cie.”. 150 years ago, the atmospheric gas-powered engine was taken to Paris, where it was presented to the world for the very first time.

In April 1867, more than 52,000 exhibitors from 32 countries met at the “Champ de Mars”, a public greenspace in the French capital. For the second time during the term of Napoleon III, the “World Exhibition” was held here, spanning an exhibition area of roughly 67 hectares – a cultural highlight of the Second French Empire. Inside the vast, oval exhibition venue, built by more than 26,000 workers over a period of two years, hundreds of small pavilions had been set up to represent the participating nations through typical buildings: there was a Tunisian coffee house, a minaret, a Dutch dairy, a Chinese tea house, and so on. Date palms, fountains, saltwater aquariums and even a camel enclosure surrounded the technological innovations on display, among which were steam generators, heating devices and the first hydraulic lift. One machine particularly caught the attention of the crowd: two gentlemen from the Cologne-based gas engine factory “N. A. Otto & Cie.” presented a technological novelty that made the visitors of the fair gasp in admiration. A so-called “atmospheric gas-powered engine” designed to power commercial machines. The two gentlemen were Nicolaus August Otto, a merchant from Holzhausen an der Haide, and Eugen Langen, an engineer and businessman from Cologne. Three years earlier, they had founded a machine manufacture in the middle of Cologne's old town. Their gas-powered engine, which achieves a performance of 0.5 HP at 80 rpm and boasts a solid weight of 700 kilograms, was the first gas engine that operated on the basis of the atmospheric principle.

Otto had heard about the development of a gas engine by a Frenchman named Jean Joseph Etienne Lenoir as early as 1860, but the machine still had several flaws, including malfunction due to the explosive forces involved and a very high level of gas consumption. Even though Otto had never undergone any training in engineering or technology, he was extremely interested in the latest technological developments at the time. He decided to familiarise himself with the intricacies of engineering and engine manufacturing. In 1863, he already achieved his first success: together with a mechanic from Cologne, he developed his first atmospheric crank machine whose piston was moved by external air pressure. Otto applied to have the principle patented by the Royal Prussian Ministry of Trade, but the endeavour failed repeatedly. Fearing that his idea might spread prematurely and be copied by competitors, he set out to build a self-financed workshop and overhaul the engine control system, which was still underdeveloped. But he soon ran out of money, and his plan seemed doomed – until he met Eugen Langen, a businessman and engineer from Cologne who was known throughout the city as an enthusiast for technological novelties. Langen was a partner in his father's sugar factory, but he had a passion for technology and a reputation for inventions such as his multi-stage grate, which facilitated the economical generation of energy from brown coal. Having heard about Otto's attempts at building a gas-powered engine, he visited the inventor in his workshop in Cologne. As soon as he had seen the machine in action, he was fully on board with Otto's project and decided to support him financially. Only few weeks later, Otto and Langen established the limited partnership “N. A. Otto & Cie.”, the world's first engine factory. And thus began a professional collaboration that was to last more than three decades. But it was soon put to the test: the design and functionality of the test engine turned out to be unviable at an early stage of their project. During the experiments the two men conducted in a small factory on Servasgasse near the sugar factory, they realised that the piston mechanism was incompatible with the functionality of an atmospheric machine. Following a string of preliminary tests, they decided to detach the piston from the crank: in order to utilise the available power most efficiently, the working piston had to be decoupled from the engine drive by a so-called freewheel during the explosion. Over the course of three years of hard work, Otto and Langen finally transitioned from a crank machine to a free-piston machine.

The underlying principle is simple: a piston connected to a rack stands inside a cylinder. It is lifted a few centimetres, and a gas-air mixture is sucked into the resulting cylinder chamber underneath the piston. Controlled by a slider, a gas flame burning outside the cylinder ignites the mixture. The force of the explosion propels the piston to the upper edge of the cylinder. No power is transmitted during this upward movement. As the burnt gases rapidly cool down and lose volume, a vacuum is created underneath the piston. Due to the atmospheric pressure and its own weight, the piston drops back to its original position. As it drops, the rack sets a flywheel in motion.

In a letter dated 1865, Eugen Langen describes the ignition system, which had just been invented by Otto: the control valve of the machine “channels” the gas flame into the cylinder after the gas mixture is sucked in. It was a true innovation, and its successor system breathed life into the first four-stroke engine several years later. The recipient of the letter was a personal friend of Langen's, Professor Franz Reuleaux at ETH Zurich. He immediately replied: “[...] Have you applied to the exhibition in Paris with your machine? [...]”

In the spring of 1867, Otto and Langen arrived in Paris with their invention, which Langen had finally given its unique shape after drafting scores of different construction plans. The World Exhibition was a roaring success for the two businessmen. Their atmospheric gas-powered engine received the highest distinction from the jury: a gold medal. Because the machine only required a third of the gas needed by the Lenoir engine, it was awarded the title of “most economical drive unit for small businesses”. The first engine, carrying the serial number 1, was sold to a Parisian mechanic right at the exhibition. For “N.A. Otto & Cie.”, the Paris World Exhibition constituted the starting signal for the serial production of atmospheric gas-powered engines. And the rest is history.

Since then, engine no. 1 has found its way back to Cologne: in 1875, Eugen Langen bought it back as a collector's item in exchange for a discounted version of a newer engine. Today, the engine is kept at the engine museum of DEUTZ AG in Cologne – always ready for operation.



Sketch from the private notebook of Eugen Langen: The final construction plan for the atmospheric gas-powered engine.



The gold medal „N.A. Otto & Cie“ received at the World Exhibition in Paris.







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